Section-1
Shareera Rachana Vignana
Paper-I

Chapter-1

SHAREEROPAKRAMANIYA
(शरीरोपक्रमनिय)

Introduction–

Ayurveda is a science of life, which is one of the bioscience of human body. The science of ayurveda has main two principles.

स्वस्थस्य स्वास्थ्य रक्षणं, आतुरस्य विकार प्रशमनं च।

The first principle is always to maintain the healthy body and healthy mind for healthy persons. The second principle is put together relief to the patients from the psychosomatic disorders. This is the main entity of science of life.

व्याध्युपसृष्टानाम व्याधि परिमोक्षः।

स्वस्थस्य रक्षणं च। इह खलु आयुर्वेद प्रयोजनम ॥ सु.सू.१/१४.

1. Treating the diseases, those who are suffering from diseases.
2. To maintain the normal health of human beings.

These are the two main principles of Ayurveda.

The basic knowledge of normal and abnormal Study of Sharira [human body] is stipulation to perform the above two principles, without the basic knowledge, it is very difficult to maintain the normal healthy life and treatment. So, the physician must be perfect with basic knowledge.

The knowledg of prakruta and vikruta tridosha, saptadhatu and trimala are to be considered as the basics of ayurveda. The knowledge of five basic elements like pratvi, apa, teja, vayu, akasha and bio-elements

like vatadi dosha and various angapratyangas are very essential to maintain the healthy life and also to the treatment of various disorders.

The various ayurvedic literatures were explained the knowledge of sharira on their own principle, every authors given importance to the basic knowledge. The sharira is considered as combination of pancha mahaboota and atma. The panch mahabootas are basic elements like pratvi, apa, teja, vayu, and akash and bio elements are vatadi dosha, rasadi dhatu and purishadi mala are the basic components of sharira. The detail knowledge of these basic components is most important in the science of life.

The five basic elements are unites and forms the biological elements like vatadi dosha, rasadi dhatu and purishadi mala and angapratyangas. The five basic elements, the tridosha, saptadhatu, trimala and organs are associated with each other and constitute as sharira. The five basic elements are also main causative factors for the formation and development of the organs. The group of the organs, which are having the similar functions, such a group of organs is known as system viz, respiratory system, circulatory system etc. According to our samhita it may be considered as sroto shaarira like pranavaha srotas, mutravaha srotas etc.

The anatomy is the science that deals with the study of formation and structure of any animal or a plant. The structural study, related to the human body is known as "Human Anatomy."

The term "Anatomy" has been indirectly derived from the Greek word.

"Ana tome " It is a combination of Ana + tome. It's meaning is cutting up. The knowledge of the anatomy subject has been based on the dissection of human body.

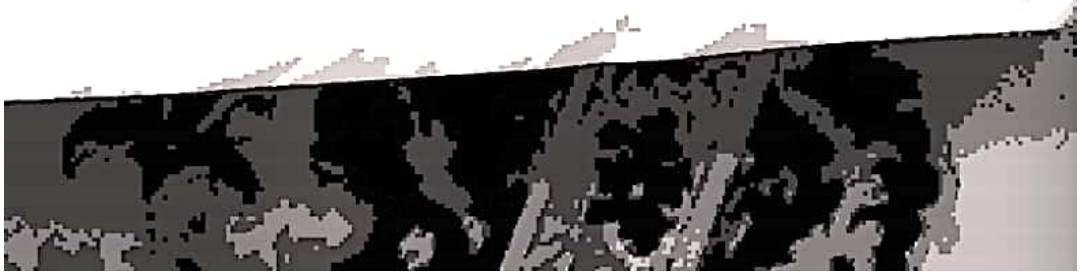
[Shava vichedana]. When we think of human anatomy we must also think that to learn it properly, we must have a set of bone, a dead body and a good book to guide us. Atoms are the basic of all the structures. Several atoms are uniting and forms the molecules. Molecules are contribute in the formation of cell membrane and cell organelles. The organelles together with cell membrane form a complex structure, known as the cell. Cells of similar type and function are aggregated to form tissues. The tissues unite and form organs. Organs are associated for perforing particular functions to form systems like cardiovascular, respiratory, reproductive systems etc. Systems work in dynamic relationship with one another and are associated together to constitute an organism.

Definition of Shareera (शरीर शारीरयोः व्याख्या)–

शरीर शब्द व्याख्या–

Normally, the living and dead body both constitute the five basic elements like pratvi, app, teja, vayu, and akasha. The both are most important basic objects for the science of life. With the help of dead body dissection; we are learning the basic knowledge of anatomy. On the basis of knowlwdge living body, we are learning the basic knowledge of physiology. The knowledge of both human bodies is necessity for the maintenance of normal health and treatment. The union of sukra, shonita, atma, prakruti and vikaras forms the garbha at the time of garbhadhana, then further it develops with the role of pancha mahaboota and becomes as sharira [human body]. So, the combination of atma with panchamahaboota and other factors is known as sharira [human body].

The creation of the sharira is mainly by four types, the Acharya Sushruta explained as follows.



स्वेदज – The Generation by Swedaja. [Sweating]

अण्डज – The Generation by Egg.

जरायुज – The Generation by Kosha [Membranous]

उद्भिज – The Generation by the Earth.

शरीर शब्द उत्पत्ति – As per गर्भोपनिषद्

The word meaning of sharira is आश्रय, for example house is ashraya to the people, similarly sharira is ashraya. It gives आश्रय to the प्राण & आत्म

The शरीर word which is derived from the श्री dhatu and it's meaning is the श्रयन्ते [आश्रय to the others]. The sharira is ashraya to the chetanaa, dosha, dhatu, and mala. The human body consists of three types of agni. These are :

ज्ञानाग्नि – The knowledge of sukha and dukha,

दर्शनाग्नि – The knowledge of observation and

कोष्ठाग्नि – The metabolism

These अग्नि are important to maintaining the physical and mental health.

As per रचना शारीर –

The शरीर word which is derived from the श्रि dhatu, its meaning is to "deteriorate" or change from time to time.

शीर्यते इति शरीरम । शीर्यते हिनस्ति आत्मानम इति शरीरम ।

The depreciation processes, of the body, starts from zygote, up to the end of life. Every second by second there is a revolution in the body. There is metabolic process by agni, due to metabolic process there is

changes in the dhatu. Such change due to the metabolism in the body is considered as शरीर.

According to Ayurvediya Samhita–

As per Acharya Charaka

तत्र शरीरम् नाम चेतनाधिष्ठानभूतं पञ्चमहाभूत
विकार समुदायात्मकं समयोगवाहि ॥ च.शा.६/४

The adhisthana of chetanaa [Atma] along with the pancha maha bhoota and vikaras is known as Sharira. The sharira is samayogavahi. The tridosha, sapta dhatu, and trimala are in the normal status. Such normal status of the dosha, dhatu and mala is called as Sharira.

As per Acharya Sushruta–

शुक्र शोणितं गर्भाशयस्थं आत्म प्रकृति विकार संमूर्च्छितं गर्भ इत्युच्यते ।
तं चेतनावस्थितं वायुर्विभजति तेज एनं पचति, आपः क्लेदयति
पृथिवी संहन्ति, आकाशं विवर्धयति; एवं विवर्धितः स यदा
हस्तपादजिह्वाघ्राणकर्णनितम्बादिभिः अङ्गैरुपेतस्तदा शरीरम् इति संज्ञा लभते ॥
सु.शा.५/३.

The combination of sukra and shonita along with the atma, pancha mahaboota and vikaras in the uterus is known as Garbha. Then the garbha develops by the role of pancha mahaboota. Vayu helps in vibhajan of cells. Teja will helps in pachana [Metabolism of the cell and tissue]. Apa helps to kledana [Rasa dhatu in the form of nourishment to the tissue] Pratvi helps in samhanan [compact the cells and tissue], Akasha helps in vivardhan [Expansion and development of the body].

By the role of the five basic elements the garbha differentitate and develops the anga, prtyangas like hand, foot, tongue, nose, ears, hip regions etc. After the

development of anga, prathyangas, it gets definite shape and size then it is called as शरीर.

As per Acharya Kasyapa–

गर्भाशयगतं शुक्रं आर्तवं जीवसंज्ञकम ।
प्रकृतिः सा विकार च ततसर्वं गर्भसंज्ञकम ॥
कालेन वर्धितो गर्भो यदङ्गोपाङ्गसंयुतः ।
भवेत् तदा स मुनिभिः शरीरामिति निगद्यते ॥

The sukra and arthava merge in the garbhasaya with jivatma, prakruthi and vikaras to form the garbha, further gradually garbha expands and develops to form anga prathyangas and after the development of the anga prathyangas, it is considered as sharira.

The vishista combination of pancha mahaboota and atma is also known as Sharira. By the vishista combination of panchamahaboota there is formation of dosha dhatu and mala. These dosha, dhatu and mala are the basic components and moola for the formation of sharira. These dosha, dhatu and mala are the three pillars of the body. So, the definition of sharira may be considered as दोष धातु मला मूलं ही शरीरम ।

According to the Modern–

The sperm and ovum unite in the ampulla of the uterine tube and form the zygote. Then zygote develops up to the 2nd month and known as embryo, further from the 3rd month embryo develops up to the 9 months, then distinguished as fetus. Then after the delivery, recognized as child or baby.

Definition (शारीर व्याख्या)–

शरीरिक भावमधिकृत्य कृतो अध्यायः शारीरः ।
शरीरम् अधिकृत्य कृतम् तन्त्रम् शारीरम् ॥

The science, which deals with the knowledge of how the human body is built. Such science is known as शरीर or रचना शास्त्र. It gives the knowledge of शरीर. It is structural study of human body, that is known as the शरीर रचना शास्त्र or रचना शारीरम.

Importance of Shareera (शरीर ज्ञान प्रयोजन)–

शरीरम सर्वथा सर्व सर्वदा वेद यो भिषक् ।
आयुर्वेद म कात्स्न्र्येन वेद लोकसुखप्रदम् इति ॥ च. शा.६/१७.

The knowledge of sharira is very essential and important in the field of science of life, without basic education of the sharira, the physician cannot become a successful in the field of treatment and also to maintaining the healthy life. The physician or surgeon must have the proper knowledge of the basic science for clinical diagnosis, to treat the diseases and to maintain the healthy life. Who knows the better knowledge of sharira, they will become good success in diagnosis, treating the diseases and as well as to maintain the healthy life, such a well known physician and surgeon is appreciated by the society.

शरीरे चैव शास्त्रे च दृष्टार्थः स्याद्विशारदः ।
दृष्टश्रुताभ्यां सन्देहमवाप्योचरेत क्रियाः ॥
शरीर विचयः शरीरोपकारार्थमिष्यते भिषग्विद्यायां ज्ञात्वा हि शरीरतत्व ।
शरीरोपकारकेषु भावेषु ज्ञानमुत्पद्यते ।
तस्माच्छरीरविचयं प्रशंसन्ति कुशलाः ॥ च.शा.६/३.

The physician who wants to become a perfect in the field of science of life, they must perfect in the science of human body. The normal anatomy study is very necessary. The physician has to clarify whatever doubts in his mind during the education. He must acquire the

proper comprehension by discussion with the scholars, and dedication to the science theoretically and practically. Such a well-versed physician in the science will become a admirable in the field of science of life. The disease is the situation where there is abnormality in anatomy and physiology such variation has to be identifying by only, the earlier knowledge of normal anatomy and physiology. Vikruta vatadi dosha can be detect only by the basic knowledge of prakruta vatadi dosha, rasadi dhatu and purishadi mala.

1. The developmental anatomy, gross anatomy and physiological anatomy is very essential for the clinical diagnose and treatment aspect.
2. The knowledge of sooksma and stoola sharira is most important for the clinical diagnose and treatment.
3. The prakruta knowledge of dosha, dhatu and mala is necessity before to understand the vikruta knowledge of dosha, dhatu mala and angapratyangas.
4. The constitution of five basic elements in the formation of angapraty angas is important to gain the knowledge of human body.
5. The surface anatomy, anatomical relations of the organs; clinical anatomy; pathological anatomy is very essential to the physician.
6. In surgical processors, the basic knowledge of anatomy is very necessary.
7. In medical juries prudence the anatomical study is necessity, to determine the cause of death, sex, age and identification of the soft and hard organs, etc.

Shadangatvam (षडङ्गत्वम्)–

तत्रायं शरीरस्याङ्गविभागः

तद्यथा – द्वौ बाहू, द्वे सक्थिनी, सिरोग्रीवम्, अन्तराधिः, इति षडङ्गमङ्गम्। च.शा.७/५.

(१) द्वौ बाहू	– २	Two upper limbs	– 2
(२) द्वे सक्थिनी	– २	Two lower limbs	– 2
(३) सिरोग्रीवम्	– १	Head and Neck	– 1
(४) अन्तराधिः	– १	Trunk	– 1

तच्च षडङ्गम् – शाखाश्चतस्रो, मध्यं पञ्चमं, षष्ठं शिर इति। सु.शा.५/३.

(१) उर्ध्व शाखा	– २	Two upper limbs	– 2
(२) अध शाखा	– २	Two lower limbs	– 2
(३) सिरोग्रीवम्	– १	Head and Neck	– 1
(४) मध्यमाङ्ग	– १	Trunk	– 1

The human body is divided mainly into six regions [six angas] for the description purpose. These divisions will help to understand the each anga pratyanga perfectly. The anatomical study according to the six regions is known as regional anatomy [pradeshika shaarira]. The sharira divisions in to the six regions is considered as shadangatvam.

The six regions of the body are as follows :

Two upper limbs– These are lies on either side of the body, connects to the upper part of the trunk.

Two lower limbs– Connects to the pelvis part of the abdomen and helps for locomotion.

Trunk–

It is middle part of the body, superiorly it is connected with neck and inferiorly with lower limbs. The trunk is again divided into two regions, as upper region thorax; and lower region the abdomen. The abdomen again divided in to two regions as proper abdomen and pelvic abdomen.

Head and Neck–

These are lies above the trunk, neck is connecting part of the thorax and head, the head is upper most part of the body, and it is formed by the articulations of cranial bones and consisting the brain.

Anatomy Classifications (शरीर शास्त्र विभाग)–

The human body consists of different systems, each system is group of organs, and that particular organs are belongs to the similar type of function. The different type of tissues forms the each organ, and the cells make up the tissue off. The different chemicals make the cells.

The anatomy was explained in a particular sthana like shaarira sthana of the different samhitas; and also in the related chapters of the disease. The minute portion was also explained in samhitas with elaborating explanation regarding manas, atma, purusha, prkruti and panchamaha bhoota. There was very brief explanation regarding the organs in the samhita. The some classifications are as follows.

(१) शरीर रचना विज्ञान :– रचना प्रतिपादकं शारीरं रचनाशारीरम ।

The structural study of the human body is known as rachana shaarira.

(२) शरीर क्रिया विज्ञान :– क्रिया प्रतिपादकं शारीरं क्रियाशारीरम

The functional study of the human body is known as kriya shaarira.

The structures of the human body can be studied with unaided eyes by dissecting the dead body, such studies based on naked eye is gross or macroscopic anatomy. Whenever we want to know about a structure in more details beyond the scope of naked eye vision

with help of microscopic, such study is know as Microscopic Anatomy. E.g. Cytology, Histology etc.

Sub divisions of Anatomy–

There are various methods by which the study of anatomy can be under taken. The study methods are almost explained as according to the divisions of the anatomy.

Divisions–

Gross or Macroscopic Anatomy (स्थूल शारीर)–

1. Cadaver Anatomy.
2. Living Anatomy.
3. Experimental Anatomy.
4. Topographical or Surface Anatomy.
5. Comparative Anatomy.
6. Applied or Surgical Anatomy.
7. Embryology.
8. Clinical Anatomy.

Microscopic Anatomy–

1. Cytology 2. Histology 3. Organology

Living Anatomy (जिवित शारीर)–

Living Anatomy is very much limited. The studies in living anatomy is incomplete, without the knowledge of cadaver anatomy. The following are the some study methods in the living anatomy.

1. Inspection
2. Palpation
3. Percussion
4. Auscultation
5. Endoscopic Examination
6. Radiographic Anatomy
7. Isotopic Methods
8. Computed Tomography

Cadaver Anatomy (मृत शारीर)–

The knowledge of anatomy is based on the cadaver or dead body. The study of the structures may be taken up in two ways.

1. Systemic Anatomy 2. Regional Anatomy

Systemic Anatomy–

The systemic anatomy is depending on the functions of the body. The whole body has been divided into different systems like

Locomotor System–

It is mainly concerned in locomotion. It consist the following sub systems.

1. Skeletal system or Osteology – अस्थि शारीर
2. Muscular system or Myology – पेशि शारीर
3. Articular system or Arthrology – सन्धि शारीर

Visceral System or Splanchnology (कोष्ठाङ्ग शारीर)–

In this system all the viscera are included, except the heart with the blood vessels, it has been subdivided into the following sub groups.

1 Alimentary System 3. Endocrine System
2. Respiratory System 4. Urogenital System

Cardio Vascular System or Angiology (सिरा धमनि श्रोतो शारीर)–

Which deals with the heart, blood vessels and the lymphatic system.

Nervous System or Neurology (नाडि तन्त्र शारीर)–

Which deals with the brain and spinal cord and the various nerves. Including Shat chakra and nadi vigynana.

Sense Organs (इन्द्रिय शारीर)–

It includes the organs of vision, hearing, smell, taste and touch.

Regional Anatomy (प्रादेशिक शारीर)–

Study of various structures of particular region of the body, usually the body is divided in to six regions; like two upper limbs, two lower limbs, one trunk and one head & neck.

Embryology (गर्भ शारीर)–

Which deals with the formation and development of the embryo, from the stage of fertilization up to the end of prenatal life.

Comparative Anatomy (तुलनात्मक शारीर)–

Which deals with the comparative study of gross anatomy with different mammals or embryology.

Experimental Anatomy (प्रायोगिक शारीर)–

In order to study the functions, growth and behavior of a particular tissue in normal and abnormal conditions experiments are done on various ways. Such studies come under the experimental anatomy.

Topographical or Surface Anatomy (पृष्ट शारीर)–

Identification and palpation of anatomical land marks, such as landmark of viscera, blood vessels and bony prominence etc.

Applied Anatomy (व्यवहारीक शारीर)–

The anatomical facts are correlated with surgical and medical treatment procedures for the sake of successful treatment.

Clinical Anatomy (चिकित्सा शारीर)–

It is study of the examination and compared with the situation in normal anatomy.

Preservation and Dissection (मृतशोधन एवं संरक्षण)–

The ancient ayurvedic scientist Acharya Sushruta has been described the method of dead body preservation and dissection in his samhita. The Acharya Sushruta was the ancient surgeon and master in the anatomy. He is the first person conducted the dead body dissection in the field of medical profession.

There was a history of preservation of dead body in the olden days. It was noticed all over the country, even in the history of Mahabharata. The king of Dasharata maharaja dead body was preserved in the tail droni still arrival of king Bharat. The Acharya Sushruta has been elucidating preservation and dissection in the three stages.

तस्मात् समस्तगात्रम् अविषोपहतम अदीर्घव्याधिपीडितम् अवर्षशतिक निःसृष्टान्त्रपुरीषं पुरुषमावहन्त्यापागायां निबद्धं पञ्जरस्थं मुञ्ज वल्कल कुश शणादी नामन्यतमेनावेष्टित अङ्गप्रत्यङ्गम अप्रकाशदेशेकोथयेत्, सम्यक् प्रकुथितं चोदधृत्य ततो देहं सप्तरात्रादुशीर बालवेणुवल्कल कूर्चानामन्यतमेन शनैः शनैः

अवघर्षयन् स्त्वगादीन् सवनिव बाह्य अभ्यन्तर अङ्गप्रत्यङ्ग विशेषान् यथोक्तान् लक्षयेच्चक्षुषा ॥ सु.शा

Three stages of preservation and dissection of the dead body.

1. Selection Criteria of the Body.
2. Preservation Procedure of the Body.
3. Dissection Procedure of the Body.

Selection Criteria–

While selecting the dead body for dissection the following criteria has to be followed.

समस्त गात्रम– The body must have all the organs, no any deformity in the body, it should consists all the angapratyangas.

अविषोपहतम्– The death must be naturally, should not be caused by any poisoned..

अदीर्घव्याधिपीडित् – Death should not be caused by any chronic diseases.

अवर्ष शतक– The age of the body should not be crossed 100 years. Body must be with in the age of 100 years, not too old age.

पुरुष– Acharya Sushruta usually mentioned the male body is ideal for dissection, but both male and female bodies are needed for the proper knowledge.

Preservation Procedure (मृतशोधन पद्धति)–

After the selection of the body. The preservation is most important, with out proper preservation there is very difficulty to carry the dissection. Acharya Sushruta has explained the process of preservation in the following methods. Acharya Sushruta named this process as जल – मज्जन कोथ पद्धति.

निःसृष्टान्त्रपुरीषं–

Clean the body external and internal waste material like fecal matter from the intestine with any antiseptic lotion.

मुञ्जवल्कलकुशशणादीनामन्यतमेनावेष्टित अङ्ग प्रत्यङ्ग निबद्धम् पन्जरस्थ–

The each and every part of the body has to be completely covered by the herbs like munja, valkal, kusha, shan etc. Then the body should be keep in the iron cage with proper closing.

अप्रकाशदेशे–

Where the communal peoples are not moving, where there is nonappearance of the brightness, usually the shady vicinity, such river is ideal for keeping the dead body iron cage.

आवहन्त्याम् आपगायाम् , सप्तरात्रात्कोथयेत्–

Keep the dead body iron cage in the slowly flowing river up to the seven days, for appropriate preservation. Within seven days the body becomes perfect for dissection.

Dissection Procedure–

Then after the seven days, body has to take out from the river and take away the all herbs that have wrap the body. Then dissection has to be carried out at the side of the river. Acharya Sushruta has explained the following procedures of the dissection.

उशीर बालवेणुवल्कल कूर्चानामन्यतमेन–

उशीर कूर्च, बाल कूर्च, वेणु कूर्च, वल्कल कूर्च, These are the instruments prepared by the hard substance of plants. These are sharp and blunt instruments, just like scalpel, blades, scissors, forceps and knife etc.

शनैः शनैः अवघर्षयन् त्वगादीन्–

With the help of above instruments gradually, bit-by-bit and little by little scraping and removing the skin of the whole body.

बाह्य अभ्यन्तर अङ्गप्रत्यङ्ग–

After scraping the skin, recognize the all-internal and external organs and realize the particulars with the help of special sense of knowledge.

विशेषान् यथोक्तान् लक्षयेच्चक्षुषा–

Specifically by carrying all these common procedures, keep the detail knowledge of anatomy in the mind. This comprehension will make perfect the physician in the field of science.

The physician is revolve into the well versed in the subject and appreciated by the society.

Importance of Dissection (शवच्छेदन महत्व)–

तस्मान्निःसंशयं ज्ञानं हर्त्रा शल्यस्य वाञ्छता ॥
शोधयित्वा मृतं सम्यग्दृष्टव्योऽङ्गविनिश्चयः ॥
प्रत्यक्षतो हि यद् दृष्टं शास्त्रदृष्टं च यद्भवेत् ॥
समासतस्तदुभयं भूयो ज्ञानविवर्धनम् ॥ सु.शा.५/४७

The surgeon or physician, who wishes to possess the exact knowledge of sharira and science of surgery, they should thoroughly examine and study all the parts of the body after its proper dissection. In brief whatever is obtained by doing practical and by studying authentic literature, it increases the knowledge of surgeons and physicians when combined study together.

Modern Concept of Preservation and Dissection–

The unclaimed dead body to be collected from the concerned authority. Make it clean with the any antiseptic solution once or twice. Then inject the formaldehyde 40% solution with other chemicals, with high pressure through the right or left common carotid artery in the cervical region or inject the solution in the right

or left femoral artery in the femoral triangle with different direction of the needle. The practically 5 to 10 liters of solution [formaldehyde] is needed to inject the body. After complete injecting the solution the body becomes bolge and hard to touch, the solution is comes out through the nostrils, ears, and oral cavity. Close the injected area by putting the sutures accurately. Then keep the body in a water tank containing the 10% formaldehyde solution. Now the body is ready for dissection purpose. Dissection is followed as according to the regional anatomy by using the instruments like scalpel, blade, knife, and forceps etc. with help of well-known teachers and literatures.

Solution–

1. Formaldehyde - 5 to 10 liters
2. Water - 5 to 10 liters
3. Glycerin - 50 to 100 ml
4. Acetic acid - 5 to 10 ml

Indian ink [red or blue] may be used as dye for indication to the vessels. It is not compulsory.

Instruments for Dissection–

1. Scalpel with blade.
2. Forceps plain and toothed.
3. Scissors small and medium size.
4. Bone cutter.
5. Brain cutting knife.
6. Hand lens and Gloves.

Anatomical Position and Terms–

The body as standing in erect position with looking forward, and arms by the side with the palm faces forward. This is the position for the descriptive purpose, is known as anatomical position.

Anatomical Planes–

Sagittal Plane / Median Plane–

It is the vertical plane from above downward at the region of sagittal suture of the skull, which divides the body or organ into two equal halves as right and left, it is also known as mid sagittal or median plane. Any other plane parallel to it, is called as Para sagittal plane that divides the body or organ into unequal halves as right and left.

Coronal Plane–

It is vertical plane from above downwards, that plane at right angle to the median plane, which divides the body or organ into anterior and posterior.

Transverse Plane–

It is plane transversely parallel to the ground level, which divides the body or organ into superior and inferior.

Oblique Plane–

It is plane that cut the sagittal plane at any angle is oblique plane; it is not parallel to the ground.

Anatomical Terms–

Anterior : The structures lie in front of the coronal plane.

Posterior : The structures lie in back of the coronal plane.

Superior : The structures lie above the transverse or oblique plane.

Inferior : The structures lie below the transverse or oblique plane.

Medial : The structures lie nearer to the median plane.

Lateral : The structures lie away from the median plane.

Ipsi Lateral : Refers to the same side of the body.
Contralateral : Refers to the opposite side of the body.
Ventral : Towards the front of the body.
Dorsal : Towards the back of the body.
Cranial : Towards the head side.
Caudal : Towards the tail side or away from the head.
Proximal : Nearer to the trunk or head. (to the root)
Distal : Away from the trunk or head. (to the root)
Superficial : Immediately below the skin. / on the surface
Deep : Deep to the skin
Interior : Inside the body.
Exterior : Outside the body.
Invagination : Inward bulging of a wall of a cavity.
Evagination : Outward bulging of a wall of a cavity.
Foramen : an opening or hole in a bone or organ
Canal : A bony tunnel (foramen of some length)
Meatus : A narrow passage
Sulcus : A groove
Fossa : A large depression
Ridge : Elevation / usually rough
Facet : Small, smooth, articular area of a bone
Crest : Ridge some breadth (elongated with elevation)
Process : Projection large size
Ttubercle : Rounded thick projection
Lingula : Tongue shape
Lamina : Thin plate
Cornua : A horn like projection
Spine : Sharp pointed projection
Uncus : Hook like projection
Ala : Expanded part

Chapter-2

DEVELOPMENTAL ANATOMY
(अभिनिवृत्ति शारीरम्)

Karma Purusha (कर्म पुरुष)–

कर्म पुरुष – पुरि वसति इति पुरुषः ।

चेतनाधातुरप्येकः स्मृतः पुरुषसंज्ञकः ।

खादयः चेतनाषष्ठा धातवः पुरुषः स्मृतः ॥ च.शा.१/१६

The person who lives in the village is known as pura, similarly the atma lies in the panchaboutika shareera, so the panchaboutika shareera with atma is called as karma purusha, He will be considered as chetanaa purusha, and chikitsadhikruta purusha. The chetanaa with panchaboutika shareera is karma purusha. The atma itself is known as chetanaa purusha, Chaturavimshati purusha with atma is known as karma purusha. He has 16 gunas like sukha, dukha, dwesha, Ichcha etc. He is Trigunatmka and adhisthana for chikitsa, chikitsadhikruta purusha is karma purusha.

In Sambita karma purusha was explained in different aspect by combination of Dharma and Adharma the purusha born in manava yoni. Atma enters during the combination of sukra and arthava in the process of Garbhadharana, so the purusha, is considered as panchamahabhoota and atma. The shadadhatvaja purusha is known as purusha, The satva, atma and sharira joins and forms, chikitsadhikruta purusha so this purusha becomes Adhisthana for chikitsa, so he is known as karma purusha. Acharya Atreya makes very clear.

स एव कर्मपुरुष चिकित्साधिकृतः । सु.शा.१/२०

Mind, atma and sharira combine and show chetanaa, the chetanaa becomes as one of the important factor for the functioning of the sharira. The purusha becomes adhistana for karma on account of the presence of सत्व, आत्म, शरीर. The same purusha is known as karma purusha and also known as Rashi purusha. There will be a combination of 24 tatvas along with chetanaa tatva.

पञ्चमहाभूतशरीर समवायः पुरुष इति स कर्मपुरुषश्चिकित्साधिकृतः ॥

क्षेत्रज्ञः पञ्चमहाभूतशरीरक्षेत्रवित् कर्म पुरुषः ॥

षोडष कलाः – कर्म पुरुष लक्षण–

तस्य सुखदुःखे इच्छाद्वेषौ प्रयत्नः प्राणापानौ उन्मेषनिमेषौ बुद्धिर्मनः संकल्पो विचारणा स्मृतिर्विज्ञानमध्यवसायो विषयोपलब्धिश्च गुणाः ।

सु.शा. १/१८

There are sixteen gunas to the purusha, Atma with panchamahaboota sharira is known as karma purusha, gunas are also known as shodas kala. Or purusha lakshana, characters of purusha are considered as gunas. These are as follows.

- सुखः (Happiness)
- दुःख (Misery)
- इच्छा (Desire)
- द्वेष (Aversion)
- प्रयत्नः (Endeavour)
- प्राणः (Respiration)
- अपान (Excretion)
- उन्मेष and निमेष (Opening and closing of eye lids)
- बुद्धिः (Wisdom)
- मनः (Determination of mind)
- संकल्प (Confident)
- विचारण (Discretion)
- स्मृतिः (Memory)
- विज्ञान (Knowledge)
- अध्यवसाय (Perseverance)
- विषयोपलब्धि (Perception)

Dwadasha Pranayatana (द्वादश प्राणायतन)–

There are twelve pranayatana and these are as follows:

अग्नि सोमो वायुः सत्वं रजस्तमः पञ्चेद्रियाणि भूतात्मेति प्राणाः ॥ (सु. सू.)

- अग्नि (पित्त)
- सोम (कप)
- वायुः (वात)
- सत्व
- रजः
- तमः
- पञ्चेन्द्रिय (कर्ण, नासा, जिह्वा, त्वक्, नेत्र)
- आत्म

Dasa Pransthana (दश प्राणस्थान प्रतिघ्नान)–

There are ten regions of prana in the body and life lies in this regions.

दशैवायतनान्याहुः प्राणायेषु प्रतिष्ठिता ।
शंखौ मर्मत्रयं कण्ठो रक्तं शुक्रौजसी गुदम् ॥ च.सू. १२/३०

- शंखौ
- हृदय
- बस्तिः
- शिरः
- कण्ठ
- रक्त
- शुक्र
- ओजः
- गुदम्

Dasa Pranayatani (दश प्राणायतनानि)–

There are ten pranayatana, these are seats of vital breadth in the body.

तद्यथा– मूर्धा कण्ठ हृदयं नाभिः गुदं बस्तिः ओजः शुक्रं शोणितं मांसमिति ।
तेषु षट् पूर्वाणि मर्मसंख्यातानि ॥ च.शा. ७/९

- मूर्धा
- कण्ट
- हृदय
- नाभिः
- शोणित
- गुद
- बस्तिः
- ओजः
- शुक्रं
- मांस

Trishuna (त्रिशून)– These are three in number and they are as follows – सत्व, रज, तम

Deha Prakruti (देह प्रकृति)–

शुक्रशोणित संयोगे यो भवेद्दोष उत्कटः ।
प्रकृतिर्जायते तेन तस्या मे लक्षणं शृणु ॥ सु.शा. ४/६२
सप्त प्रकृतयो भवन्ति । दोषैः पृथक् द्विशः समस्तैश्च ॥

- वातज प्रकृति
- पित्तज प्रकृति
- कफज प्रकृति
- द्विदोषज प्रकृति,
- सन्निपातज प्रकृति

Deha Prakruti usually starts at the time of union of sukra and shonita in the formation of garbha. Among the three doshas, which dosha is become predominant in the sukra and shonita during the formation of embryo in the mother womb the same doshaja prkruti develops during the development of embryo, and the same doshaja prakruti will also continue in the development of foetus. The same prakruti continuous the whole life, such prakruti is called as "Deha prakruti". So the beejas of mother and father, which they have moola dosha predominant, the same doshaja prakruti develops in the foetus. So, the deha prakruti depends upon the dosha of shukra and shonita. The father and mother prkruti is also causative factor for the deha prakruti. There are seven types of Deha prakruti. Ekadoshaja Prakruti - 3, Dvidoshaja Prakruti - 3 , Sannipataja Prakruti -1

वातज प्रकृति लक्षण–

तत्र वात प्रकृतिः प्रजागरूकः शीतद्वेषीदुर्भगः
स्तेनोमत्सर्यनायो गन्धर्वचित्तः ।
स्फुटितकरचरणो अल्परूक्षश्मश्रुनखकेशः
क्रोधीदन्तखादीच भवति)) (सु.शा. ४/६४)
अधृति अदृढ्सौहृदः कृतघ्नः कृशपरुषो धमनीततः प्रलापी ।
दृतगतिरटनोनवस्थितात्मा वियति च गच्छति सम्भ्रमेणसुप्तः ॥
अव्यवस्थितमतिश्चल्दृष्टिः मन्दरत्नसंचयमित्रः ।
किंचिदेव विलपत्यनिबध्दं मारुतप्रकृतिरेष मनुष्यः ॥

Vataja prakruti prurusha lakshana–

The vata prakruti purusha lakshanas are as follows. He has conscious about his work, not tolerating

the cold, rough body, not smart to look, robbery nature, disapprove of others opinion, interest in music and dance, lovely with others, skin appears rough in nature, cracking skin, unkind mind, crushing of teeth during the night hours.

No courage, no intimate in the friendship, not keep in mind of those who helped, thin body, hard-hitting mind, prominent appearance of blood vessels, rapidity of speech, traveling nature, dreams feeling like travel in sky, not proper mind, having less friends, less money and gold. Such signs person is considered as vataja prakruti prusha.

पित्त प्रकृति लक्षण–

पित्तप्रकृतिस्तु स्वेदनो दुर्गन्धः पीतशिथिलांगस्ताम्र–
नखनयनतालु जिह्वौष्ठ पाणिपादतलो।
दुर्भगोवलीपलितखालित्यजुष्टो बहुभुगुष्णद्वेषी
क्षिप्रकोपप्रसादो मध्यबलो मध्यायुश्च भवति॥ (सु.शा. ४/६८)
न भयात प्रणमेदनतेष्वमृदुः। प्रणतेष्वपि सांत्वनदानरुचिः॥
भवतीह सदा व्यथितास्यगतिः स भवेदिह पित्तकृतप्रकृतिः॥ (सु.शा. ४/७१)

Pittaja prakruti purusha lakshana–

The pitta prakruti purusha lakshanas are as follows. He has more perspiration, foul smell and yellowish skin, redness in the nails, eyes, throat, tongue, hand leg, etc. Folding nature of skin, hairs are grey shade, not interest in the hot, appetite more, and short temper, moderate built, immediate feeling of happiness nature, not hesitate for dangers, feel affection for giving the things to others, intelligent, high wisdom, clear speech. Such signs person is considered as Pittaja prakruti purusha.

कफ प्रकृति लक्षण–

रक्तांतनेत्रः सुविभक्तगात्रः स्निग्धच्छविः सत्वगुणोपवन्नः॥

क्लेशक्षमो मानयितागुरूणां ज्ञेयो बलासप्रकृतिर्मनुष्यः ॥ (सु.शा. ४/७४)
दृढशास्त्रमतिः स्थिरमित्रधनः परिगण्य चिरात प्रददाति बहु ।
परिनिश्चितवाक्यपदः सततं गुरुमानकरश्च भवेत स सदा ॥

Kaphaja prakruti purusha lakshana–

The kapha prakruti purusha lakshanas are as follows. The person appears like whitish green color skin, beauty and well built body, interest in sweet food, courage person, helping mind, remembering the helped peoples, silent nature, healthy developed mind, high memory power, eyes are clean, highly and black color hairs, rich in money and mind. Such sign person is kaphaja prakruti purusha.

द्विदोष त्रिदोष प्रकृति लक्षण–

द्वयोर्वा तिसृणां वाऽपि प्रकृतीनां तु लक्षणैः ।
ज्ञात्वा संसर्गजा वैद्यः प्रकृतीरभिनिर्दिशेत ॥

Dvandvaja and Thridoshaja prakruti purusha–

The combination of signs of two dosha becomes as dvandvaja prakruti purusha, and combination of signs of tridosha becomes as tridoshaja prakruti purusha. The combination of dosha to be understand the others.

Dosha, Dhatu, Mala Moolam (दोष धातु मल मूलं)–

दोष धातु मला मूलं ही शरीरम् । पञ्चमहाभूत आत्म विशिष्ट संयोजते ।
दोष धातु मल मूलो ही देहः । वात पित्त श्लेष्माण एव संभव हेतवः ॥

Dosha, Dhatu, and Malas are the basic and biological concepts of sharira these are the biological elements which are formed by the union of five basic elements. The body consists of three dosha, sapta dhatu, and three malas. The healthy and unhealthy condition of the body mainly depend up on the prakruta and vikruta dosha, dhatu and malas. If these are vitiated

then it is unhealthy, if these are in normal states then it is called healthy. The roots are the main basic structures to grow the tree healthy. similarly the dosha, dhatu and malas are the basic concepts and roots of the body.

Sharira consists three components, these are, three dosha, sapta dhatu and three malas. All these three must be in a normal status other wise it is abnormal status. So for the maintenance and development of the body, these dosha, dhatu, and malas are basic components of body.

Pancha Boutikatvam (पञ्चमहाभौतिकत्वंम्)–

सर्वद्रव्यं पाञ्चभौतिकस्मिन्नर्थे ॥ पञ्चभूतात्मके देहे आहारः पाञ्चभौतिकः ॥
विपक्वं पञ्चधा सम्यक् स्वान् गुणानभिवर्धयेत ॥

Every objects are formed by panchamahabhoota panchbhoutika means five basic elements, like prathvi, apa, teja, vayu and akasha; all the objects are made up of five basic elements. The five basic elements combines in different ratio and forms anga-pratyangas and other objects. The sharira is also panchaboutikatva,it is formed by the unification of five basic elements. These have their own special qualities, like Akasha guna - laghu, prathvi guna- guru, apa guna -snigdha, vayu guna- ruksha, and teja guna- tikshna. The basic elements are trigunatmaka and tridhoshamaya..

Pancha Maha Boota Guna (पञ्च महाभूत गुण)–

१. आकाश महाभूत – सत्व गुण
२. वायु महाभूत – रजो गुण
३. तेज महाभूत – सत्व रजो गुण
४. अप महाभूत – सत्व तमो गुण
५. पृथ्वि महाभूत – तमो गुण

Biological Elements–

१. वायू आकाश महाभूत – वातदोष
२. अप तेज महाभूत – पित्त दोष

३. अप पृथ्वि महाभूत – कफ दोष

Trigunatmakatvam (त्रिगुणात्मकत्वम्)–

तत्र सत्व बहुलमाकाशः रजो बहुलो वायुः मत्व रज like satva, raja and tama. The panchamahaboota have characters of trigunas in the purusha.

दोष धातु मल मूलकत्व–

The tridosha, sapta dhatu and tri malas are the basic components of the body, with out these there is no body, body consist these basic biological elements. These factors are the origin of shareera.

The purusha as different perception (धातु भेद पुरुष संघटनम्)–

पुरुष – पुरि शेते, पुरौ शेते, पुर्याम् शेते, इति पुरुषः ॥

The chetanaa which lies in the panchbhoutika shareera is purusha.

Shudda Purusha (शुद्ध पुरुष)– The atma itself is shudda purusha.

एक धातुज पुरुष –

चेतनाधातुरप्येकः स्मृतः पुरुषसंज्ञकः ॥ च.शा. १/१६

चैतन्ये कारणं नित्यो द्रष्टा पश्यति हि क्रियाः ॥ च.सू. १/५६

सत्व शरीरयोस्तु विशेषात विशेषोपलब्धिः ॥ च.शा. ४/३३

The chetanaa dhatu itself is considered as purusha, The atma alone, it self is to be treated as ekadhatuja purusha, it is constant.

Dvidhatuja Purusha (द्विधातुज पुरुष)–

अग्नि सोमात्मकं सर्वजगत् स्थावर जंगमम् ।

अग्नि सोमात्मकाः सर्वे देहिनस्तु चतुर्विधाः ॥ भे. शा. ४

The agneya and soumya gunas are the two factors, the kshetra and kshetrajnu factors are considered in the dvidhatuja purusha. Kshetra is atma and kshetrajna is shareera that is ashraya ashrayi bhava relation of body and atma. The atma lives in the shareera.

Tridhatuja Purusha (त्रिधातुज पुरुष)–

सत्वात्मा शरीरम् च त्रयमेतत् त्रिदण्डवत् ॥

The satva, raja and tama are the trigunas of the body, these are considered as tridhatuja purusha. These trigunas are basic factors of the human body.

Shada Dhatuja Purusha (षड धातुज पुरुष)–

पञ्चमहाभूत शरीरि समवायः पुरुषः सु.सू.१/२३.

षड्धातव समुदिताः पुरुष इति शब्दं लभन्ते तद्यथा।

पृथिव्यापस्तेजोवायुराकाशं ब्रह्मचाव्यक्तमिति ॥ च.शा.५/४

The amalgamation of panchamahabhoota and Atma is called as shada dhatuja purusha. Atma is clear, but manifest the trigunas after joining with panchamahabhoota shareera. The five basic elements like pruthvi, apa, teja, vayu, and akasha with atma is called as shaddhatuja purusha. Such shaddhatuja purush is known as karma purusha or chikitsadhikruta purusha. The karma purusha has sixteen gunas and has synonyms like Samyoga purusha, Chikitsa purusha, Adhikarana purusha etc. The matruja, pitruja, atmaja, satmaja, rasaja, and satvaja bhavas are also known as shad dhatuja purusha. Matrujadi bhavas help in formation and development of the angapratyangas.

Trayadasha Dhatuja Purusha (त्रयोदश धातुज पुरुष)–

दोष धातु मला मूलं हि शरीरम् ॥ सु.सू. १५/३

The amalgamation of thirteen dhatus is known as trayodasha dhatuja purusha, tridhosha, sapta dhatu and trimalas, are considered as the trayodasha dhatuja purusha.

The thirteen dhatus are –

१. वात	४. रस	७. मेद	१०. शुक्र	१३. स्वेद
२. पित्त	५. रक्त	८. अस्थि	११. पुरीष	
३. कफ	६. मांस	९. मज्जा	१२. मूत्र	

Chaturavimshali Purusha (चतुर्विंशति धातुज पुरुष)–

मनो दशेन्द्रियाण्यर्थाः प्रकृतिश्चाष्टधातुकी ॥

The amalgamation of five jnanendriya, five karmendriya, five tnamatra, eight prkruti and mind considered as caturvimshati purusha.

The twenty four dhatuja are–

१. चक्षुः	६. वाक्	११. शब्द	१६. पृथ्वि	२१. अव्यक्त
२. कर्ण	७. पाणि	१२. स्पर्श	१७. अप	२२. महान्
३. नासा	८. पाद	१३. रूप	१८. तेज	२३. अहंकार
४. जिह्वा	९. पायु	१४. रस	१९. वायु	२४. मनस्
५. त्वक्	१०. उपस्थः	१५. गन्धः	२०. आकाश	

Panchavimshali Purusha (पञ्चविंशति धातुज पुरुष)–

The amalgamation of five jnanendriya, five karmendriya, five tanmatra, eight prkruti, mind and atma is considered as pancha vimshati purusha. All the twenty five dhatus are included in the panchavimshati purusha.

The twenty five dhatuja are

१. चक्षु	६. वाक	११. शब्द	१६. पृथ्वि	२१. अव्यक्त
२. कर्ण	७. पाणि	१२. स्पर्श	१७. अप	२२. महान्
३. नासा	८. पाद	१३. रूप	१८. तेज	२३. अहंकार
४. जिह्वा	९. पायु	१४. रस	१९. वायु	२४. मनस्
५. त्वक्	१०. उपस्थः	१५. गन्धः	२०. आकाश	२५. आत्म

Chapter-3

EMBRYOLOGY
(गर्भ शारीरम्)

Garbhavakranti (गर्भावक्रान्ति शारीरम्)–

गर्भस्यावक्रान्तिरवक्रमणं संप्राप्तिः ।

तस्यावक्रान्तिरुपागमनम् अवतरणमिति यावत् ॥ (डल्हण टिका)

The Garbhavakranti shareera includes the formation of shukra and shonita, the creation, development and growth of the embryo. The augmentation of foetus till the rescue knowledge and study is known as Garbhvakranti shareera.

Sukra (शुक्र)–

It is one of the dhatu among the seven dhatus, and it is sara of the other six dhatu. It is present in both sex, just like ghee in the milk and oil in the oil seeds. It is considered as one of the purusha beeja in garbha Sharira, and helps for fertilization, it is maintained as one of the beeja, according to the literature it is considered as both, one is dhatu and second one is as a beeja.

शुक्र धातु– अस्थ्नो मज्जा ततः शुक्रं प्रजायते । च.चि. १४/१४

मज्ञः शुक्रं तु जायते ॥ सु.सू. १४/११

तस्मान्मज्ञस्तु यः स्नेहः शुक्रं संजायते ततः । च. चि. १४

The sukra dhatu is formed after the asthi and majja dhatu. Acharya Sushruta also explained the same; the sukra is formed by the unction of the majja dhatu.

यथा मुकुलपुष्पस्य सुगन्धो नोपलभ्यते ।

लभ्यते तद्विकाशातु तथा शुक्रं हि देहिनाम् । च.चि. २

The smell cannot come from any bud of the flower, but when the bud becomes the flower then the smell spreads all over, similarly the sukra is in the form of avyakta in the children, when they attain the adult age then the sukra appears in the body.

सप्तमि शुक्रधरा, या सर्वप्राणिनां सर्वशरीर व्यापिनि।
यथा पयसि सर्पिस्तु गुडेक्षौ रसो यथा।
शरीरेषु तथा शुक्रं नृणां विद्यात् भिषग्वरः॥

The seventh sukradhara kala lies in all over the body, As and how milk consists ghee, sugarcane consists jaggery, similarly the body consists the sukra dhatu.

Functions of the Sukra–

शुक्राद् गर्भः प्रजायते। च.चि. १४
शुक्रं धैर्यं चयवनं प्रीति देहबलं हर्ष बीजार्थं च। सु.सू. १४/६

The happiness, strength, appreciation, courage, love, and elation for conception. It is considered as one of the beeja.

Pramana of Sukra–

It is 1/2 anjali pramana in the body

शुक्रास्यार्धञ्जलि प्रमाणम्। च.शा.७/१६
मासेन रसः शुक्रीभवति स्त्रीणां च आर्तवम्। सु.सू. १४/१४
स्त्रीणां शुक्रं न गर्भाय भवेद् गर्भाय च आर्तवम्॥ चक्रपाणि

The sukra is formed within the one month from the rasa dhatu in males and arthva is formed in the females, these are considered as beejas of mother and father which are responsible for formation of the garbha. Acharya Cakrapani commented on this as the sukra is formed in females but it is not for fertilization.

Lakshanas of Pure Sukra (शुद्ध शुक्र लक्षण)–

स्फटिकाभं द्रवं स्निग्धं मधुरं मधुगन्धि च।

शुक्रमिच्छन्ति, केचित्तु तैलक्षौद्रनिभं तथा ॥ सु.शा.२/१२
स्निग्धं घनं पिच्छिलं च मधुरं चाविदाहि च ।
रेतः शुद्धं विजनियाच्छ्वेतं स्फटिक सन्निभम् ॥ च.चि. ३०
शुक्रं शुक्लं गुरु स्निग्धं मधुरं बहलं बहु ।
घृतमाक्षिकतैलाभं सद्गर्भाय ॥ अ. हृ शा. १/१७

In Astang Hradaya it is mentioned, that the shudda sukra and shonita are needed for formation of healthy foetus. It appears like a crystal white, fluid viscous, sweet, odour of honey and similar to oil and honey, these are the qualities of shudda sukra.

Lakshanas of Impure Sukra (अशुद्ध शुक्र लक्षण)–

वात पित्त श्लेष्म शोणित कुणप ग्रन्थि पूतिपूय क्षीण
मूत्रपुरीषरेतसः प्रजोत्पादने न समर्था भवन्ति ॥ सु.शा.२/३.
फेनिलं तनु रूक्षं च विवर्णं पूति पिच्छिलम् ।
अन्यधातूपसंसृष्टामवसादि तथाष्टमम् ॥

The sukra which has been vitiated by vata, pitta and kapha, which emits a cadaveric smell, clotted, has the smell of pus, little quantity, the smell of urine and faeces, incapable of reproduction, It has bad smell, thin in nature, more dryness, not in the normal colour, too much sticky, combination with other dhatus, painfull during discharge.

Artava (आर्तव)–

ऋतुस्तु द्वादशरात्रं भवति दृष्टार्तवः ।
अदृष्टार्तवाप्यस्तीत्येके भाषन्ते ॥ सु. शा.३/५.
मासेनोपचितं काले धमनीभ्यां तदार्तवम् ।
ईषत् कृष्णं विगन्धं च वायुर्योनिमुखं नयेत् । सु. शा.३/१०

Artava is the menstrual flow of blood within a few hours of the necrosis caused by constriction of terminal

arteries of uterus followed by their dilatation. It is slightly black in colour that is brought to the mouth of the vagina by vayu mahabhoota. Menstruation occurs every month; it is normal cycle of menstrual blood flow from the vagina; starts at the age of twelve years and stops at the age of fifty years in women.

Lakshanas of Pure Arthava (शुद्ध आर्तव लक्षण)–

शशासृक् प्रतिमं यत्तु यद्वा लाक्षारसोपमम्।
तदार्तवं प्रशंसन्ति यद्वासो न विरञ्जयेत्॥ सु. शा.२/१७

The menstrual blood which is either like rabbit's blood or like liquid shellac [laksha rasa]; blood colour does not stain on the clothes, no bad smell, such menstruation blood is known as shudda artava.

Definition of Garbha (गर्भस्य परिभाषा/गर्भ धारण)–

शुक्र शोणितं गर्भाशयस्थं आत्म प्रकृति विकार संमूर्च्छितं "गर्भ" इत्युच्यते। सु.शा.

गर्भाशयगतं शुक्रं आर्तवं जीवसंज्ञकम्।
प्रकृतिः सा विकारं च तत्सर्वं गर्भसंज्ञकम ॥
शुक्रशोणित जीवसंयोगे तु खलु कुक्षिगते गर्भसंज्ञा भवति॥ च.शा.५/५

The creation of garbha in the garbhashaya, by the permutation of shudda sukra and shudda shonita with atma is known as garbha. So, this process is known as garbhadharana. The four factors rutu, kshetra, ambhu and beeja are the necessary factors for the garbhadharana. Putra kameshti yajna also helps to get the better garbha. Healthy uterus, healthy rasa dhatu, healthy time, and healthy purusha and stree beeja along with healthy mind are the most necessary factors for the garbhadhana. The 12th day after the menstruation is the ideal time for garbhadharana.

According to modern concept the union of sperm and ovum in the ampulla of the fallopian tube is called as embryo, further it develops after the second month it is identified as foetus.

Garbhotpadaka Bhava (गर्भोत्पादक भावा)–

तत्र गर्भस्य पितृज–मातृज–रसज–आत्मज–सत्त्वज–सात्म्यजानि शरीरलक्षणानि व्याख्यास्यामः मातृतः पितृत आत्मतः सात्म्यतो रसतः सत्वत इत्येतेभ्यो भावेभ्यः समुदितेभ्यो गर्भः संभवति ॥

तस्य ये ये अवयव यतो यतः संभवतः संभवन्ति तान्विभज्य मातृजादीनवयवान् पृथक पृथगुत्क्रमगे ॥ च.शा.४/४

मातृजायं गर्भः पितृजा आत्मजा सात्म्यजा रसजा।

अस्तिच सत्वमुपपादुकमिति होवाच भगवानात्रेयः ॥ च.शा / ३/४

It is mainly explained by Acharya Charaka, according to him there are six bhavas, these are the factors which helps in the formation and development of angapratyangas. These six factors are mainly responsible in the formation of "garbha" and during the formation of anga pratyangas and sharira. Other than these factors there are prathvi, apa, teja, vayu, akasha and atmaja are also considered as shada dhatvatmaka bhavas.

Pitruja Bhava (पितृज भाव)–

गर्भस्य केशश्मश्रु लोमास्थि नखदन्तसिरास्नायुधमनीतः प्रभृतीनि स्थिराणि पितृजानि।

Kesha, smasru, roma, nakha, asthi, danta, sira, snayu, dhamani etc are formed by the pitruja bhavas.

Matruja Bhava (मातृज भाव)–

मांस शोणितमेद मज्जहृत्नाभियकृत् प्लीहान्त्रगुदप्रभृतीनि मृदूनि मातृजानि।

Mamsa, shonita, meda, majja, hrudaya, nabhi, yakruta, pliha, antrani, and guda etc are formed by the matruja bhavas.

Atmaja Bhava (आत्मज भाव)–

इन्द्रियाणि ज्ञानं विज्ञानमायुः सुखं दुःखादिकं च आत्मजानि।

Jnanam, vijnanam, sukha, and dukha etc. are formed by the atmaja bhavas.

Satmaja Bhava (सात्म्यज भाव)–

वीर्यमारोग्यं बल वर्णाः मेधा च सात्म्यजानि ॥ सु.शा.३/३३.

Viryama, arogyam, balam, varnam, medha etc. are formed by the satmyaja bhavas.

Rasaja Bhava (रसज भाव)–

शरीरोपचयो बलं वर्णः स्थितिर्हानिश्च रसजानि।

Sariropachayam, balam, varnam, sthiti, hani etc. are formed by the rasaja bhavas.

Satvaja Bhava (सत्वज भाव)–

सत्वजान्युत्तरतः वक्ष्यामः।

Bhakti, smruti, moha, dwesha, krodha, mruduta, tikshnata and gambhiratha etc. are formed by the satvaja bhavas.

Garbhotpadaka Samagri (गर्भोत्पादक सामग्रि)–

ध्रुवं चतुर्णां सान्निध्याद् गर्भः स्याद्विधिपूर्वकम्।
ऋतुक्षेत्राम्बुबीजानां सामग्र्यादङ्कुरो यथा एवं
जाता रूपवन्तः सत्ववन्तः चिरायुषः।
भवन्ति ऋणस्य मोक्तारः सत्पुत्राः पुत्रिणे हिताः ॥

According to Acharya Sushruta Rutu, Kshetra, Ambu and Beeja are the most important factors for the formation of the Garbha.

Rutu Kala (ऋतु काल)–

ऋतुस्तु द्वादशरात्रं भवति दृष्टार्तवः। अदृष्टार्तवाप्यस्तीत्येके भाषन्ते ॥

सु. शा.३/५.

Rutu means the proper time [kala] for conception of garbha and time to associate the male partner with female partner, within this proper time garbha forms appropriately. The union of sukra and artava in the suitable period will confirm the garbha. Such a phase is rutukala. The time is one of the significant factors according to Ayurveda. The 12th day after the menstruation is accurate rutukala (time) for the garbhadharana. After the twelth day there will be no fertilization.

निवर्तं दिवसेतीते संकुचत्यंबुजं यथा । ऋतौव्यतीतेनार्यास्तु योनिः संव्रियते तथा ॥

सु. शा. ३.

Once the day hours complete and during the night hours the lotus closes. Similarly the orifice of the cervix closes after the rutukala, it will not allow entry of the sperms in to the uterus, hence there will be no fertilization after the rutukala.

Kshetra (क्षेत्र)–

Kshetra means place (sthana or ashraya), the suitable place is necessity for the formation and development of garbha. The uterus (garbhasaya) is appropriate place for development of fetus, if the kshetra is proper the growth of fetus becomes in good health. Similar comparision given here to the land and crop, if the land is good, the crop is also good.

Ambu (अंबु)–

Ambu means water (jala) or nutritious fluid for the development of fetus. The nutritious fluid (ahara rasa) of the mother is nourishing the fetus, so for the healthier development of fetus the healthful ambu is necessary, the same was compared with water and crop in general.

Beeja (बिज)–

Beeja are seeds, the seeds are very necessary belongings for configuration of garbha. In the formation of embryo the sperm and ovum are the significant factors. There is no embryo formation without of these germ cells. The sukra and artava are the germ cells which will responsible for the formation of the garbha. The sukra and artava are the purusha and stree beejas. The same was compared with seed and yield in general

Pumsavana Karma (पुंसवन कर्म)–

लब्ध गर्भायाश्चैनयहःसु लक्ष्मणवटशृंग सहदेवा विश्वदेवानामन्यतमां क्षीरिणामिषुत्य
त्रींश्चतुरोवा विन्दून् दद्याद्दक्षिणे नासा पुटे पुत्र कामायै न च तान्निष्ठीवेत् ॥

सु. शा. २/३२

The pumsavan karma is procedure to obtain the desired male child. The plants like lakshaman, vatashranga, sahadeva and visvadeva are used to achieve the desired male child. The bark of any one of the above plant tricturated with cow milk and put 3 to 4 drops in to the right nostril of the women before rutukala or earlier to rutukala, by doing this procedure may be getting the desired male child.

Sex Determination (लिंग भेद)–

तत्र शुक्रबाहुल्यात् पुमान् आर्तवबाहुल्यात् स्त्री, साम्यादुभयोर्नपुंसकमिति ॥

सु.शा.३/४.

रक्तेन कन्यामधिकेन पुत्रं शुक्रेण तेन द्विविधीकृतेन ।
बीजेन कन्यां, च सुतं च सूते यथास्ववीजान्यतराधिकेन ॥ च.शा.२/१२.
वाम नाड्याम् भवेत् कन्या, दक्षिणे पुत्र निश्चयः ॥

In Ayurvedic literature the linga nirnaya is based on the sukra and arthava bhahulya, if the sukra is predominant the garbha becomes male, if the arthava becomes predominant the garbha will be female.

The time (days) of conception is also a cause for sex determination. If the conception take-place in even days the child becomes male. If conception takes in odd days the child become female. The even days are 8, 10, 12, etc. The odd days are 9, 11, 13 etc.

[illegible]

The arthava is not predominant, instead the sukra is leading in the even days, if the male and female partners are joined in these days probably the offspring will be a male child. The arthava is predominant but the sukra is not leading in the odd days, so if the male and female partners are together in these days the probably the offspring will be female child. If the partners are unites in between i.e. during sandhyaa kaala the offspring will be napumsaka. The even and odd days are to be counted after the menstrual period starts (rutusrava) and before the onset of next menstruation.

The sperm released from the right testis, and unites with ovum which release from right ovary then there will be a male child. The sperm emancipation from left testis that unites with ovum released by left ovary the child becomes female.

According to the modern concept the embryo is formed on the basis of sex chromosomes, sperm consists "x" and "y" sex chromosomes, the ovum consists "x" and "x" chromosomes. The "x" [ovum] and "x" [sperm] sex chromosomes unite then the baby is female. The "x" [ovum] and "y" [sperm] sex chromosomes unite then the offspring is male.

Garbha Matra Paratantrata (गर्भ मात्रा परतन्त्रता)–

The garbha which develops from the combination of sukra and shonita in the garbhashaya is completely depended upon the mother, it is not independent, the nutrition in the form of rasa dhatu of the mother will supply the foetus for the growth and development, starting from the formation of garbha upto 9 months [upto delivery]. Garbha is fully dependant t0n the mother, no any independent activities from the embryo. It is nourished in two methods. first before the formation of nabhinala and next after the formation of nabhinala. The placenta is the main organ which allow exchange nutrients and waste products in between the mother and foetus, so the placenta is considered as secondary lung of the foetus. It supplies all the nutrients including oxygen and collects waste products from the foetus. The garbhotpadaka bhavas like matraja, pitraja, rasaj and satmyaj etc. are most relative factors in-between the mother and foetus, for example some of the organs develops from matraja bhava and some are by pitraja bhava etc.

In modern concept the genes are the most responsible factors for the development of the foetus. So, the formation and growth of the foetus is fully dependant on the mother. It is ashrya and ashryi relation between mother and foetus.

Sadyo Grahita Garbha lakshana (सद्योगृहित गर्भ लिंगानि)–

तत्र सद्योगृहितगर्भाया लिंगानि श्रमोग्लानिः पिपासासक्थिसदनं
शुक्र शोणितयोरवबंधः स्फुरणं च योनेः ॥ सु. शा. ३/१३

The confirmation of the garbha lakshanas are as follows,

The body feels weakness or exhaustion in absence

of any hard work or any physical work, feeling of too much tiredness, feeling of thirst, gripping like pain in the thigh region, no discharge of menstrual blood (avarodha of artava sukra), and reduction and recreation of muscles in the region of vaginal canal (yoni region). Sphurana like sensation in the yoni region, such signs and symptoms are confirming the garbha.

Vyakta Garbha Lakshana (व्यक्त गर्भ लक्षण)–

स्तनयोः कृष्णमुखता रोमराज्युद्गमस्तथा।
अक्षि पक्ष्माणि चाप्यस्याः संम्मील्यतेविशेषतः॥
अकामतः छर्दयतिगंधादुद्विजतेऽशुभात प्रसेकः मदनं चापि गर्भिण्या लिंगमुच्यते॥

मु. शा. ३

The following signs and symptoms are confirmatory for the pregnancy.

The surrounding area of the nipple becomes dark, hair like lines appear just below the umbilical or lower abdomen region. Closing of the eyelids without any reason, which is feeling of the tiredness, vomiting without any reason, feeling of discomfort even in presence of fragrant flowers, nausea and watery discharge in the oral cavity, general weakness, such signs and symptoms are to be considered as lakshanas of garbhini.

Foetal Development (मासानुमासिक गर्भ परिवृद्धिक्रम)–

First month development–

प्रथमे मासि– तत्र प्रथमे मासि कललं जायते। मु.शा. ३

It is formed as kalala [embryo] nature, by the union of sperm and ovum. All the body parts in minute form, it comprises all the organs, it appears like jelly 1st day, with in 7 days frothy, with in fortnight like bolus, and at the end of month it solidifies.

Second month development–

द्वितीये मासि– द्वितीये शीतोष्मानिलैरभिप्रपच्यमानानां महाभूतानां संघातो घनः सञ्जायते; यदि पिण्डः पुमान्, स्त्री चेत् पेशी, नपुंसकः चेदर्बुदमिति ॥ सु.शा.३

चतुरस्रा भवेत् पेशी, वृत्तः पिंडो घनः स्मृतः ॥
शाल्मलि मुकुलाकारमर्बुदम् परिचक्षते । (गयादास)

It is processed by influence of tridosha like vata, pitta and kapha, becomes a solid mass of panch mahaboota with atma. If the solid mass is globular [pind] form then offspring is male child. If it is elongated [peshi] in nature then it is a female child; if it is tumor like then it is a hermaphrodite child. (नपुंसक)

Third month development–

तृतीये मासि– तृतीये हस्तपादशिरसां पञ्च पिण्डका निर्वर्त्तन्ते अङ्ग प्रत्यङ्ग विभागश्च सूक्ष्मो भवति । सु.शा.३

The foetus grow and develops into five buds of two arms, two legs and head. All the organs [anga] of the body and their sub divisions of organs [pratyangas] are in the minute and non visible form.

Fourth month development–

चतुर्थे मासि– चतुर्थे सर्वाङ्ग प्रत्यङ्ग विभागः प्रव्यक्तो भवति, गर्भहृदय प्रव्यक्तिभावाच्चेतनाधातुरभिव्यक्तो भवति, कस्मात् ? तत्स्थानत्वात, तस्माद् गर्भश्चतुर्थे मास्यभिप्रायमिन्द्रियार्थेषु करोति । द्विहृदयां च नारीं दौहृदिनीमाचक्षते । सु.शा.३

दौहृदविमाननात् कुब्जं कुणिं खञ्जं जडं वामनं विकृताक्षमनक्षं वा नारी सुतं जनयति, तस्मात् सा यद्यदिच्छेत्तत्तस्यै दापयेत् । लब्धदौहृदा हि वीर्यवन्तं चिरायुषं च पुत्रं जनयति ॥

All the organs [anga pratyangs] and their subdivisions become observable and more visible. The

chetanaa dhatu also gets manifested because the foetal heart becomes obvious. The seat of chetanaa is the heart. Therefore in the fourth month the foetus desires things to taste, to smell etc ; through the mother. The mother now possesses two hearts so known as दौहृदिनी Nonfulfillment of desires may leads to the birth of a child who would have a hump back or deformed arm or would be an idiot or dwarf or be with defective eyes or without eyes. Therefore, whatever she [mother] desires should be given to her. One who gets fulfillment of all the longings would deliver a strong and long-lived child. Pregnant women desires should be given to her by the physician in order to avoid harm to the foetus.

Fifth month development-

पञ्चमे मासि- पञ्चमे मनः प्रविबुद्धतरं भवति, ॥ सु.शा.३

पञ्चमे मासि गर्भस्य मांसशोणितोपचयो भवत्यधिकमन्येभ्यो मासेभ्यः।

च.शा.४/२१

In the fifth month the mind and wisdom becomes more noticeable and perception.

Sixth month development-

षष्ठे मासि- षष्ठे बुद्धिः ॥ सु.शा.३;

बलवर्णौजसांवृद्धिः षष्ठे। का.शा.२/७

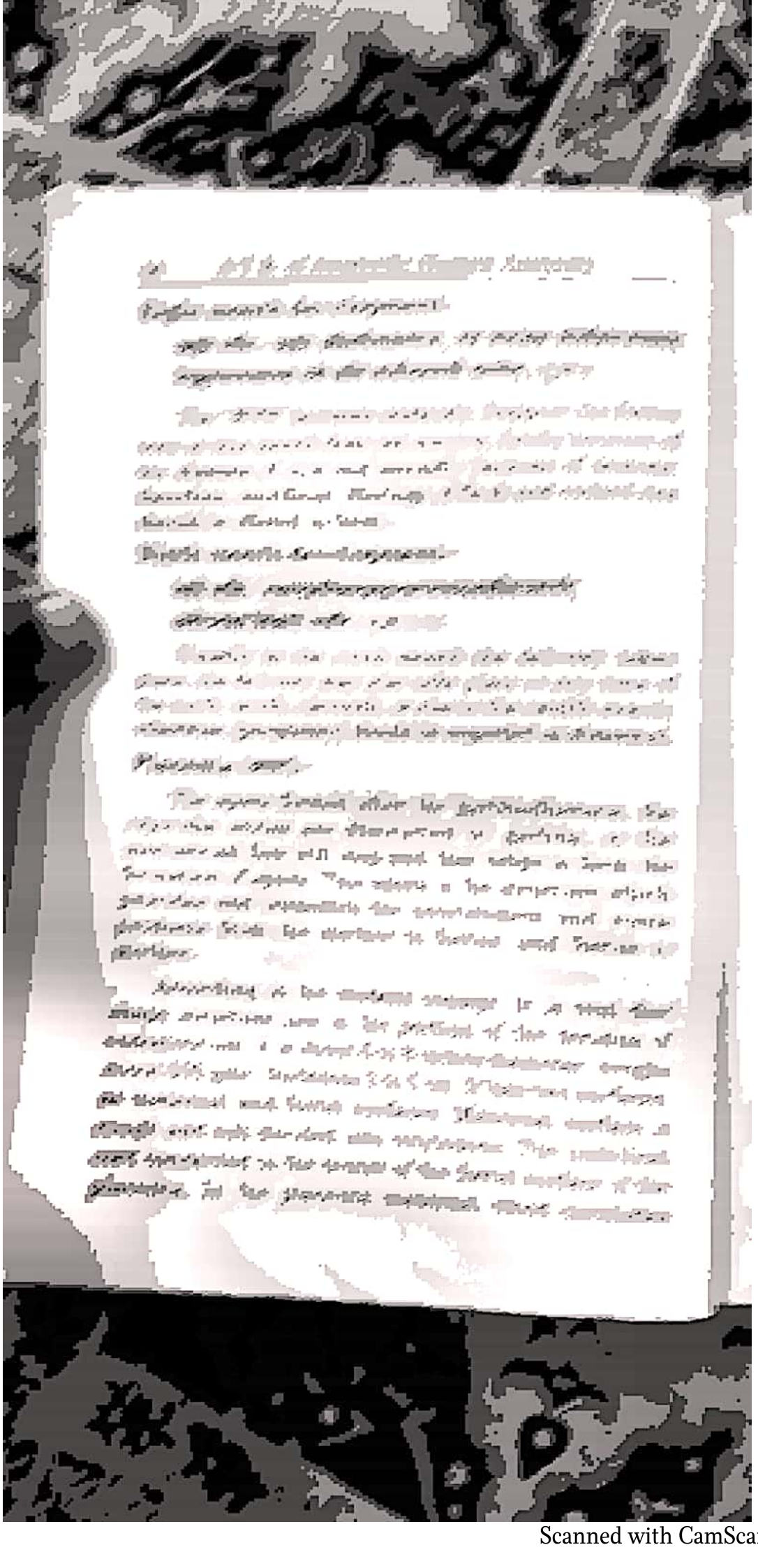
In the sixth month the wisdom is perceived.

Seventh month development-

सप्तमे मासि- सप्तमे सर्वाङ्ग प्रत्यङ्गविभागः प्रव्यक्ततरः ॥ सु.शा.३

गर्भः सर्वैः भावैः आप्यायते सदृशा। च.शा. ४

In the seventh month all the anga pratyangas are becomes more obvious. May make out the all body parts. Both the internal and external organs are noticeable during this month.



through the intervillous space and foetal blood circulates through blood vessels in the villi. The maternal blood and foetal blood do not mix with each other, they are separated by a placental membrane. The total area of this membrane is as great as 14 square meters.

Umbilical Cord (नाभिनाळ)–

मातुस्तु खलु रसवहायां नाड्यां गर्भनाभिनाडि प्रतिबद्धा, सास्य मातुराहाररस वीर्यमभिवहति तेनोपस्नेहोपस्वेदेनास्याभिवृद्धिर्भवति ॥ सु.शा. ३/१७

The mother's rasavaha nadis are allied with nabhinadi of foetus, the nutrient [ahara rasa] convey form mother to foetus for the development. The nabhi nadi [umbilical cord] is the main connecting arrangement which allows to flow of nutrient [upasneha] and waste products [upasweda] between mother and foetus.

According to modern, the umbilical cord is a set of blood vessels which are in communication by means of arteries and veins passing through the connecting stalk in the foetal life between mother and foetus. At first there are two umbilical arteries and two umbilical veins in connecting stalk but later the right umbilical vein disappears. The amnion has a circular attachment to the margins of the umbilicus opening and forms a wide tube. This cord progressively increases in length to allow free movement of the embryo within the amniotic cavity. It is about half meter long and shows a marked spiral torsion. One end is attached to the centre part of the foetal surface of placenta and other end is attached to the umbilicus of the foetus. It transmits blood with nutrients and waste products between mother and foetus. The umbilical vein carries high concentration of oxygenated blood and the umbilical arteries carries less concentration of oxygenated blood.

Nourishment of Garbha (गर्भ पोषण)–

गर्भस्तु खलु मातुः पृष्ठाभिमुख उर्ध्वशिराः संकुंच्याङ्गान्यास्तेऽन्तःकुक्षौ ।
च.शा. ६/२२

The foetus lies in the womb facing the mother's back, with head upwards, and folded limbs. It is covered by membrane and consisting fluid with in the membrane. The foetus floats within the fluid and nourishedby the mother.

कश्चित् लोमकूपायनैरुपस्नेहः । कश्चित् नाभिनाड्यायनैः ।
नाभ्यां ह्यस्य नाडी प्रसक्ता, नाड्यां चापरा, अपरा चास्य मातुः
प्रसक्ता हृदये, मातृहृदयं ह्यस्य तामपरामभिसंप्लवते,
सिराभि स्यन्दमानाभिः स तस्य रसो बलवर्णकरः संपद्यते ॥ च.शा. ६/२३

The foetus is linked with placenta of the mother by nabhi nadi [umbilical cord], the nabhi nala is connected from the placenta to the umbilicus of the foetus. It consist sira and dhamani, through these sira and dhamani the ahara ras is transforming from mother to foetus and nourishing the foetus. The apara [placenta] is linked with mother blood through blood vessels, and same is linked with foetus through the blood vessels connecting with umbilicus of the foetus. By this the foetus gets bala varna and develops in all aspects with proper anga and pratyangas.

Foetal Circulation (गर्भस्थ रक्त संवहन)–

The blood circulation during the fetal life with in the mother womb is known as fetal circulation, the blood circulates between the placenta in the mother and foetus.

The Circulation before and after the birth is as follows.

The following structures are involved in the fetal circulation

1. Left umbilical vein – संवहनि सिरा
2. Right and left umbilical arteries – दक्षिण वाम संवहनि धमनि
3. Ductus venosus – संवहनि सेतु सिरा
4. Ductus arteriosus – संवहनि सेतु धमनि
5. Foramen ovale – शुक्थि छिद्र

Left umbilical vein (संवहनि सिरा)–

It is the vein which carries the highly concentrated oxygenated blood from the placenta to the foetus and connects from the placenta to the left branch of the portal vein of the foetus.

Right and left umbilical arteries (दक्षिण वाम संवहनि धमनि)–

These are two arteries which carry the less concentrated oxygenated blood from the foetus to the placenta and connect the right and left internal iliac arteries of the foetus to the placenta.

Ductus venosus (संवहनि सेतु सिरा)–

It is vessel which connect the left branch of the portal vein to the inferior vena cava in relation with liver, it transmits the majority of blood from the left umbilical vein to the inferior venacava of the foetus.

Ductus arteriosus (संवहनि सेतु धमनि)–

The ductus arteriosus is connecting vessel to the arch of the aorta, from the just at the bifurcation of the pulmonary trunk as right and left pulmonary arteries.

Foramen ovale (शुक्थि छिद्र)–

It is foramen present in the atrial septum between the right and left atrium.

Circulation (रक्त संवहन)–

There are two right and left umbilical veins in the early life of foetus, later the right umbilical vein disappear and degenerates, only the left umbilical vein persist.

The blood from the placenta about 80 % saturated with oxygen, returns to the foetus by way of left umbilical vein, on approaching the liver most of the blood flows through the ductus venosus directly into the inferior vena cava, a smaller amount of blood enters in to the liver through left portal vein and mixes with portal venous blood.

After short course in the inferior vena cava, the blood mixes with blood returning from the lower limbs. It enters the right atrium, here it is guided towards the foramen ovale, by the valve of inferior vena cava and most of the blood passes directly in to the left atrium through foramen ovale. The foramen ovale is present in the atrial septum it allows the blood flow from right atrium to left atrium. Some amount of blood remains in the right atrium, here it mixes with blood returning from the head, neck and upper limbs by way of superior vena cava.

From the left atrium where it mixes with small amount of blood returning from the lungs, and enters the left ventricle, flow in to the ascending aorta.

The blood from the superior vena cava flows by way of the right ventricle in to the pulmonary trunk, most of this blood passes directly through the ductus arteriosus, into the arch of the aorta where it mixes with blood from the proximal aorta. After coursing through the descending aorta, blood flows toward the placenta by way of the two umbilical arteries. The oxygen saturation in the umbilical arteries is 58%

approximately. The foetus nourishes through the branches of aorta.

Circulatory changes after birth

Changes in the vascular system take place in the fetal blood vessels. It is caused by cessation of placental blood flow and the beginning of the respiration.

The Ductus arteriosus closes by muscular contraction of its wall, the amount of blood flowing through the pulmonary trunk increases rapidly. The pressure in the left atrium raises, simultaneously pressure in the right atrium decreases, as a result of interruption of placental blood flow. The foramen ovale closes by the apposition of septum premium to septum secundum.

Changes in the Vessels-

1. Closure of Umbilical Arteries-

Functionally the arteries close within a few minutes after the birth. The actual obliteration of the lumen by fibrous proliferation may take 2 to 3 months.

(a) Distal part of the umbilical arteries forms the medial umbilical ligaments.

(b) The proximal part remains open as the superior vesical arteries.

2. Closure of the Umbilical Vein and Ductus Venosus-

Occurs shortly after that of the umbilical arteries. The umbilical vein forms the ligamentum teres hepatis.

The ductus venosus is obliterated and forms the ligamentum venosum.

3. Closure of the Ductus Arteriosus-

By contraction of its muscular wall occurs almost immediately after birth, it forms the ligamentum

arteriosum. Complete anatomical obliteration by proliferation of the intima is to take 1 to 3 months.

4. Closure of the Foramen Ovale-

It is caused by increased pressure in the left atrium combined with a decrease in pressure on the right side; it is formed as fossa ovalis.

Modification of the structures-

Before birth	After birth
1. Umbilical arteries	1. Medial umbilical ligaments
2. Left umbilical vein	2. Ligamentum teres
3. Ductus venosus	3. Ligamentum venosum
4. Ductus arterious	4. Ligamentum arteriosum
5. Foramen ovale	5. Fossa ovalis

Chapter-4

PARIBHASHA SHAREERA
(परिभाषा शारीर)

Asthi Sanghata (अस्थि संघाता:)–

अस्थि संघाता: – चतुर्दशास्थां संघाता:; तेषां त्रयो गुल्फ जानु वंक्षणेषु एतेनेतरसक्थि वाहू च व्याख्यातौ, त्रिक शिरसोरेकैक: ॥

The meeting point of more than two or three bones in one place is called as asthi sanghatha. The articulation of two or more bones forms as joint such joint region may be known as asthi sanghata. There are fourteen asthi sanghatas in the body.

- गुल्फ [Ankle] – 2
- जानु [Knee] – 2
- वंक्षण [Hip] – 2
- शिर [head] – 1
- कक्ष [Shoulder] – 2
- कूर्पर [Elbow] – 2
- मणिवन्ध [Wrist] – 2
- त्रिक [sacral] – 1

Seevani (सीवनि)–

सीवनि– सप्त सेवन्य: शिरसि विभक्ता: पञ्च, जिव्हाशेफसोरेकैका ता: परिहर्तव्या: शस्त्रेण ॥ (सु.शा.५/१५)

Seevani means suture, there are seven sutures in the body. The zig zag articulation of the bone appears like a suture is called as seevani. The joint region has zig zag appearance. The interlacing region of the muscle, membrane with each other is also known as suture/ raphe. The incision should not be done in the suture and rape region, the care to be taken of these regions during surgery.

E.g. : Coronal Suture, Lambdoid Suture and Sagittal Suture, Median raphe and Perineal raphe etc.

1. In the skull region	–	5 Seevani [cranial sutures]
2. Inferior surface of the tongue	–	1 Seevani [frenulum of the tongue]
3. Inferior surface of the penis and scrotum in male, in female between vagina and anus.	–	1 Seevani (perineal raphe)

Seemanta (सीमन्त)–

There are fourteen seemantas in the body, these are almost similar to the seevani. The articulation of more than two bones in one region, is known as seemantas and these may be counted and considered as like asthisanghata.

चर्तुदश एव सीमन्ताः तेच अस्थिसंघातवत् गणनीयाः ।
यतः तैर्युक्ताहि अस्थिसंघाताः ये ह्युक्ताः
संघातास्तुखलु अष्टादश एकेषाम् ॥ (सु.शा ५/१८)

In one concept says, there are eighteen seemantas and these are as follows.

शिर – ५ ; शाखा – १२ ; त्रिक – १

Acharya Dalhana also said more obvious about seemanta.

संघाताः सीविताः यैस्तु सीमंतास्तान् प्रचक्ष्महे, इति भोजः ।
संघातवत् सीमन्तः । पञ्च शिरसि इअत्यष्टादश ॥ (अ.सं.शा ५)

Jala (जाल)–

मांस सिरास्नाय्वस्थि जालानि प्रत्येकं चत्वारिः तानि मणिबंध गुल्फ संश्रितानि परस्पर निबद्धानि परस्परगवाक्षितानि चेति यैर्गवाक्षितमिदं शरीरम् ॥ (सु.शा. ५)

मणिबंध– ४ (मांस, सिरा, स्नायु, अस्थि – प्रत्येकः)

गुल्फ– ४ (मांस, सिरा, स्नायु, अस्थि – प्रत्येकः)

The jala is almost a network arrangement of the sira, snayu, mamsha and asthi in one particular region within the body, such a region is known as jala. There are sixteen jalas in the body. The two manibandha sandhi regions consist eight jalas. The two gulpha regions consist eight jalas.

Mamsa Rajju (मांस रज्जु)–

रज्जुः – महत्यो मांसरज्ज्वश्चतस्रः – पृष्ठवंशमुभयतः पेशिनिबन्धनार्थम् द्वे बाह्ये, आभ्यन्तरे च द्वे ॥ सु.शा.५/१२।

There are four mamsa rajju in the body, these are long fibro muscular bands, these lies in the region of the vertebral column, two are in the internal aspect and two are external aspect of the vertebral column. It helps to binding the muscles and bones of the vertebral column. These may be considered as ligaments of vertebral column which helps to bind the vertebrae.

Koorcha (कूर्च)–

षट् कूर्चाः , ते हस्त पाद ग्रीवा मेढ्रेषु ; हस्तयोः द्वौ पादयोः द्वौ ग्रीवा मेढ्रयोरेकः ॥ सु. शा.५/१३।

These are thick broad fibro muscular structures. There are six kurchas in the body, they are present in the palm region two, in the neck region one, in the plantar region two, and in the lower part of the penis one. These help to grasp the tendons in a appropriate arrangement. It may be considered as aponeurosis of palmar and plantar regions etc.

1. Palm region – Two
2. Neck region – One
3. Plantar region – Two
4. Penis region – One

Kandara (कण्डरा)–

षोडश कण्डराः – तासां चतस्रः पादयोः तावत्यो हस्त ग्रीव मेढ्रे।

तत्र हस्तपादगतानां कण्डराणां नखाः अग्ररोहाः ॥ वृत्त स्नायु कण्डरा ।

There are sixteen kandaras in the body, these are lies in the feet region - four; in the hand region - four; in the neck region - four; and in the back region - four. the round shape of ligaments are known as kandar, these mainly helps in attachment of muscles and joints. According to the modern these may be considered as retinaculum, which are present in the wrist and ankle joints.

1. Foot region – Four
2. Hand region – Four
3. Neck region – Four
4. Back region – Four

Snayu (स्नायु)–

Totally there are 900 ligaments in the body, these are four types, namely Prathna snayu - like a branches; Vrutta snayu - like round; Prathula snayu - like thine flat type; Sushira snayu - thread like. Ligaments which are helps to binding the joints and also helps to transmits the body weight.

1. In shakha	600 snayu (Each limb has 150 snayu)
2. Madhyamanga	230 snayu
3. Siro Greeva	70 snayu
Total	900 snayu

Uradhva and Adha Shakagata Snayu–

- Each toe $6 \times 5 = 30$
- Ankle/wrist 30
- Leg/fore arm 30
- Knee/elbow 10
- Thigh/arm 40
- Hip/shoulder 10

Total = $150 \times 4 = 600$ Snayu

Madhyamanga gata Snayu-

- *Lumbar region* 60
- *Back region* 80
- *Side region* 60
- *Chest region* 30

Total = 230 Snayu

Siro Greeva gata Snayu-

- *Neck region* 36
- *Head region* 34

Total = 70 Snayu

Chapter-5

PRAMANA SHAREERA
(प्रमाण शारीर)

Anguli Sankya (शरीरस्य अंगुलि संख्येयं प्रमाणम)–

शरीर प्रमाणं पुनः यथा स्वेन अंगुलि प्रमाणेन उपदेक्षते ।
उत्सेध विस्तार आयामैः यथा क्रमम् ॥ (च.चि.८)
केवलं पुनः शरीरम् अंगुलिपर्वाणि चतुरशीतिः ।
तत् आयाम विस्तार समं समुच्यते ॥
तत्र आयुर्बलम् ओजः सुखम् ऐश्वर्यं वित्तं
इष्टश्च अपरे भावा भवन्ति आयताः
प्रमाणवति शरीरे विपर्ययस्तु अतो हीने अधिके वा ॥ (च.वि.८)
देह स्वैरंगुलिरेष यथावदनुकीर्तितः । युक्त प्रमाणेनातेन पुमान् वा यदिवांगना ॥
दीर्घमायुरवाप्नोति वित्तंच महच्चच्चति । मध्यमं मध्यमैरायुर्वित्तं हीनैस्तथावरम् ॥
(सु.सू.३४)

सविंशमंगुल शतं पुरूषायाम इति ॥ सु.सू.
स्वं स्वं हस्तत्रयं सार्ध वपुः पात्रं सुखायुषोः ॥ (अ.ह.शा.३)

Sankya Shareera (संख्या शारीर)–

त्वचः सप्त, कलाः सप्त, आशयाः सप्त, धातवः सप्त, सप्त सिराशतानि, पंच पेशिशतानि, नव स्नायुशतानि, त्रीण्यस्थिशतानि, द्वे दशोत्तरे संधिशते, सप्तोत्तरं मर्मशतं, चतुर्विंशति धमन्याः, त्रयो दोषाः, त्रयो मलाः, नव स्त्रोतांसि, षोडश कंडराः, षोडश जालानि, षट् कूर्चाः, चतस्त्रो रज्जवः, सप्त सेवन्यः. चतुर्दश संधाताः, चतुर्दश सीमन्ताः, द्वाविंशतिर्योगवहानि स्त्रोतांसि, द्विकान्यंत्राणि चेतिसमासः
(सु.शा.५/६)

त्वच – ०७	कला – ०७	आशय – ०७	धातु – ०७
सिरा – ७००	पेशि – ५००	स्नायु – ९००	अस्थि – ३००
सन्धि – २१०	मर्म – १०७	धमनि – २४	दोष – ०३

मला: – ०३	स्रोतस – ०९	कन्डरा – १६	कूर्चा – ०६
रज्जु – ०४	मेवनि – ०७	संघात – १४	सीमंत – १४
योगवाहि स्रोतस्– २२	अंत्राणि – ०२		

अंजलि प्रमान–

उदक	– १०	आहार रस	– ०९	शोणित	– ०८
पुरीष	– ०७	श्लेष्म	– ०६	पित्त	– ०५
मूत्र	– ०४	वसा	– ०३	मस्तिष्क	– १/२
मेद	– ०२	मज्जा	– ०१	शुक्र	– १/२
ओज	– १/२	आर्तव	– ०४		

चरकोक्त अंगुल प्रमाण –

प्रत्यंग नाम –	वर्तुल Circumferance	उत्सेध Height	विस्तार breadth	आयाम length
1	2	3	4	5

१	२	३	४	५	१	२	३	४	५
पाद	–	४	६	१४	स्तनांतर	–	–	१२	–
जंघा	१६	–	–	१८	स्तन	–	–	०२	–
जानु	१६	–	–	–	हृदय	–	–	०३	–
ऊरु	३०	–	–	१८	स्कंध	०८	–	–	–
वृषण	०८	–	–	०६	अंस	–	–	०६	–
शिश्न	०५	–	–	०६	बाहु	–	–	–	१६
भग	१२	–	–	–	प्रबाहु	–	–	–	१५
कटि	–	–	१६	–	हस्त	–	–	–	१२
बस्तिशिर	–	–	१०	–	कक्ष	–	–	०८	–
उदर	–	–	१०	१२	त्रिक	–	१२	–	–
पार्श्व	–	–	१०	१२	पृष्ठ	–	१८	–	–

१	२	३	४	५
उरः	–	–	१२	२४
मुखमण्डल	१४	१२	–	–
चिबुक	–	–	०४	–
कर्ण	–	–	०४	–
नासा	–	–	०४	–
शिर	३२	–	१६	–

१	२	३	४	५
मन्या	२२	०४	–	–
मुख	–	–	०५	–
ओष्ठ	–	–	०४	–
अक्षिमध्य	–	०४	–	–
ललाट	–	–	०४	–

Chapter-6

SIRA, DHAMANI, SROTO ADHYAYA
(सिरा धमनि स्त्रोतो अध्याय)

Sira (सिरा)–

सरणात् सिरा। सरणात् रसादीनाम् गमनात् सिरा इत्युच्यते ॥ (चरक)

सप्त सिरा शतानि भवन्ति ॥ (सुश्रुत)

The flow of blood without force in the vessels, such vessels are known as siras. The pressure is always less in the siras. The Siras are 700 in the body, these may be considered as veins. Acharya Sushruta has classified them as bahirmukha and antarmukha siras.

Mula Siras are 40 in numbers–

(1) Vatavaha Sira	– 10	Again Sub divide	– 175
(2) Pittavaha Sira	– 10	Again Sub divide	– 175
(3) Kaphavaha Sira	– 10	Again Sub divide	– 175
(4) Raktavaha Sira	– 10	Again Sub divide	– 175
Total	– 40	Total	– 700

(1) Vata vaha Sira – Aruna varna and Vata sthana

(2) pitta vaha Sira – Ushna, Neela varna and Pitta Sthana

(3) Kapha vaha Sira – Seeta, goura varna, stira, kapha sthana

(4) Rakta vaha Sira – Natyushna Sheeta, Rakta-varna & Raktasthana

Sira according to Shadangatvam–

(a) Urdhva and Adha Shakha – 25 × 4 limbs – 100 × 4 = 400

(b) Kostha (Madhyamanga) – 34 × 4 = 136

(c) Jatrurdhva (Head & Neck) – 41 × 4 = 164

Total 175 sira X 4 types of mula sira = Total 700 siras.

Dhamani (धमनि– ध्मानात् धमन्य)–

The blood flow with force in the vessels, such vessels are known as dhamani. The pressure is always more in the dhamanis. Acharya Charaka said as ध्मानात् (force). The dhamnis are twenty four in the body, these may be considered as arteries.

Dhamanis are 24 in the body and classified as follows.

(1) Urdhvagami Dhamani – 10
(2) Adhogami Dhamani – 10
(3) Tiryakgami Dhamani – 4

Structure of the sira and dhamani - (Blood vessels)–

Siras having 3 coats, walls are thin consisting less muscular fibres and internally having valves. Smaller veins are called venules and minute venules are known as capillaries (sookshma sira).

Dhamanis are made up of three layers as same like veins, but walls are thick. The middle layer consists of the muscular and elastic fibers, usually the muscle fibers are thick. Internally no valves, The arteries are divided as muscular and elastic arteries. Smaller artery is called as arteriole [Sooksma dhamani], minute branches of arterioles are called as capillaries [Jalakas]. Capillaries are made up of single layer of endothelial cells [Rakta dhara kala]. The length of capillaries is about 0.3 mm.

1. Bahya prachirika– Tunica adventitia outer layer consists of Sanyojaka dhatu [connective tissue].

2. Madhya prachirika– Tunica media middle layer, consists of "Swatantra peshi" [Smooth muscular tissue]

3. Abhyantara prachirika– Tunica intima inner most layer, consists of "Sanyojaka dhatu" Rakta dhara kala [endothelial and connective tissue].

Difference between Sira and Dhamani–

Acharya Charaka has very clearly mentioned about the difference in between Sira, Dhamani and Srotas in his Samhita.

Sira: सरणात् सिरा; Dhamani: ध्माणात् धमन्य; Srotas: स्रवणात् स्रोतांसि;

Sira	Dhamani
1. Blood flow without force	1. Blood flow with force
2. 700 in No.	2. 24 in No.
3. Made up of three layers and thin walls (a) Tunica Externa (b) Tunica Media (c) Tunica Intima	3. Made up of three layers and thick walls (a) Tunica Externa (b) Tunica Media (c) Tunica Intima
4. Carries blood towards the heart	4. Carries away from the heart
5. Internally valves are present	5. No valves internally
6. Lies superficial and deeply	6. Lies deeply,
7. Vascular pressure is less	7. Vascular pressure is more
8. Siras are classified as (a) Vata vaha sira (b) Pitta vaha sira (c) Kapha vaha sira (d) Rakta vaha sira	8. Dhamani are classified as (a) Urdhva gami dhamani (b) Adho gami dhamani (c) Tiryak gami dhamani

Channals (स्रोतस)–

It is denoted as a channel, it is derived from the root word 'sravane' meaning 'to flow gradually', 'to ooze ', or ' to exude ' etc. It is also a vessel which allow flow of different substances gradually.

स्रवणात स्रोतांसि। स्रवणादिति रसादेव पोष्यश्य स्रवणात (चक्रपाणि)

प्राणान्नवारि रसशोणित मांसमेदोवाहित्वं स्रोतसाम्। (डल्हण)

Srotas carry the dosha, dhatu, and mala through out the whole body. Srotas are the sthoola and sookshma channels. The dhatu will flow drop by drop with out any force within the srotas. Just oozing of the dravya through the membrane and helps in development of the dhatu. by diffusion, hence purush is known as स्रोतोमय पुरुष। Srotas are named as according to their functions. They have specialized functions like, Percolation (निस्यंदन), Conveyance (अभिवहन) Osmosis (अभिसरण), Absorption (शोषण), Oozing (स्रावण).

Mainly there are two types of srotas as explained by Acharya Sushruta.

बाह्यानि अन्तराणि च इति द्विविधानि।

बहिर्मुखानि योगवहानि च ॥ (अ. स. शा.२)

(१) बहिर् मुख स्रोत्स् (२) अन्तर् मुख स्रोतस्

1. Bahira Mukha Srotas (बहिर् मुख स्रोतस्)–

These are external channals and openings which helps to excrete the waste substance and serve as indriyas.

श्रवण,नयन,वदन,घ्राण,गुद,मेढ्राणि नव स्रोतांसि नराणां बहिर्मुखानि ॥

एतान्येव स्त्रीणामपराणि च त्रीणि द्वे स्तनयोरधस्तादक्तवहं च ॥

(सु. शा .५/१०)

नव द्वारे पुरे देही नैव कुर्वन्न कारयन् ॥ (भ.गीता. ५/१३)

बहिर्मुख स्रोतस्–

There are 9 bahir mukha srotas and are as follows-

(1) कर्णद्वार (ears)	2	(4) मुखद्वार (oral cavity)	1
(2) नेत्रद्वार (eyes)	2	(5) गुदद्वार (anus)	1
(3) नासाद्वार (nostrils)	2	(6) शिश्नद्वार (medra)	1

Three Bahir Mukha Srotas are more in females.

(1) Stana vaha – 2 (2) Arthava vaha – 1

2. Antar Mukha Srotas [अन्तर् मुख स्रोतस्]–

These are internal channels which help transmission of different substances. Acharya Charaka stated that there are 13 srotas.

प्राणोदकान्नरस रुधिर मांस मेदोऽस्थि मज्जा शुक्र मूत्र पुरीष स्वेद वहानि ॥ (च.वि.५/६)

(१) प्राणवह स्रोतस्	(६) मांसवह स्रोतस्	(११) मूत्रवह स्रोतस्
(२) उदकवह स्रोतस्	(७) मेदोवह स्रोतस्	(१२) पुरीषवह स्रोतस्
(३) अन्नवह स्रोतस्	(८) अस्थिवह स्रोतस्	(१३) स्वेदवह स्रोतस्
(४) रसवह स्रोतस्	(९) मज्जावह स्रोतस्	
(५) रुधिरवह स्रोतस्	(१०) शुक्रवह स्रोतस्	

Acharya Sushruta has explained there are 11 srotas and each two in number, these are known as योगवाहि स्रोतस्

तानि तु प्राणान्नोदक रस रक्त मांस मेदो मूत्र पुरीष शुक्रार्तव वहानि ॥ (सु.शा.९/१२)

प्रत्येकं द्वे द्वे इति – द्वाविंशतिर्योगवहानि स्रोतांसि ॥ (सु.शा. ५/६)

(१) [illegible] = १
(२) [illegible] = १
(३) [illegible] = १
(४) [illegible] = १
(५) [illegible] = १
(६) [illegible] = १
(७) [illegible] = १
(८) [illegible] = १
(९) [illegible] = १
(१०) [illegible] = १
(११) [illegible] = १

दोषो दुष्टिलक्षणे–

अतिवृद्धिः क्षयो वा सिराणां ग्रन्थयोऽपि च।
विमार्गगमनं च अपि स्रोतसां दुष्टिलक्षणम्॥ (च. वि. ५/१८)

कुपितानां हि दोषाणां शरीरे परिधावताम्।
यत्र संगः खवैगुण्यात् व्याधिस्तत्रोपजायते॥ (सु. स २४/१०)

Major Blood vessels–

Aorta (महा धमनि)–

The great arterial trunk receives oxygenated blood from the left ventricle, it arise from the base of the left ventricle, upwards and runs towards left, then downwards and ends at the level of 4th lumbar vertebra by dividing into right and left common iliac arteries. It has three parts.

(1) The Ascending aorta (3) The Descending aorta.
(2) Arch of aorta.

1. Ascending aorta (आरोहि महा धमनि)–

It arises from the base of the left ventricle, about 6 cm long, begins behind the left half of the sternum at the level of the lower border of the 3rd costal cartilage, runs upwards, and to the right, up to the upper border of second costal cartilage.

Aortic sinus–

Small dilatation of the vessel wall at the root of

the aorta above each cusp of the aortic valve is called as aortic sinus.

Relations–

Anterior– Sternum, Left lung, Pericardium, Infundibulum of the right ventricle, root of the pulmonary trunk, right auricle

Posterior– Transverse sinus of pericardium, left atrium, right pulmonary artery, right pulmonary bronchus.

Right– Superior vena cava, right atrium

Left– Pulmonary trunk above, left atrium below

Branches– (1) Right coronary artery

(2) Left coronary artery

Right Coronary Artery (दक्षिण हृदीय धमनि)–

It is smaller than the left, arises from the anterior aortic sinus forwards right to emerge between root of the pulmonary trunk and right auricle, then extends in the right anterior coronary sulcus to the junction of the right and inferior borders of the heart, continues in the right posterior coronary sulcus up to posterior interventricular grove. Its terminates by anastomosing with left coronary artery.

Branches–

(1) Marginal artery.

(2) Posterior interventricular artery.

(3) Nodal brs in 60% cases.

(4) Right atrial artery.

(5) Infundibular artery.

(6) Terminal artery.

Distribution–

1. Right atrium
2. Greater part of right ventricle and smaller part of left ventricle adjoining the posterior interventricular grove, except the area adjoining the anterior interventricular grove.
3. Posterior part of the interventricular septum.
4. Conducting system of the heart, except left branch of the A V bundle, S A node is supplied by the left coronary artery in about 40% cases.

Left Coronary Artery (वाम हार्दिक धमनि)–

It is larger than the right, originates from the left posterior aortic sinus, forwards and to the left emerges between pulmonary trunk and left auricle, here it gives the anterior inter ventricular branch, downwards in its grove some times continuation of this artery is as the circumflex artery, runs towards left in the left anterior coronary sulcus, continues in the left posterior coronary sulcus, where it terminates by anastomosing with the right coronary artery.

Branches–

(1) Anterior inter Ventricular Artery.
(2) Branch to Diaphragmatic surface of Left Ventricle.
(3) Pulmonary Artery.
(4) Left Atrial Artery.
(5) Terminal Artery.

Distribution–

1. Left atrium.
2. Greater part of left ventricle, smaller part of right ventricle adjoining the anterior inter ventricular grove, except the area adjoining the posterior inter ventricular grove.

3. Anterior part of the inter ventricular septum.
4. Part of the left branch of the A.V. Bundle.

Applied–

1. Thrombosis is a common cause of sudden death in persons past middle age.
2. Incomplete obstruction causes "Angina pectoris."

Arch of the aorta (तोरणि महाधमनि)–

It is the continuation of the ascending aorta, situated in the superior mediastinum behind the lower half of the manubrium sterni. It begins from the upper border of the 2nd right sternochondral joint, and runs upwards backwards and to the left across the left side of the bifurcation of trachea, down wards behind the left bronchus on the left side of the body of 4th thoracic vertebra. It thus arch over the left lung, then it ends at the lower border of the body of 4th thoracic vertebra as continuation of descending aorta. It begins anteriorly and ends posteriorly.

Relations–

Anterior– (1) Left phrenic nerve.
(2) Left vagus nerve.

To the left–

(1) Left sympathetic chain.
(2) Left superior inter costal vein.
(3) Left pleura and Left lung.
(4) Remains of thymus.

Posterior– (1) Trachea (2) Cardiac plexus

To the right– (1) Oesophagus. (2) Thoracic Duct.
(3) Left recurrent laryngeal nerve.
(4) Vertebral column.

Superior–

Branches of arch of the aorta and left brachiocephalic vein.

Inferior–

1. Bifurcation of the pulmonary trunk.
2. Left bronchus.
3. Ligamentum Arteriosus with cardiac plexus.
4. Left recurrent laryngeal nerve.

Branches–

1. Brachiocephalic artery again it divides into right common carotid and right sub clavian arteries.
2. Left common carotid artery.
3. Left subclavian artery.

Occasionally–

1. Thyroid ima artery 2. Vertebral artery

Radial artery (बहिर् प्रकोष्ठीय धमनि)–

It is one of the small terminal branches of the brachial artery, arises opposite of the neck of radius in the cubital fossa.

It passes downward and laterally deep to the brachioradialis muscle. It emerges on the medial side of the tendon of the brachioradialis, resting on the tendon of biceps, supinator and pronator teres. Along the radial side

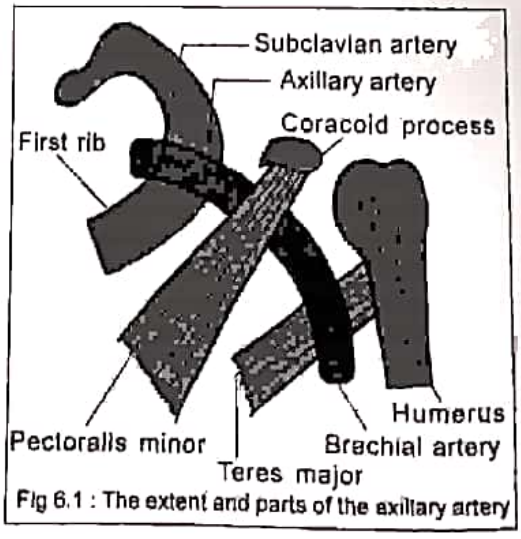


Fig 6.1 : The extent and parts of the axillary artery

of forearm to the wrist, where its pulsation can readily be felt in between flexor carpiradialis tendon medially and radius laterally. It crosses towards the ulnar side and forms the deep palmar arch by uniting with the deep branch of the ulnar artery.

Branches–

1. It gives a branch in the fossa as radial recurrent artery.
2. Muscular branches.
3. Palmar and dorsal carpal branches.

Ulnar artery (अंतर् प्रकोष्ठीय धमनि)–

It is one of the terminal branches of the brachial artery, arises in the cubital fossa at the level of the neck of the radius.

It passes downward and medially, deep to the muscles, and then runs downward under the flexor carpi ulnaris on the lateral side of the ulnar nerve. At the wrist it is quite superficial and lies with ulnar nerve. The artery enters the palm on the lateral side of the ulnar nerve. It crosses in front of the flexor retinaculum and lies laterally to the pisiform bone. It ends by joining superficial palmar branch of the radial artery to form the superficial palmar arch.

Branches–

1. Muscular branches
2. Recurrent branches
3. Common interosseous artery.

Descending aorta (अवरोहि महाधमनि)–

It is the continuation of the arch of the aorta, It begins left side at the lower border of the body of 4th thoracic vertebra, and ends at the level of lower border of the 4th lumbar vertebra by dividing into two com.

mon iliac arteries. It is divided into two parts by diaphragm.

(1) Thoracic aorta. औरसि महाधमनि

(2) Abdominal aorta. औदरि महाधमनि

These two parts are separated at the level of lower border of 12th thoracic vertebra at the aortic opening of the diaphragm.

Thoracic aorta (औरसि महाधमनि)–

It is continuation of the arch of the aorta, begins at the level of 4th thoracic vertebra and ends at the level of 12th thoracic vertebra, at the aortic opening of the diaphragm muscle, further continues as abdominal aorta.

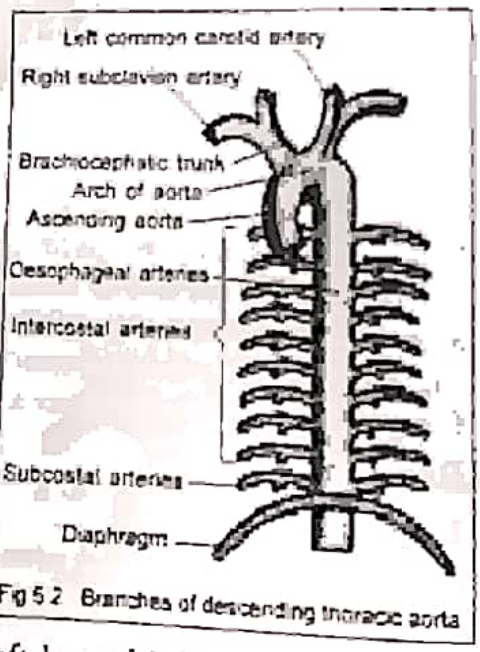


Fig 5.2 Branches of descending thoracic aorta

Branches–

(a) Pericardial branches– Vessels distributed to the posterior surface of the pericardium.

(b) Bronchial arteries– Very in number, size and origin. Right bronchial artery arises from the 3rd posterior inter costal artery, or from the left bronchial artery. Left bronchial arteries are usually two in numbers.

(c) Oesophageal Artery– 4, 5 in numbers, arises from the front of the aorta, then passes obliquely downwards to the oesophagus.

(d) Mediastinal Branches– Numerous small vessels.

(e) Phrenic branches– Small, arises from the lower part of the thoracic aorta, distributed to the posterior part of the upper surface of the diaphragm and anasto moses with the musculo phrenic and pericardio phrenic arteries.

(f) Posterior Intercostal Arteries– Usually 9 pairs derived from the back of the aorta and are distributed to lower 9 inter costal spaces.

(g) The Subcostal Arteries– ast pair of branches from the thoracic aorta.

Abdominal aorta (औदरि महाधमनि)–

It is the continuation of the thoracic aorta at the aortic hiatus of the diaphragm, in front of the lower border of the 12th thoracic vertebra, and descends in front of the vertebral column ending at the level of the body of the 4th lumbar vertebra by dividing into right and left common iliac arteries.

Branches– These are grouped as follows

1. Ventral branches–

(a) Coeliac trunk (b) Superior mesenteric artery

(c) Inferior mesenteric artery

2. Lateral branches–

(a) Inferior phrenic artery

(b) Middle Suprarenal artery

(c) Renal arteries

(d) Testicular/Ovarian artery

3. Dorsal branches–

(a) Lumbar arteries – 4 pairs

(b) Median sacral artery

4. Terminal branches–

(a) Right and Left common iliac arteries

Coeliac Trunk–

It is a wide and short ventral branch, about 1.25 cm long, arises at the front of aorta, just below the aortic hiatus of the diaphragm, at the level of the disc between vertebra T12 and L1; passes nearly horizontally forwards and slightly to the right above the pancreas and the splenic vein. It is surrounded by the coeliac plexus anteriorly, related to the lesser sac, lesser omentum, right side - right crus and caudate process, left side - left crus and cardiac end of the stomach. It divides into three branches.

1. Left gastric artery – आमाशय कौष्ठिक धमनि
2. Hepatic artery – अभियकृतीय धमनि
3. Splenic artery – अधि प्लिहिक धमनि

These branches supply the derivatives of foregut organs, the foregut organs are lower end of esophagus, liver, stomach, spleen, upper $^1/_2$ part of duodenum and Greater part of the pancreas.

1. Left gastric artery–

This smallest artery passes upwards and to the left behind the omental bursa, to the cardiac end of the stomach, lies close to the left inferior phrenic artery and medial to or infront of the left suprarenal gland; near the cardiac end of the stomach it gives off 2 or 3 oesophageal branches.

2. Hepatic artery–

It is intermediate in size between the left gastric and splenic branches. Early in post natal life it is the largest branch, accompanied by the hepatic plexus. It

crosses in front of the portal vein and ascends between the layers of the lesser omentum and infront of the epiploic foramen to the porta hepatis; where it divides into right and left branches to supply the corresponding lobes of the liver.

Branches–

Right gastric, Gastroduodenal, and cystic arteries.

Right gastric artery–

Arises above the superior part of the duodenum, descends in the lesser omentum to the pyloric end of the stomach, and passes from right to left along the lesser curvature. Suppling the upper parts of the anterior and posterior surface of the stomach and ends by anastomosing with the left gastric artery.

Gastro duodenal artery–

It arises behind or some times above the superior part of duodenum, short but large, descends between the superior part of the duodenum and neck of the pancreas, lies to the left of the bile duct. It divides into the right gastroepiploic and superior pancreaticoduodenal arteries.

Cystic artery–

Right branch of the hepatic artery passes behind the common hepatic and cystic ducts supplies to the gallbladder.

3. Splenic artery–

Largest branch, surrounded by the splenic plexus and accompanied by the splenic vein, lies behind the pancreas. It passes horizontally to the left, behind the stomach and omental bursa and along the upper border of the pancreas, crosses in front of the left suprarenal gland, near the spleen it divides into five

or more segmental branches which enter the hilum of the spleen.

Branches–

The Pancreatic Brs– These are numerous, small vessels supplying the neck, body and tail of the pancreas.

Short gastric arteries–

Five to seven in numbers, arise from the end of splenic artery, distributed to the fundus of the stomach.

Posterior gastric artery–

Derived from any part of the splenic artery distributed to the fundus and posterior gastric wall.

Left gastro epiploic artery–

Largest branch arises near the hilum of the spleen, runs obliquely downwards, forwards, and to the right, sends several brs, and distributed upper third of the greater curvature.

Superior mesenteric artery–

It is ventral branch of the abdominal aorta at the level of L1 vertebra. It diverges from the front of the aorta 1cm below the coeliac trunk and is crossed out at origin by the splenic vein and the body of the pancreas. It is separated from the front of the aorta and left renal vein. It supplies the derivatives of midgut. The midgut organs are lower half of the duodenum, jejunum, Ileum, right $^{2}/_{3}$ of transverse colon, appendix, caecum, ascending colon, lower $^{1}/_{2}$ of the head of the pancreas. It gives the following branches.

Branches–

1. Inferior pancreatico duodenal artery.
2. Ileocolic branch.

3. Jejunal artery.
4. Right and middle colic arteries.
5. Ileal artery.

The Inferior pancreaticoduodenal artery–

Usually it divides at once into anterior and posterior branches. Anterior branch goes to the right in front of the head of the pancreas, and then ascends to anastomoses with anterior superior pancreatico- duodenal artery. The posterior branch passes upwards to the right behind the head of the pancreas.

The jejunal and ileal arteries–

Arise from the left side of the artery, usually 12 to 15 in numbers and are distributed to the jejunum and ileum except the terminal part.

Ileocolic artery–

Lowest branch runs down wards and to the right behind the peritoneum, towards right iliac fossa, where it divides into superior and inferior branches, supplies terminal part of jejunum, ileum, front and back of the caecum and appendix.

Right colic artery–

It arises from near the middle of the artery, it passes to the right behind the peritoneum and infront of the right testicular artery and vein. It supplies the ascending colon.

Venous System–

The venous system consists of three sets of veins and also it is considered as three types of circulation.

1. Pulmonary circulation. 2. Systemic circulation.
3. Portal circulation.

Pulmonary circulation–

Consist four pulmonary veins, which carries oxygenated blood, from the both lungs to the left atrium of the heart.

Systemic circulation–

Consist two venacavas, as superior and inferior venacavas drains the venous blood from the different parts of the body in to the right atrium of the heart.

(a) Smaller arteries are generally accompanied by a pair of veins lying on either side of the artery.

(b) Larger arteries have usually only one accompanying vein.

(c) Some arteries are however no companion of the veins.

Portal circulation–

It is one of the major circulation through the portal vein, which drains blood from sub diaphragmatic area and abdominal organs mainly from gastro intestinal tract into the liver through the portal vein, then in to the inferior venacava through the hepatic vein.

The Pulmonary veins–

Carries oxygenated blood from the lungs to the left atrium of the heart. These are four in number two from each lung, commence on the capillaries network on the walls of the alveoli of the each lung, joining together to form a single trunk from each lobe. Three trunks from right lung and two trunks from left lung. From right lung two pulmonary veins are formed by the union of upper and middle trunks as superior pulmonary vein, lower trunk remains separate and forms inferior pulmonary vein. From left lung two pulmonary veins as superior and inferior pulmonary veins. Occasionally

three pulmonary veins on the right side from the right lung, and left side two veins unite and found a single pulmonary vein. The pulmonary veins perforate the fibrous pericardium and opens separately into the upper and posterior part of the left atrium.

Right side– Superior pulmonary vein behind the superior venacava Inferior pulmonary vein lies behind the right atrium.

Left side– Both pulmonary veins passes in front of the descending thoracic aorta.

Systemic veins–

The systemic veins may be arranged into three groups.

1. The veins which drain to discharge into the heart.
2. Veins of the upper limbs, head, neck and thorax, all of which forms as Superior venacava.
3. Veins of the lower limbs and abdomen, pelvis all of which forms as Inferior venacava.

Coronary Sinus–

Most of the cardiac veins drains into the coronary sinus. This is wide venous channel two to three centimeter long. It is in the posterior part of the coronary sulcus between the left atrium and left ventricle ends in the right atrium between the opening of the inferior venacava and right atrioventricular orifice displaying on a semilunar flap.

Tributaries–

1. Great cardiac vein– Drains the blood from apex of the heart.
2. Small cardiac vein– Drains from back of the right atrium and ventricle.

3. Middle cardiac vein– Drains from near the apex of the heart.

4. Posterior vein of the left ventricular drains from diaphragmatic surface of the heart.

5. Oblique vein of the left atrium.

Anterior cardiac vein–

Drains from the anterior part of the right ventricle may be two or three in numbers.

Venae cardis minimi - Thebisian veins–

The smallest veins opening in to all the cavities of the heart more in the right atrium.

Veins of the neck–

1. External jugular vein– Two in numbers as right and left receives blood mostly from the scalp and face, including its deeper parts. It is formed by the union of posterior division of the retro mandibular vein and posterior auricular vein.

It begins at the mandibular angle just below or with in the parotid gland runs downwards towards the neck and to the middle of the clavicle. It crosses sternocleidomastoid muscle obliquely, ends in the subclavian vein lateral to or in front of the scalenus anterior muscle. It is occasionally double. It has two pairs of valves a lower at its entrance in to the subclavian vein. The part of the vein between two sets of valve is often dilated, and sometime termed as sinus. These valves do not prevent back flow of blood.

Tributaries– 1. Posterior external jugular vein.
2. Transverse cervical vein.
3. Supra scapular vein.
4. Anterior jugular vein
5. Occipital vein occasionally drains in to it.

2. Internal jugular vein– Two in number as right and left collects blood from the brain, superficial parts of the face and the neck. It begins at the base of the skull in the posterior compartment of the jugular foramen as a direct continuation of the sigmoid sinus. At its origin is a dilatation, known as the superior bulb. The vein runs downwards through the neck with in the carotid sheath and behind the sternal end of the clavicle. It unites with the subclavian vein to form the brachiocephalic vein.

Thoracic veins–

Brachiocephalic veins - innominate veins–

These are two large trunks in the root of the neck and the upper most part of the thorax, each is formed by the union of internal jugular and subclavian veins of its side and both are devoid of valves.

Right brachiocephalic vein–

About 2.5 cm long begins behind the sternal end of the right clavicle and passes almost vertically downwards, to join the left brachiocephalic vein and form the superior venacava, behind the lower border of the 1st right costal cartilage close to the right border of the sternum.. It lies anterolateral to the brachiocephalic artery and the right vagus nerves.

Tributaries–

Right vertebral vein, Internal thoracic vein, Inferior thyroid vein. Some times first right post intercostal vein.

Left brachiocephalic vein–

About 6 cm long, begins at the sternal end of the left clavicle, in front of the cervical pleura. It runs obliquely downwards to the right behind the upper half

of the manubrium sterni and infront of the bes of the arch of the aorta to the sternal end of the first right costal cartilage, where it unites with the right brachiocephalic vein to form the superior vennacava. It is separated from the left sterno clavicular joint and manubrium sterni by sternohyoid and sternothyroid muscles.

Tributaries–

Internal thoracic vein, Internal thyroid vein, Superior intercostal. Sometimes 1st left posterior inter costal veins.

Superior venacava (ऊर्ध्व महासिरा)–

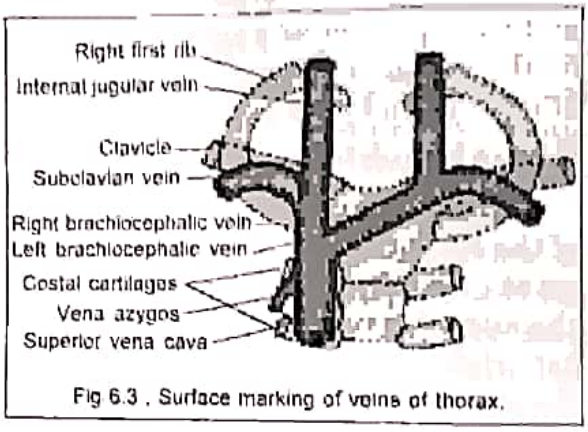


Fig 6.3 . Surface marking of veins of thorax.

Collects the blood from the upper half of the body, posterior thoracic and abdominal walls. It is about 7 cm. In length formed by the union of right and left brachiocephalic veins and devoid of valves, behind the lower border of the first right costal cartilage close to the sternum, descends vertically behind the first and second inter-costal spaces, ends in the upper part of the right atrium opposite the third right costal cartilage. The lower half of the vessel lies within the fibrous pericardium.

Veins of the upper limbs–

These can be divided into two sets.

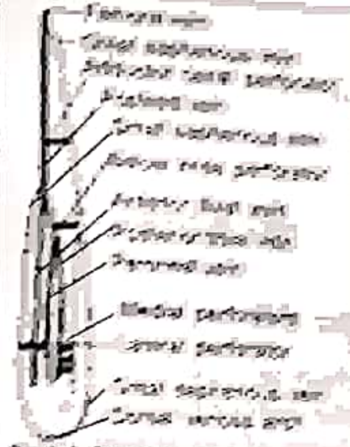


Fig 5.4 Schematic ... arrangement of the veins of the lower limb

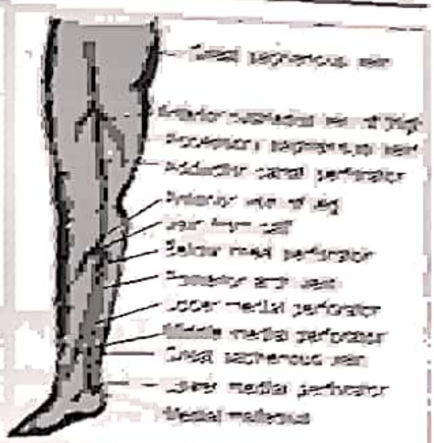


Fig 5.5 The perforating veins of the lower limb

1. Superficial veins– Lies immediately under the skin in the superficial fascia. These are cephalic, basilic, median cubital and median vein of the fore arm.

2. Deep veins– Lies deep to the skin and accompanied with arteries; both sets are provided with valves. These are Subclavian vein; Axillary vein; Brachial vein; Ulnar and Radial veins.

Veins of the lower limbs– These can be divided into two groups.

1. Superficial veins– Immediately under the skin in the superficial fascia these are Great Saphenous vein and Small Saphenous vein.

2. Deep veins– Lies deep to the skin and accompanied with the arteries both sets are provided with valves these are Plantar digital vein, anterior and posterior tibial veins, popliteal vein and femoral vein.

Abdomen and Pelvic veins–

1. External Iliac Vein (बाह्य श्रोणिका सिरा)–

Continuation of the femoral vein begins behind

the inguinal ligament and ascends along with the brim of the lower pelvis, to end in front of the sacroiliac joint by uniting with the internal iliac vein, to form the common Iliac vein.

Tributaries–

1. Inferior epigastric
2. Deep circumflex
3. Pubic vein

2. Internal Iliac Vein (अभ्यंतर श्रोणिका सिरा)–

It ascends behind and slightly medial to the internal Iliac artery and join with the external iliac vein to form common iliac vein at the brim of the lesser pelvis in front of the lower part of the sacroiliac joint.

Tributaries–

1. Superior gluteal vein.
2. Inferior gluteal vein.
3. Internal pudendal vein.
4. Obturator vein.
5. Lateral sacral vein.
6. Middle rectal vein.
7. Dorsal veins of the penis.

Common iliac vein (अधिश्रोणिका साधारण सिरा)–

These are two in number right and left, these are formed by the union of the external and internal iliac veins in front of the sacro iliac joint passing obliquely upwards and on the right side of the fifth lumbar vertebra by uniting at an acute angle to form the Inferior veincava. Right common iliac vein is shorter than left Iliac vein; right common Iliac vein nearly vertical, ascends behind and then lateral to its artery. Left common iliac vein larger and more oblique, it lies at first medial to its artery, and then behind the right common iliac artery, no valves in these veins.

Inferior Venacava (अधर महासिरा)–

This is large vein conveys blood from the lower half

of the body below the diaphragm to the right atrium of the heart; formed by the union of right and left common iliac veins, at the body of the 5th lumbar vertebra a little to the right. Ascends in front of the vertebral columns on the right side of the aorta; reaching the liver it is continued in a deep groove on its posterior surface. It then perforates the tendinous part of the diaphragm between the median and right portions of tendinous centre. After passing through the fibrous pericardium it opens into the posteroinferior part of the right atrium.

Tributaries–

Lumbar veins, testicular veins or ovarian veins. The renal veins, supra renal veins, Internal phrenic vein and hepatic vein.

Portal vein (प्रतिहारिणि सिरा)–

It is a large vein which starts and ends in capillaries; which drains the blood from the abdominal organs mainly large and small intestine, spleen, gallbladder and pancreas. It is about 8 cm long and starts at the level of the 2nd lumbar vertebra formed by the union of superior mesenteric and splenic veins in front of the inferior venacava and behind the neck of the pancreas.

It passes upwards behind the first part of the duodenum, the bile duct, and the gastroduodenal artery. It then ascends in the right border of the lesser omentum in front of the epiploic foramen to reach the right end of the porta hepatis; where it divides into right and left branches; which accompany the corresponding branches of the hepatic artery. In the lesser omentum it is behind the bileduct and the hepatic

The right branch of the portal vein enters into the right lobe of the liver, and generally receives the cystic

vein; the left branch given branches to the caudate and quadrate lobes and then enters into the left lobe of the liver. The portal vein breaks into the sinusoids which are drained by the hepatic veins to the inferior venacava. Thus the portal vein can be divided into infra duodenal, retro duodenal and supra duodenal parts. It has following tributaries.

Tributaries–

- Splenic vein
- Superior Pancreatico duodenal vein
- Superior mesenteric vein
- Cystic vein
- Left gastric vein
- Paraumbilical vein
- Right gastric vein

Splenic vein (प्लिहिक सिरा)–

Larger vein commences from 5 to 6 tributaries, issuing from the spleen; these tributaries unite, form a single vessel, descends to the right, across the posterior abdominal wall, lying at the lower level than the splenic artery and immediately posterior to the body of the pancreas. It crosses out to the right kidney and right hilar structures. It ends behind the neck of pancreas where it unites at a right angle with the superior mesenteric vein, to form the portal vein.

Tributaries–

Short gastric vein, left gastroepiploic vein, pancreatic vein, and inferior mesenteric vein.

Inferior mesenteric vein–

It is a small vein collects the venous blood from the upper part of rectum, sigmoid colon and descend-

ing colon and left one third part of the transverse colon. It begins from the superior part of rectum and ends in splenic vein.

Tributaries –

Superior rectal vein, Sigmoidal vein, left colic vein and marginal vein.

Thoracic Duct (वाम रस कुल्या)–

It is the largest lymphatic vessel in the body, it extends from the upper part of the abdomen to the lower part of the neck. It is about 18 inches long, it begins as a continuation of the upper end of the cisterna chyle near the lower border of the 12th thoracic vertebra and enters the thorax through the aortic opening of the diaphragm, then ascends through the posterior mediastinum crossing from right to left at the level of the 5th thoracic vertebra, runs through superior mediastinum and reaches the neck. It arches laterally ends by opening into the angle of junction between the left subclavian and left internal jugular veins.

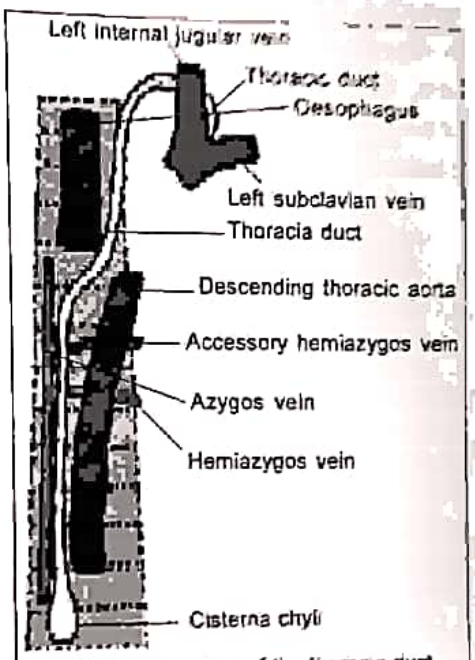


Fig 8.6 : The course of the thoracic duct

Thoracic ducts received lymph from both halves of the body below diaphragm, and the left half above the diaphragm. It receives left jugular trunk, left sub-

clavian trunk, left mediastinal trunk, at the root of the neck.

Cisterna Chyle (रस प्रपा)–

It is on elongated lymphatic sac situated in front of L1-2 vertebrae to the right of abdominal aorta about 5-7 cm long. Its upper end is continuous with the thoracic duct, and joins the lumbar and intestinal lymph trunks. Lumbar trunk drain the lymph from pelvic wall with viscera, the kidneys, the suprarenal gland, testes, deeper part of abdominal wall. The intestinal trunks bring lymph from stomach, the intestine, the pancreas, the spleen, some parts of liver.

Chapter-7

OSTEOLOGY
(अस्थि शारीर)

Introduction-

Bone (अस्थि)-

अस्यते इति अस्थि। तस्मात् चिर विनष्टेषु त्वक् मांसेषु शरीरिणाम्।
अस्थीनि न विनश्यन्ति सारापयेतानि देहिनाम्॥ (सु.शा. ५/२२)

The organs of the body destroy after the death except the bone. The bone do not decay after death and remains as for longer duration.

Numbers of Bones (अस्थि संख्या)-

त्रीणि षष्टीन्यस्थिशतानि वेदवादिनो भाषन्ते; शल्यतन्त्रेषु तु त्रीण्येव शतानि।
तेषां सविंशमस्थिशतं शाखासु, सप्तदशोत्तरं शतं श्रोणिपार्श्वपृष्ठोरःसु,
ग्रीवां प्रत्यूर्ध्वं त्रिषष्टिः एवमस्थ्नां त्रीणि शतानि पूर्यन्ते॥ (सु.शा. ५/ १८)

According to the followers of the Vedavadi, 360 bones in the body. But according to the science of Shalya tantra, 300 bones., and as per modern science 206 bones in the body.

According to shadangatvam-

	Sushruta	Charaka	Modern
1. Extremities	120	120	120
2. Madhyamanga	117	140	57
3. Jatrurdhva	63	100	29
Total	300	360	206

Importance of Bones (अस्थि महत्व)-

अभ्यन्तरगतैः सारैर्यथा तिष्ठन्ति भूरुहाः।
अस्थिसारैस्तथा देहा धियन्ते देहिनां ध्रुवम्॥

तस्मात्स्थिरविनद्धेषु लक्षणावेषु शरीरिणाम्।
अस्थीनि न विनश्यन्ति सारवन्त्येतानि देहिनाम्
मांसान्यत्र निबद्धानि सिराभिः स्नायुभिस्तथा।
अस्थीन्यालम्बनं कृत्वा न शीर्यन्ते पतन्ति वा॥ (सु.शा.५/२१-२३)

The asthi is the pitruja bhava avayava and formed by the pruthvi and apa mahabhoota.

The shape of the body is the articulation of bony frame work, this bony network supports the body just like trees stand on support of their inner wood.

1. The flesh bound to the bones by means of ligaments and vessels.
2. To provide attachments for muscles, ligaments, tendons and fascia.
3. Protects the vital organs like brain, spinal cord, bladder and lungs.
4. It is the store house of calcium and bone marrow.
5. Long bones act as levers for movement and locomotion.

Types of Bones (अस्थि प्रकार)–

एतानि पञ्चविधानि भवन्ति।
तद्यथा–कपालरुचकतरुणवलयनलकसंज्ञानि।
तेषां जानु नितम्ब अंस गण्ड तालु शङ्ख शिरःसु कपालानि,
दशनास्तु रुचकानि,
घ्राणकर्ण ग्रीवाक्षिकोषेषु तरुणानिपार्श्व पृष्ठ उरःसु वलयानि,
शेषानि नलकसंज्ञानि॥

According to Acharya Sushruta the bones are classified into five types,

१. कपालास्थि; २. रुचकास्थि; ३. तरुणास्थि;
४. वलयास्थि; ५. नलकास्थि

कपालास्थि-

The bones are flat in shape, such bones are called as कपालास्थि, E.g. - भालास्थि, पृष्ठकपालास्थि, पार्श्वकपालास्थि, त्रिकास्थि, नितंबास्थि.

दन्तकास्थि-

These helps to taste and to cut the food such bones are called as दन्तकास्थि, E.g.: दन्त

तरुणास्थि-

The bones which are soft and elastic in nature, such bones are called as तरुणास्थि, These are allmost cartilages. E.g.: कर्णपालि, [ear pinna] उपपर्शुकास्थि, [costal cartilages], नासाग्र [tip of the nose].

वलयास्थि-

The semicircular and circular bones are called as वलयास्थि, E.g.: पर्शुकास्थि & कशेरुकास्थि. [Ribs and vertebrae]

नलकास्थि-

The long and short bones are known as नलकास्थि, E.g. प्रगण्डास्थि, ऊर्वस्थि- [humerus and femur] etc.

According to the Modern science bones are classified as follows-

1. Flat bones are flat in nature.
2. Long bones are long in nature.
3. Short bones are short in length.
4. Long short bones are in between long and short bones.
5. Irregular bones are indefinite in shape.

6. Pneumatic bones are possessing a hallow space within their body which contains air. E.g., Ethmoid, maxilla.
7. Sesamoid bones, are seed like which develop in certain tendons. E.g. : Patella, Pisiform.

According to Gross Structure–

• Compact bones • Spongy bones • Diploic bones

According to Development–

• Membranous bones • Cartilaginous bones

Vertebra (कशेरुकास्थि)–

The vertebral column consists of a number of irregular separate bones, these are vertebrae forms the central axis of the body. As per Samhita these are type of valayasthi. These protects the spinal cord, provides attachment to axil muscles and provides the movement of the trunk. There are 33 vertebrae and are classified into as follows.

1. Cervical vertebra – 7; 2. Thoracic vertebra – 12;
3. Lumbar vertebra – 5 4. Sacral vertebra – 5
5. Coccygeal vertebra – 4

Common Features of vertebra–

The Typical vertebra has mainly two parts–

1. Body 2. Arch

1. Body (कशेरु पिण्ड)–

It is anterior part, nearly cylindrical in shape, the size varying. It has six surfaces as 1. Upper 2. Lower 3, Anterior 4. Posterior 5. Lateral - 2

The upper and lower surfaces are rough and provide attachment to intervertebral discs.

The anterior surface convex from side to side, concave from above downwards.

The posterior surface flat from above downwards, slightly concave from side to side. The lateral surfaces are continuous with anterior surface.

2. Arch (कशेरु बाहु)–

It has – 1. Pair of Pedicles 2. Pair of laminae
3. Seven processes.

1. Pedicles (कशेरु पत्र)–

It is short thick processes pass backwards from the junction of lateral and posterior surfaces of the body. It has two surfaces and four borders.

The medial surface forms the boundary of vertebral foramen, lateral surface free. The anterior border fused with body, Posterior border fused with laminae, superior and inferior borders are concave forms the superior and inferior vertebral notches respectively.

Intervertebral foramen–

It is formed by when two vertebra articulates with each other, the superior and inferior notches converted into foramen.

2. Laminae (कशेरु पत्र)–

These are broad plates behind and medial to the pedicle. They forms posterior boundary of vertebral foramen.

3. Processes - There are seven processes

1. Spinous Process (Spine) (पृष्ठ कण्टक)–

It is backwards and downwards from the junction of the two laminae. Shape and size varies and gives attachment to muscles and ligaments.

2. Articular process–

These are four in numbers, Superior and Inferior

Superior articular process are two projects upwards, from the junction of laminae and pedicles. Articular process faces more or less backwards. The inferior articular process downwards faces more or less forwards.

3. Transverse Processes (बाहु प्रवर्धण)–

These are two in numbers, project laterally from the junction of pedicle and laminae.

Main features in Cervical, Thoracic and Lumbar vertebrae -Cervical -

Presence of a foramen in the transverse process, called foramen transversarium.

Thoracic– Presence of costal facets on the body.

Lumbar– No foramen transversarium and no costal facets on the body.

Cervical Vertebra (ग्रीवा कशेरुकास्थि)–

There are seven cervical vertebrae, which lie in the cervical region and supports the head. Ist (Atlas), 2nd (Axis) and 7th (Vertebral prominence), cervical vertebrae are having special features, hence called "Atypical" 3rd, 4th, 5th, and 6th has similar features hence called "Typical".

The presence of "foramen transversarium" in the transverse process is the main feature of cervical vertebra The foramen transversarium [matraka chidra] transmits the vertebral artery, vein and sympathetic fibers. The body is small and vertebral foramen is large in proportion to the size of the body and triangular in shape. The spinous process is short and bifid; ends in 2 terminal tubercles of unequal size except seventh.

Transverse process has anterior and posterior root which are connected to each other on the lateral side of the foramen by a bar of bone called the "costo-transverse bar." The roots are end in anterior and posterior tubercle.

Atlas (चूडा वलय)-

It is Atypical 1st cervical vertebra, which supports the globe of the head so it is called Atlas. The free nodding movement of the head is possible due to the absence of spine and body. It is ring shaped which has no body and no spine, body and spine are modified into anterior and posterior tubercles.

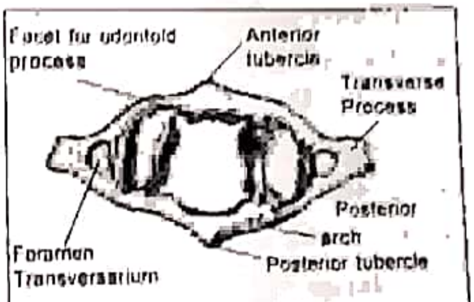


Fig 7.1 Atlas - चूडा वलय

It has two lateral oblique masses which lie between the two arches, anterior arch is short curved, convex anteriorly, superior articular facets are kidney shaped and concave, which articu-

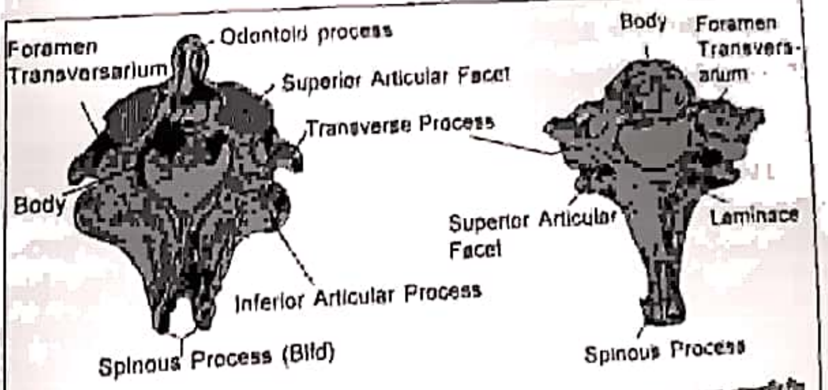


Fig. 7.2a; 2nd Cervical vertebra

Fig. 7.2b, 7th Cervical vertebra - [illegible]

late with condyles of the occipital bone. Inferior articular facets, nearly round, slightly concave and flat, articulate with superior facets of second cervical vertebra. It helps to rotate the skull, vertebral foramen is large, transverse processes are quite long and strong end in a tubercle act as adequate levers for muscles to rotate the head.

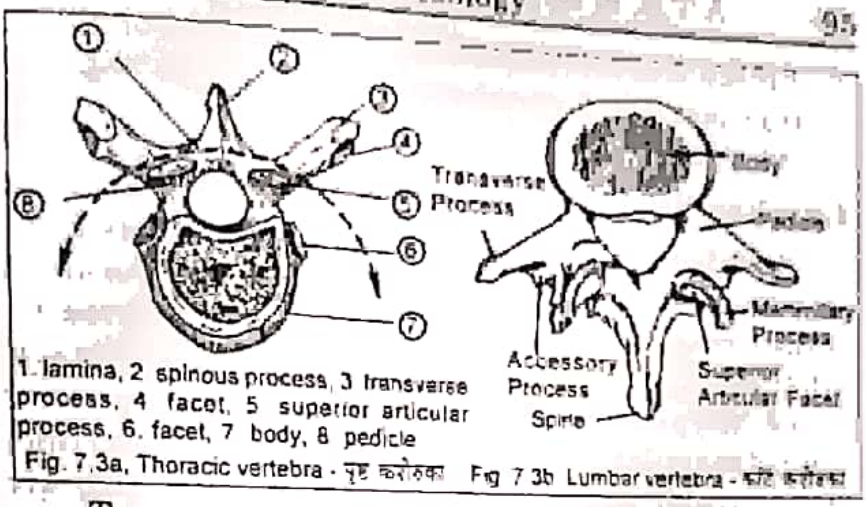
Axis (दन्त चूडा)–

It is Atypical 2nd cervical vertebra, called Axis. The tooth like upward projection on the superior surface of the body is known as odontoid process it articulates with facet for odontoid process of atlas vertebra forms as atlanto axial joint. It has the following features.

- Tooth like projection from the upper surface of the body - Dens.
- Spinous process - bifid and large.
- Laminae thick and rounded.
- Foramen transversarium is present.
- Inferior vertebral notches are very deep.
- Facet in front of the dens for articulation with anterior arch of Atlas forming. Atlanto axial joint (Synovial- pivot type joint)

Vertebra Prominence (महा कण्टकिणि)–

It is atypical 7th cervical vertebra, which is called vertebra prominence because of its long and thick prominent spinous process. The long thick spinous process ends in a tubercle. So it can be felt through the skin on the posterior aspect of vertebral column. It serves as an important land mark for counting the vertebrae. The kanataka pravardhana (spinous process) is predominant, so it is called as "maha kantakini"



1. lamina, 2 spinous process, 3 transverse process, 4 facet, 5 superior articular process, 6. facet, 7 body, 8 pedicle

Fig. 7.3a, Thoracic vertebra - पृष्ठ कशेरुका Fig 7.3b Lumbar vertebra - कटि कशेरुका

Transverse process is big size, foramen transversarium is relatively small, it may be double or absent. Very rarely the vertebral artery and accessory vertebral vein, may pass through foramen transversarium.

Thoracic Vertebra (पृष्ठ कशेरुकास्थि)–

There are 12 Thoracic vertebrae which lie in between the cervical above and lumbar vertebrae below, body large, spinous process downwards, backwards and ends in a tubercle. There are two articular facets on each side of the body which articulate with head of the ribs.

Transverse process is big in size; club shaped, faces laterally and backwards, bears a facet on anterior aspect near its end for articulation with tubercle of numerically corresponding rib. The 1st, 9th, 10th, 11th and 12th, thoracic vertebrae having special features, hence called atypical thoracic vertebrae. The 2nd to 8th thoracic vertebrae have common features hence called "typical thoracic vertebrae"

Distinguishing points are as follows–

1. Presence of facets on either sides of the body, articulates with head.

2. Presence of facet on transverse processes of all, except last 2 or 3 vertebrae for articulation with the tubercle of ribs.

Lumbar Vertebra (कटि कशेरुकास्थि)–

Lumbar vertebrae are five in number, body large in size, and absence of costal facets and foramen transverasrium on either side of transverse process, 5th lumbar vertebra presents a special features so it is called "Atypical" other are "Typical". Spinous process is quadrangular, horizontal backward and thick. Inferior articular process has articular facets which are convex, faces forwards and laterally.

Accessory process is a rough elevation posterio inferior aspect of the transverse process and mammillary process in the posterior border of superior articular process is the main feature. Vertebral foramen is triangular in shape. 5th lumbar vertebra body is very large, spine is small, transverse process is massive and stout.

Spinous Process of Vertebra–

It is a process projecting posteriorly downwards from the junction of the two laminae, size, shape and direction of this process varies, in vertebrae of different regions. It provides for attachment of muscles and ligaments, the spinous process has different features like, Bifid spine in cervical vertebra; not bifid, ends in tubercle in thoracic vertebra; flat and horizontal in lumbar vertebra etc.

Ribs (पर्शुकास्थि)–

There are 12 pairs ribs lies on either side of the sternum, numbered from above downwards. They forms the thoracic wall and cage including sternum anteriorly and thoracic vertebra posteriorly. The above seven ribs

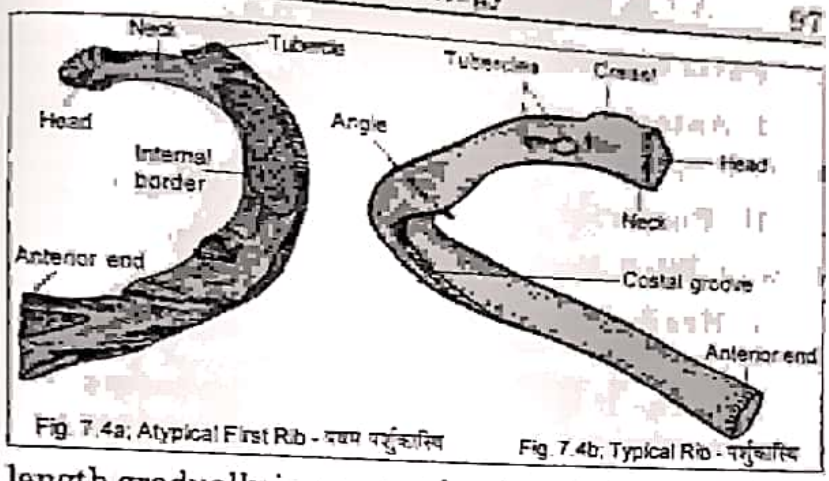


Fig. 7.4a: Atypical First Rib - पथम पर्शुकास्थि Fig. 7.4b: Typical Rib - पर्शुकास्थि

length gradually increases. then length decrease gradually from 8th rib onwards. The space in-between two ribs is intercostal space, there are 11 spaces on each side.

Classification–

True ribs (मुख्य पर्शुकास्थि)–

The 1st to 7th ribs are true, anteriorly these articulates to the sternum through the costal cartilage, posteriorly to the corresponding vertebrae.

False ribs (गौन पर्शुकास्थि)–

The 8th to 12th ribs are false, the 8th, 9th, 10th ribs articulates with the rib just above anteriorly.. The 11th and 12th ribs are anteriorly free.

Typical rib–

The ribs which presents common features, these are 3rd to 9th ribs.

Atypical rib–

The ribs which presents special features, these are 1st, 2nd, 11th, & 12th

Features of typical ribs–

Typical rib is (1) Curved (2) Angulated (3) Twisted

Parts of the rib– It consists the following parts

I. Anterior end (पुर भाग)– It has a small cup shaped depression.

II. Posterior end (पश्चिम भाग)– It consists of 1. Head (शिर) 2. Neck (ग्रिवा) 3. Tubercle (अर्बुद)

1. Head– It has two small facets separated by transverse ridge

2. Neck– It is flat, about 1 inch long having two surfaces anterior and posterior, two borders upper and lower.

3. Tubercles– Lies on the posterior surface of the rib at the junction of neck and shaft. It consists two parts – (1) medial articular, which articulates with the transverse process of numerically corresponding vertebra. (2) lateral non articular is rough and gives attachment to costotransverse ligament.

III. Shaft (काण्ड भाग)– It is thin, flat, curved and twisted on itself.

It has– Two surfaces –External and Internal,
Two borders – Superior and Inferior

External surface– It is convex and smooth, a rough ridge acrosses from tubercle, indicating the position of angle.

Internal surface– It is smooth and has a groove (costal groove) along its lower border. It lodges the intercostal vein, artery and nerve.

Superior border– It is rounded, has inner and outer lip behind, inner lip gives insertion to internal intercostal and intimi muscles. Outer lip gives insertion to external intercostal muscle.

Inferior border– It is sharp forms the lower mar-

gin of costal groove given origin to external intercostal muscle.

First Rib (प्रथम पर्शुकास्थि)–

It is most curved and "Atypical" rib. It is a type of valayasthi, shortest, and broadest. It does not twist, no angle, no costal groove, and has single facet on the head. Shaft has upper and lower surfaces, internal and external borders. There is a tubercle at its centre near the inner border called scalene tubercle. There is a groove for subclavian vein and artery on the superior surface, head is small and circular, neck rounded, tubercle is thick and prominent, anterior end is largest and thickest.

Second Rib (द्वितीय पर्शुकास्थि)–

It has no twist, slight angle, which lies close to the tubercle. It is twice as long as 1st rib. Head bears two facets. Neck is small. Tubercle divided in to articular and non articular, surfaces are external and internal.

Tenth rib–

Head bears single facet, other features are same as typical rib.

Floating Ribs (गौण पर्शुकास्थि)–

The 11th and 12th pairs of ribs are floating ribs, these are attached posteriorly to the corresponding body of the vertebra and are anteriorly free with pointed end.

11th Rib	12th Rib
1. Single facet on the head	1. As same as 11th
2. No tubercle no neck	2. No tubercle, no neck
3. Costal groove on the inner	3. No angle, no costal groove surface and indistinct angle
4. Anterior end pointed	4. Anterior end pointed

Sternum (उरफलक अस्थि)–

It is flat bone (कपाल अस्थि) lies in the median part of the thoracic cage.

Parts–

1. Manubrium sterni (ग्रैवेयक) 2. Body (गात्र)
3. Xiphoid process (अगपत्र)

1. Manubrium sterni (ग्रैवेयक)–

It is triangular in shape, thick, broad above and narrow below at its junction with body. Lies apposite the level of 3rd and 4th thoracic vertebra. It has two surfaces - Anterior and Posterior and four borders.

Anterior surface– It is convex from side to side concave from above downwards. Pectoralis major muscle attached. Sternomastoid near its upper end on either side.

Posterior surface– It is Concave and smoother

Borders– The superior border has a notch (supra sternal) in the median part. On either side of notch there is a clavicular notch articulates with clavicle. Inferior border is joins with body and forms as sternal angle. Lateral borders has a cup shaped depression in the upper part articulate with 1st costal cartilage.

2. Body (गात्र)–

It is long, thin and nearly triangular. It has two surfaces - anterior and posterior, and two lateral borders, and two ends upper and lower.

Anterior surface– It is flattened, and has three ill defined ridges

Posterior surface– Slightly concave related with transversus thoracic and parietal pleura.

Lateral borders– It has small facet at its sternal angle which articulate with second costal cartilage, and four facets below it which are articulates with costal cartilages of 3rd, 4th, 5th, and 6th ribs. At the junction of body and xiphoid process has small facet which articulate with costal cartilage 7th rib.

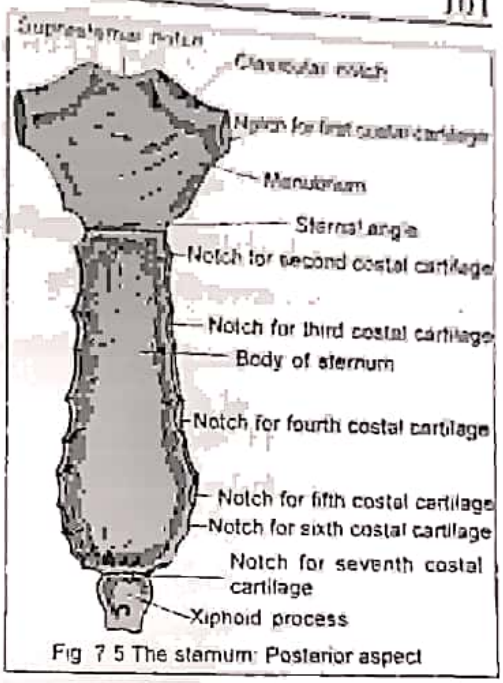


Fig 7.5 The sternum: Posterior aspect

3. Xiphoid process (अग्रपत्र)–

It is shape and size is variable, may be bifid, perforated, broad & thin.

Sternal Angle (उरस्य कोण)–

It forms an angle, at the region of inferior surface of manubrium sterni which articulate with upper surface of body of sternum. It forms as a joint, it is secondary cartilaginous joint [symphysis]. It articulates on either side with 2nd costal cartilage.

- It is an important land mark for counting the ribs as second costal cartilage articulates with sternum at this angle.
- Arch of aorta begins and ends at this level.
- Bifurcation of trachea into right and left bronchi at this level.

- It lies opposite the lower border of 4th thoracic vertebra.
- It marks the boundary between superior and inferior mediastinum.

Upper Limb Bones (उर्द्वशाखास्थि)–

Scapula (अंस फलकास्थि)–

It is triangular and flat bone (कपाल अस्थि) lying at the posterolateral aspect of chest wall. Extends from 2nd to 7th rib, and forms shoulder girdle.

It has the following features–

1. Surfaces two– Costal and Dorsal surfaces.
2. Borders three– Lateral, Medial and Upper borders.
3. Angles three– Superior, Inferior and lateral angles.
4. Process three– Spinous, Acromion and Coracoid processes.

I. Surfaces–

1. Costal– Concave and hollowed called as subscapular fossa.

2. Dorsal surface– Divided into two halves by a spine of scapula, upper part is supraspinous fossa and lower part infraspinous fossa. The supraspinatus and infraspinatus muscles are originates respectively. Teres major above and below teres minor muscles originates adjoining to the lateral border.

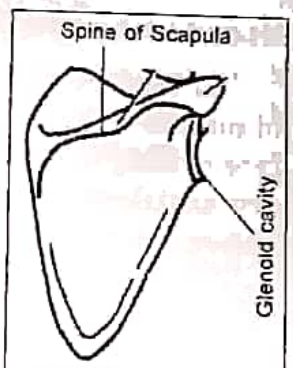


Fig. 7.6 Scapula

II. Borders–

Lateral– It is most thickest, extends from glenoid cavity to inferior angle.

Medial– It is longest, extends from superior angle to inferior angle.

Upper– It is shortest, and thinnest. Extends from superior angle to suprascapular notch.

III. Angles–

Inferior angle– formed by the union of medial and lateral borders

Superior angle– lies at the junction of superior and medial borders,

lateral angle– It is modified bears the glenoid cavity.

Glenoid Cavity (अंस पीठ)–

It is the lateral angle of scapula modified into glenoid cavity, it is concave, oval in shape articular facet which articulates with the head of humerus to form shoulder [Kaksha sandhi] Joint, it is type of ulukala sandhi [Ball and Socket]. The peripheral margin of the cavity is covered by fibro cartilaginous structure known as glenoidal labrum. It increases the depth of the cavity, the peripheral margin is attached by fibrous capsule. A small rough area above the

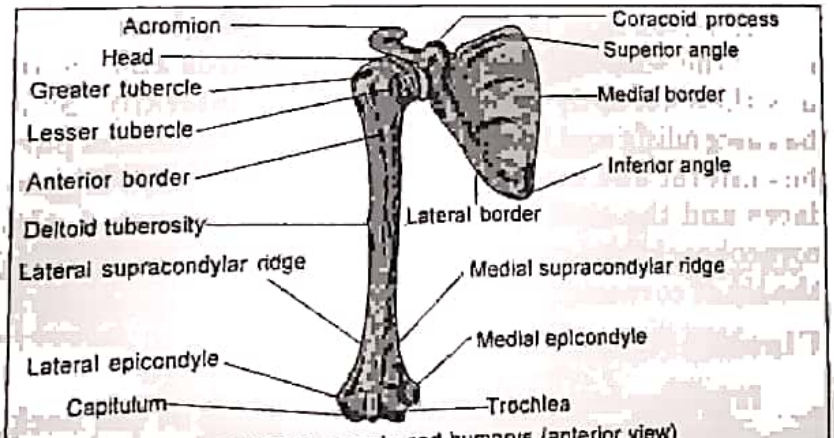


Fig. 7.7 Right scapula and humerus (anterior view)

glenoid cavity is called as supra glenoid tubercle, long head of biceps arises from this tubercle. Just below the glenoid cavity on the lateral border one more tubercle is called as infraglenoid tubercle, the long head of the triceps arises from this tubercle.

IV. Processes–

1. Spine of Scapula (अंस प्राचिर)–

It is a Shelf like projection on the upper part of the dorsal surface of the scapula, it is triangular in shape, it has 3 borders and 2 surfaces. It separates dorsal surface into upper smaller supraspinous fossa from there supraspinous muscle takes origin. Lower larger infraspinous fossa from there the infraspinatus muscle takes origin. It starts from medial border as root of spine and ends in the acromion process laterally.

2. Acromion Process–

Arises nearly at right angles from lateral end of spine and projects forwards. It is subcutaneous and overhangs the glenoid cavity. It has two borders as Lateral and Medial. Two surfaces as Upper and Lower.

3. Coracoid Process–

It arises from the upper part of head (glenoid cavity) of the scapula, it first ascends upwards and medially then abruptly bends forwards and laterally. So it has ascending and horizontal parts. The horizontal part has lateral and medial borders, upper and lower surfaces and the tip. The Pectoralis minor inserted, the coracobrachialis and short head of biceps arises from the tip of coracoid process.

Clavicle (अक्षकास्थि)–

It is long bone lies in front of the root of the neck, it resembling the letter f. It is subcutaneous through-

out. It has no medullary cavity, ossifies in membrane, and it is the first bone ossify and ossifies at 5-6 weeks of intrauterine life.

It prevents drooping of the shoulder, keeps the arm away from trunk, transmits weight of the upper limb to the trunk and forms the important part of shoulder girdle.

Parts– 1. Shaft, 2. Acromial end, 3. Sternal end

Determination points–

1. Flattened acromial end laterally.
2. Rounded sternal end medially
3. Shaft is convex forwards in its medial 2/3 and concave forwards in its lateral $^1/_3$.

Shaft– It is divided into medial $^2/_3$ and lateral $^1/_3$.

Medial $^2/_3$ part– It is cylindrical having four surfaces. Anterior, Posterior, Upper and Inferior.

Anterior surface is convex and rough. Posterior surface is smooth, concave and featureless. Upper surface is rough in its medial part and smooth in its

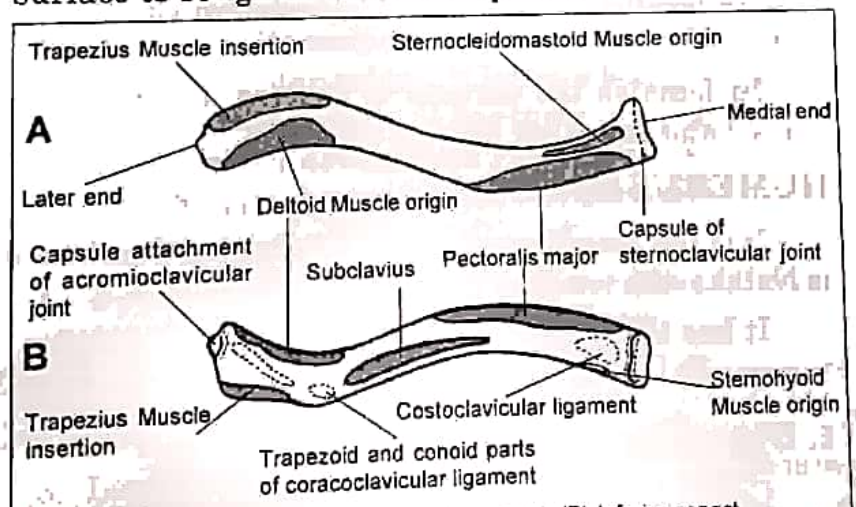


Fig. 7.8 Right Clavicle : (A) Superior aspect; (B) Inferior aspect

lateral part. Inferior surface has rough oval area (costal impression) near the sternal end. There is groove in its middle third called subclavian groove.

Lateral $^{1}/_{3}$ part– It is flattened and has two surfaces and two borders. The superior surface is subcutaneous, the Deltoid and Trapezius muscles encroach upon this surface. Inferior surface roughened bears Conoid tubercle and Trapezoid line.

The anterior border is concave bears tubercle called deltoid tubercle. The posterior border thick and convex backwards, the trapezius inserted.

Acromial end– Lateral end bears small facet articulates with acromion process of scapula forms acromioclavicular joint.

Sternal end– it is medial, quadrangular and expanded, articulates with clavicular notch of the manubrium sterni.

The sex determination points are the acromial end is slightly below the level of sternal end, while in males it is on level with or slightly higher than the sternal end.

In females the clavicle is shorter, thinner, less curved and smoother than in males.

HUMERUS (प्रगण्डास्थि)–

It is the long bone of arm region, as per Samhita it is Nalakasthi.

It has three parts– 1. Upper end 2. Shaft 3. Lower end

1. Upper End (उर्ध्व प्रान्त)–

Consists of 1. Head; 2. Neck; 3. Greater tubercle; 4. Lesser tubercle; 5. Intertubercular sulcus.

Head (शिर)–

Smooth, rounded, upwards and medially. Covered with hyaline cartilage and articulates with glenoid cavity of scapula forms an shoulder joint.

Neck (ग्रीवा शिरा)–

Next to the head constricted part is anatomical neck, it gives attachment to the fibrous capsule.

Surgical Neck (शल्य ग्रीवा)–

It is the part at the junction of upper end and shaft of the humerus. It is related with axillary nerve [branch of posterior cord (5,6,7)], and anterior and posterior circumflex humeral arteries [branches of axillary artery]. It is a common site where fracture usually occurs. The axillary nerve damages along with circumflex humeral vessels.

Greater Tubercle (महा गुलिका)–

It is the tubercle which lies at the posterolateral aspect of the upper end. It is rounded prominently on the shoulder, its medial margin forms the lateral part of intertubercular sulcus, it forms a bony prominence below acromion process. It has three muscular impressions from above downwards. The whole tubercle is covered with deltoid muscle with sub acromial bursa intervening.

1. Upper most impression for insertion of Supraspinatus (S) "S"
2. Middle impression for insertion of Infraspinatus (I) "I"
3. Lower most impression for insertion of Teres minor (T) "T"

Lesser Tubercle (लघु पिण्डक)–

Smaller and prominent, lies anterior aspect, sharp edge forms the medial border of intertubercular sulcus. Subscapularis muscle inserts.

Inter tubercular sulcus - (Bicipital groove)–

It is a groove in between the greater and lesser tubercles, contains the tendon of long head of Biceps muscle. The sulcus give insertion to three muscles, 1. Pectoralis major 2. Teres major 3. Latissimus dorsi.

2. Shaft (मध्य भाग)–

It is middle part, cylindrical above and flattened and triangular below. It consists of three borders Anterior, Lateral and Medial. Three surfaces Antero-lateral, Antro--medial and posterior.

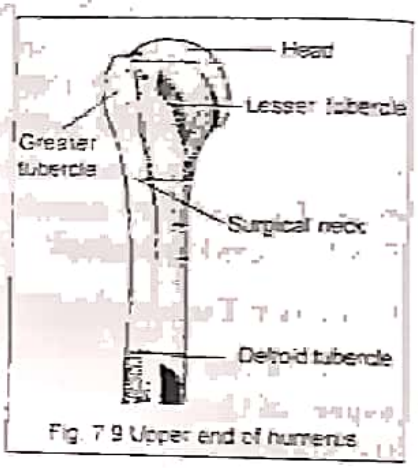


Fig. 7.9 Upper end of humerus

Deltoid Tubercle (अंसच्छदा कूट)–

It is "V" shaped rough tuberosity present in the anterolateral surface of shaft of the humerus. The deltoid muscle takes insertion in the deltoid tubercle, above the tuberosity deltoid muscle is related, and part below the tuberosity, related with origin of brachialis muscle.

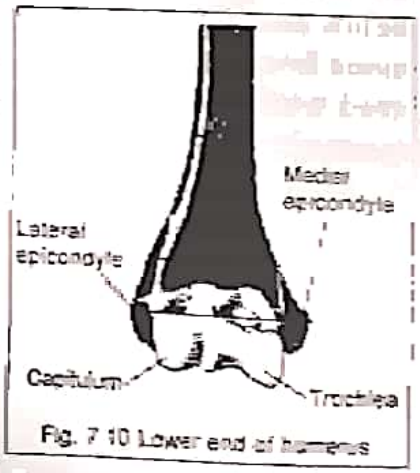


Fig. 7.10 Lower end of humerus

Radial groove–

It lies below and medial to oblique ridge and runs downwards and laterally to reach just below the middle of the lateral border. The Radial nerve passes through it. It is also known as spiral groove.

3. Lower end (अधः अन्त)–

It is flattened and broader consists of–

Articular parts	Non articular parts.
1. Capitulum	1. Medial and Lateral epicondyles
2. Trochlea	2. Olecranon fossa
	3. Coronoid fossa
	4. Radial fossa.

1. Capitulum (कन्दलि)–

It is a round, smooth and convex part which lies between lateral epicondyle laterally and trochlea medially of the lower end of the humerus. It is covered with hyaline articular cartilage. It articulates with upper surface of the head of the radius forming humero radial component of elbow joint. It is a type of Kora sandhi.

Trochlea (डमरुक)–

It is pulley shaped smooth part of the lower end of the humerus, situated medial to the capitulum which consists of two flanges as medial and lateral and a central constricted part, articulates with trochlear notch of ulna forming humero ulnar component of elbow joint. It is a type of Sandamsa Kora sandhi. As medial flange is more projecting about 6 mm than the lateral flange, helps in forming "carrying angle' of forearm.

Medial epicondyle–

It is prominent projection on medial side of the lower end, on the posterior aspect there is a shallow groove for ulnar nerve, the superficial group of flexor muscles of fore arm originates here.

Lateral epicondyle–

It is rough projection on lateral aspect, the superficial group of extensor muscles of fore arm originates here.

Olecranon fossa (चुञ्चु खात)–

It is deep hollow on posterior aspect of lower end. It lodges the olecranon process of ulna bone when elbow is extended.

Coronoid fossa (कूर्पर खात)–

It is small hollow, just above the trochlea on anterior aspect. It lodges the Coronoid process of ulna when elbow is flexed.

Radial fossa (बहिर् प्रकोष्ठीय खात)–

It is also small dipression just above the capitulum, it lodges the head of radius when elbow is flexed.

ULNA (अन्त् प्रकोष्ठास्थि)–

It is medial bone of fore arm, it has 1 Upper and Lower ends 2. Shaft.

1. Upper end (ऊर्ध्व प्रान्त)– It lower part and has

Two processes	Two notches
1. Olecranon	1. Trochlear notch
2. Coronoid processes.	2. Radial notch

(1) Olecranon Process (चञ्चु पर्वधन)– Bony projection bent forwards forming a beak like. It is an upward forward projection from the upper most part of

ulna, it occupies with olecranon fossa of humerus when elbow is extended. It has six surfaces. It is covered by capsular ligament of elbow joint, and insertion of triceps, into posterior ½ of upper surface. In the medial surface flexor carpi ulnaris and flexor digitorum profundus originates. In the lateral surface insertion of anconeus muscle.

(2) Coronoid Process (कूर्पर कूटवर्धन)– It is a shelf like projection from the upper and anterior part of the upper end of the ulna, below the olecranon process. It has four surfaces and two borders, in the anterior surface, there is a rough triangular area called ulnar tuberosity. It gives insertion of brachialis, in the lateral surface a semilunar facet called radial notch for articulation with the head of radius and form superior radioulnar joint [synovial type and subtype uniaxial pivot joint]. According to ayurveda it is Chakra Kora Sandhi.

1. Trochlear notch– It is notch present in between the olecranon and coronoid processes, it articulates with trochlea of humerus.

2. Radial notch– It lies on the lateral surface of the coronoid process, it is oval shape dipression, articulates with head of the radius, and annular ligament is attached to the anterior and posterior ends.

2. Shaft (मध्य भाग)– It is middle part, having

Three Borders	Three Surfaces.
1. Interosseous 2. Anterior 3. Posterior.	1. Anterior 2. Medial 3. Posterior

3. Lower end (अध: प्रान्त)–

It is slightly expanded and consists of

1. Head 2. Styloid process.

1. Head– It has smooth convex articular surface on lateral part for articulation with radius.

2. Styloid process– It is a short downward projection from posterior medial aspect of ulna. Posteriorly there is attachment of extensor retinaculum.

RADIUS (बहिर् प्रकोष्ठास्थि)–

It is lateral bone of the fore arm, consists of

1. Upper end 2. Lower end 3. Shaft.

1. Upper end (ऊर्ध्व प्रान्त)–

It consists of– 1. Head. 2. Neck. 3. Tuberosity

1. Head (शिर)– It is disc shaped overhangs the neck, its upper surface articulates with capitulum, its medial aspect articulates with radial notch of ulna forms as superior radioulnar joint. Annular ligament covers the head.

2. Neck (ग्रीवा)– It is constricted part below the head

3. Tuberosity (अर्बुद)– It is below the medial part of neck. Biceps brachii is inserved into its rough posterior area.

2. Shaft (मध्य भाग)–

It is narrow above and broader below. It has –

Three Borders	Three surfaces
1. Interosseous	1. Anterior
2. Anterior	2. Posterior
3. Posterior.	3. Lateral

3. Lower end (अधः प्रान्त)–

It is broad and expanded, and five surfaces–

1. Lateral
2. Medial
3. Inferior
4. Anterior
5. Posterior

Medial surface bears a smooth notch for articulation with the head of ulna. Inferior surface has smooth concave articulates with lunate medially. Scaphoid laterally helps to forming the wrist joint.

The lateral surface forms conical bony projection at its lower end called styloid process. Its tip is subcutaneous as attached by lateral liga ment.

CARPAL BONES (कर कूर्चास्थि)-

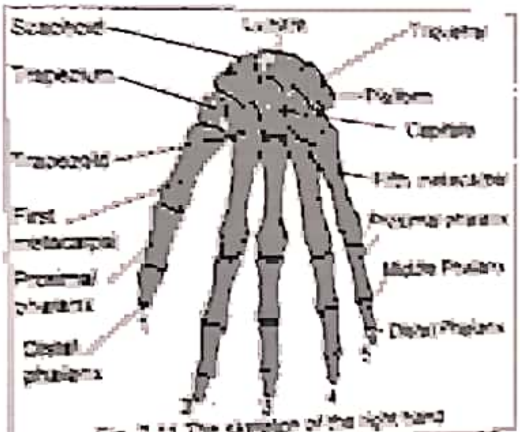


Fig. 7.11 The skeleton of the right hand

These are eight in number. short bones having six surfaces. These are arranged in two rows as proximal and distal rows. lies in the palm region. Proximal row bones form a convexity. proximally for articulation with the lower end of radius and the articular disc of inferior radio ulnar joint. Distal row bones articulate with metacarpal bones.

Proximal Row [from lateral to medial]	Distal Row [from lateral to medial]
1. Scaphoid (नौकाभ)	1. Trapezium (पर्याणक)
2. Lunate (अर्ध चन्द्र)	2. Trapezoid (कूटक)
3. Triquetral (त्रिकोणक)	3. Capitate (मध्य कूटक)
4. Pisiform (वर्तुलक)	4 Hamate (अंकुशक)

There are five metacarpal bones, numbered from lateral to medial side, they are long short bones. Each metacarpal bone has three parts as– 1. Head 2. Base 3. Shaft.

Head is rounded, lies distally, articulates with proximal phalanx.

The base is expanded lies proximally and articulates with distal row of carpal bones

The palmar surface of the shaft is concave, and the dorsal surface is convex. The shaft gradually becomes thicker from above downwards.

PHALANGES OF HAND (कर अङ्गुल्यास्थि)–

These are 14 in numbers, two for thumb and three for the four fingers. The phalanges are named as proximal, middle and distal phalanx.

1. Base 2. Shaft 3. Head

Proximally, expanded. Middle part, constricted lies, distally.

Lower Limb Bones (अध शाखागत अस्थि)–

HIP BONE (श्रोणिफलकास्थि)–

श्रोण्यांमध्ये तेषां गुदमगनितंवेषु चत्वारि त्रिकसंश्रितमेकं ॥ (सु. शा.५/२०

The Acharya Sushruta explained, There are five bones in the sroni region, these are as follows,

Gudasthi – 1, Bhagasthi – 1.
Nitambhasthi – 2, Trikasthi – 1

There two hip bones, it is triangular shape and flat bone it forms pelvic cavity along with articulation of sacrum and coccyx bones. As per Samhita it is kapala asthi type. It consists three parts and all the three parts are unites in adult age. The parts ossify and union takes pinces in the walls of acetabular cavity. Parts 1. Ilium, 2. Ischium, 3. Pubis–

Ilium (जघन कपाल)–

It is flat and expanded part it has

Two ends	Three borders	Three surfaces
Upper	Anterior	Gluteal,
Lower	Posterior	Iliac fossa
	Medial	pelvic

1. Upper end–

It is expanded upper most part forms as iliac crest, the anterior end of iliac crest is anterior superior iliac spine, the posterior end of iliac crest is posterior superior iliac spine. The crest is divided Ventral $^{2}/_{3}$ and Dorsal $^{1}/_{3}$ segments. The ventral segment has outer and inner lips and intermediate area.

Outer lip has tubercle just about 5 cm behind the anterior superior iliac spine,

2. Lower end–

It forms upper $^{2}/_{5}$th of acetabulum.

Borders–

The anterior border extends from anterior iliac spine, below the superior iliac spine there is depression then small projection is inferior iliac spine. The posterior border has same and continuous with posterior border of ischium. It has also posterior superior and inferior iliac spines.

The medial border separates the iliac fossa from sacro-pelvic surface. Its lower part is smooth and forms as arcuate line.

Surfaces–

The gluteal surface is external, concave, and divided by three lines.

1. Posterior Gluteal line 2. Anterior gluteal line 3. Inferior gluteal line. The glutous maximus, medius, and minimus muscles are originates from this surface.

The iliac fossa is internal, smooth and concave, forms the lateral wall of pelvic cavity. The ilincus muscle arises from this fossa.

The Sacropelvic surface lies behind the medial border, divided into three parts. 1. Iliac tuberosity 2. Auricular surface 3. Pelvic surface

Pubis (भगास्थि)–

It is the anterioinferior part of the hip bone that articulates with the opposite bone forming a secondary cartilaginous joint called Pubic Symphysis. It forms upper and anterior one fifth of acetabulum. It has body and two ramus as superior and inferior. The body consists of pubic tubercle, it is the lateral end of pubic crest. It is attached by medial end of inguinal ligament and origin of cremaster muscle. Crest is upper border of the body of the pubis, it gives origin to lateral head of rectus abdominus, and pyramidalis muscles.

Body has	**Three surfaces**	**One border**
	Anterior surface	Upper border
	Posterior surface	(Pubic crest)
	Symphyseal surface	
Superior ramus	**Three Borders**	**Three Surfaces**
	(i) Pectineal line	(i) Pectineal surface
	(ii) Obturator crest	(ii) Pelvic surface
	(iii) Inferior border	(iii) Obturator surface
Inferior ramus	**Two borders**	**Two surfaces**
	(i) Medial	(i) Anterior
	(ii) Lateral	(ii) Posterior

It extends from body of pubis to ischium and forms lower boundary of obturator foramen and joins with ischial ramus forming ischio pubic ramus.

Acetabulum (वंक्षणोदुखल)–

It is a deep cup shaped cavity on the lateral aspect of hip bone near its middle, it is formed by the contribution of all the three bones, pubis forms upper and anterior $^{1}/_{5}$th part, ischium forms posterior and lower $^{2}/_{5}$th part, Ilium contributes to the rest of its extents.

The fibro cartilaginous structure which lies in the peripheral margin called as acetabular labrum the head of femur is articulated with acetabulum and forms Hip Joint, it is the type of Ulukhal sandhi [Ball and socket].

It has three parts, Acetabular notch, it is the gap of lower margin of cavity, which is bridged by transverse acetabular ligament, and attached by ligament of head of femur.

Acetabular cavity is articular part and horse shoe shaped, it is covered by hyaline cartilage.

Acetabular fossa, it is rough non articular part of the cavity, contains pad of fat, acetabulum is covered by synovial membrane.

Ischium (कुकुन्दरास्थि)–

It is posterioinferior part of hip bone, contribute to form the acetabulum. It has Body and Ramus.

Body–

It is posterior part superiorly it is joined with acetabulum and inferiorly continuous with the ramus.

Body has	**Two ends**	**Three surfaces**	**Three borders**
	Upper	Femoral	Anterior
	Lower	Dorsal	Lateral
		Pelvic	Posterior

1. Ends–

The upper end forms the part of acetabulum, and lower end gives of the ramus and part of the ischial tuberosity.

2. Surfaces–

1. **Femoral surface–** It is downwards, forwards and laterally towards thigh.

2. **Dorsal surface–** It faces upwards, backwards and laterally, it continuous above with gluteal surface of ilium.

Ischial tuberosity– The lower part of dorsal surface bears a large rough area called the ischial tuberosity. It is wide near its upper part and tapers downwards. The Semi-membranosus, Semitendinosus, long head of biceps femoris and ischial part of adductor magnus muscles takes origin from ischial tuberosity. These are known as hamstring group of muscles.

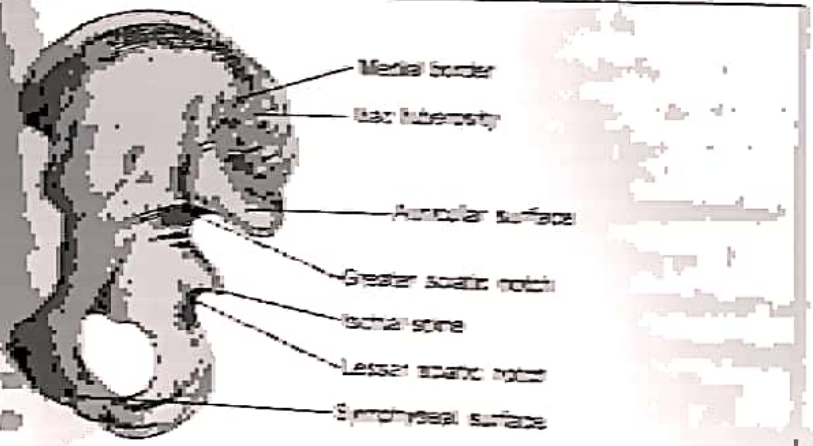


Fig. 7.12 General features of inner surface of hip bone.

3. Pelvic surface– It is smooth which forms the lateral wall of ischio-rectal fossa, the obturator internus takes origin from its upper part.

Borders–

The anterior border forms the posterior margin of obturator foramen, the lateral border separates the femoral surface from ischial tuberosity, and Posterior border continuous above with posterior border of ilium and helps to form the greater sciatic notch.

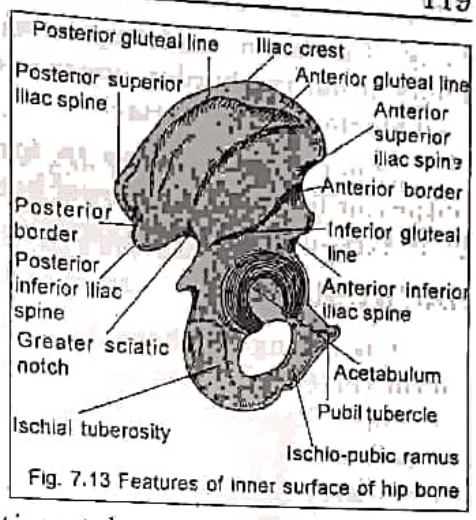


Fig. 7.13 Features of inner surface of hip bone

Greater sciatic notch–

It is notch formed by the posterior borders of ilium and ischium, in living body it is converted into a foramen by the attachment of Sacrospinous and Sacrotuberous ligaments. It transmits the sciatic pudendal, gluteal femoral cutaneous nerves and internal pudendal, gluteal vessels

Lesser sciatic notch–

It is a shallow notch below the ischial spine on the posterior border, This notch is converted into foramen by Sacrospinous ligament. It transmits the obturator internus tendon, pudendal nerve, nerve to obturator internus and internal pudendal vessels.

Ischial spine–

It is a prominent projection at the posterior border, it separates the greater and lesser sciatic notches.

Ramus of ischium–

It passes upwards, forwards, and medially from the

body of ischium, and to join with inferior ramus of pubis. It has two border, upper and lower. Two surfaces, as Anterior and posterior.

Upper border helps to form the boundary of obturator foramen. The lower border forms the lateral boundary of urogenital triangle.

SACRUM (त्रिकास्थि)–

It is triangular bone formed by the union of five sacral vertebrae it lies posteriorly in-between the two hip bones. It articulates with the hip bones and forms the pelvic cavity. It is kapala type of bone. It has Apex, Base, Three surfaces and Sacral canal.

1. Apex– It is downward, blunt and narrow part, it articulates with coccyx

2. Base– It upwards, broad and fused with 5th lumbar vertebra forms the lumbosacral joint and sacral angle.

3. Surfaces– 1. Pelvic 2. Dorsal
3. Lateral surfaces

1. Pelvic surface–

It is concave, curved and forms the posterior wall of pelvic cavity. It has four pairs of sacral foramen which communicates through intervertebral foramen with sacral canal. It has four indistinct horizontal lines that indicates the fusion of 5 sacral vertebra.

2. Dorsal surface–

It is rough irregular and convex, the spine of individual vertebra fused forms as median sacral crest. There are four pairs of dorsal sacral foramen through which dorsal rami of sacral nerves are emerges. The articular process fused to form intermediate sacral crest lies medial to sacral foramen. The fusion of transverse

processes is indicated as lateral sacral crest lies lateral to sacral foramen.

3. Lateral surface–

It is broader above and narrow below. It is formed by the transverse processes. It bears articular surface which articulates with the auricular surface of hip bone and forms the sacro iliac joint.

Sacral hiatus–

It is inverted U-Shaped opening below the 4th spinous tubercle at the lower end of sacral canal on the dorsal surface. It is formed due to the failure of non fusion of laminae of 5th sacral vertebra in the median plane. The filum terminale lies up to this level. 5th sacral spinal nerve, and coccygeal spinal nerve emerges through the sacral hiatus.

Fig. [illegible] Sacrum dorsal aspect

Difference Between Male and Female Pelvis

	Male Pelvis	Female Pelvis
1. Greater sciatic notch	Wider	Narrower
2. Acetabular cavity	Larger	Smaller
3. Bony characters.	Heavier and Stronger	Thinner and Lighter
4. Obturator foramen.	Larger and oval	Smaller and triangular
5. Depth.	More deep	Less deep
6. Subpubic angle.	Smaller [55°-60°]	Wider [80°-90°]

	Male Pelvis	Female Pelvis
7. Ischial tuberosity.	Everted	More everted
8. Shape.	Less circular	Inverted
9. Sacrum.	Less broad and abruptly curved	Broader and gradually curved
10. Inlet and Outlet.	Outlet much smaller than Inlet	Inlet and outlet nearly equal

Differences between Male and Female Sacrum

Male	Female
1. Length is more than breadth.	1. Breadth is more than length or both are equal.
2. Curved regular and gradual from above downwards	2. Abruptly curved and concavity in its lower part.
3. Sacral index lesser. average is 105	3. Sacral index. greater and average is 115
4. Weight heavier.	4. Lighter.
5. Muscles impressions more marked.	5. Less Marked

Sacral canal–

It is formed by vertebral foramen of sacral vertebra. It contain the cauda equina, filum terminale spinal meninges, spinal and coccygeal nerves and vessels.

Coccyx (अनूत्रिकास्थि)–

It is small triangular bone, formed by the fusion of four rudimentary coccygeal vertebra. It is articulated above with sacrum, below is blunt tip known as apex. The joint between the sacrum and coccyx is sacrococcygeal joint. It has 1. Base 2. Apex 3. Two surfaces - pelvic and Dorsal.

FEMUR (ऊर्वास्थि)–

It is longest and strongest bone lies in the thigh region. According to Samhita it is Nalaka type (long) bone.

It has three parts– 1. Upper end 2. Lower end and 3. Shaft.

Upper end	Lower end	Shaft
Head	Medial Condyle	Three surfaces
Neck	Lateral Condyle	Three Borders
Greater trochanter	Inter Condylar fossa	
Lesser trochanter		

I. Upper end - 1. Head (शिर)–

Round, projected upwards, forwards, medially, articulated with acetabulum of hip bone forms as hip joint. There is small depression in the centre called as fovea or pit, the ligament of the head of femur is attached to here.

2. Neck (ग्रीवा)–

It is about 5 cm long next to the head connects the shaft. It forms angle of 125° .This wide angle known as angle of inclination.

3. Greater Trochanter (महा पिण्डक)–

It is large quadrangular projection from the upper part of junction of shaft and neck of the femur. Its posterosuperior part projects upwards and medially. It has three surfaces.

1. Anterior 2. Lateral 3. Medial and one superior border.

Gluteus minimus inserted in the anterior surface.

Gluteus medius inserted in the lateral surface.

Medial surface has depression called trochanteric fossa.

Obturator externus inserted in front of the trochanteric fossa

Obturator internus with two Gemelli inserted by a common tendon. Piriformis is inserted on the superior border.

4. Lesser Trochanter (लघु िपंडक)–

It is a blunt conical projection posteromedial at the junction of neck and shaft. It gives insertion to Psoas major and Iliacus muscles.

Inter trochanteric Line–

It is a rough oblique ridge situated at the junction of anterior surface of the neck with shaft of femur, it extends from greater trochanter above to spiral line below. it attached by two ligaments and two muscles from medial to lateral.

1. Capsular ligament of hip joint.
2. Iliofemoral ligament upper and lower bands.
3. Vastus lateralis - arises from upper part of line.
4. Vastus medialis - arises from lower part of line.

Inter Trochanteric Crest–

A smooth more or less rounded ridge is situated at the junction of posterosuperior part of the neck and shaft of the femur. It extends from the greater trochanter above, to lesser trochanter below. Quadrate tubercle is the rounded elevation which is situated more or less in the middle of the crest, quadratus femoris is inserted in this tubercle.

II. Shaft–

It is middle part, cylindrical in shape.

Three Borders	Four/Three Surfaces
Lateral	Upper and Lower has four
Medial	Middle has three
Posterior (linea aspera)	

Linea aspera (प्रकाशिक रेखा)–

It is the posterior border of the middle one third of femur, it is a rough bony ridge, consists medial and lateral lips and a central area.

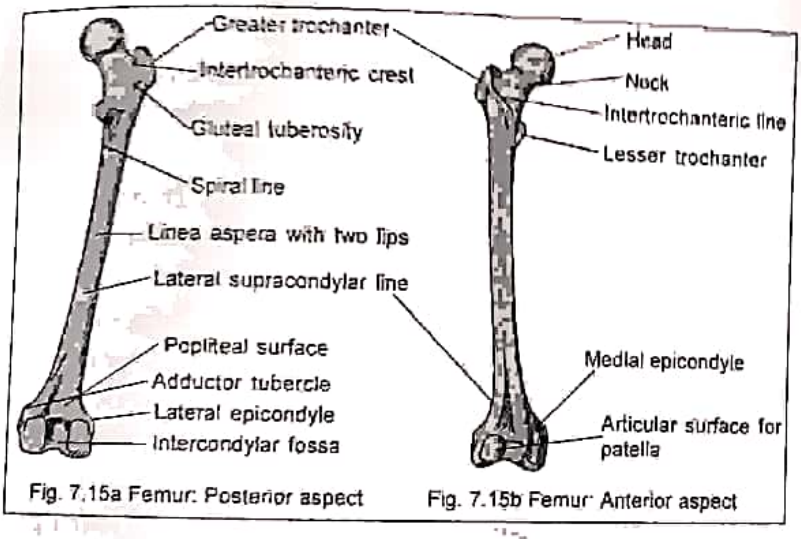


Fig. 7.15a Femur: Posterior aspect Fig. 7.15b Femur: Anterior aspect

Lateral lip attached by–

1. Vastus lateralis [origin]
2. Short head of biceps femoris [origin]

Medial lip attached by–

1. Vastus medialis [origin]

Central area attached by–

1. Adductor Magnus, Longus & Brevis [insertion]

III. Lower end–

It is broad consists two prominent thick masses

known as medial and lateral condyles. Both are separated posteriorly by inter condylar fossa. It has patellar and tibial two articular surfaces. Patella articulated anteriorly, The condyles of tibia articulated inferiorly forms knee joint.

Lateral Condyle– It is smaller and stronger than the medial condyle.

Medial Condyle– It is prominent, a small projection at uppermost part is known adductor tubercle.

PATELLA (जान्वस्थि)–

It is the largest sesamoid bone (chankasthi) in the body, it is developed in the tendon of quadriceps femoris. It lies in front of knee joint.

It is triangular and flattened bone. It has Base, Apex and Two Surfaces Two Borders. The posterior surface has two articular facet.

1. Upper larger, oval, articular part separated by vertical ridge into two articular facets, larger facet laterally and smaller facet medially which articulates with the lateral and medial condyles of the femur respectively.

2. Lower smaller rough part, is related to infra patellar pad of fat and ligamentum patellae. The anterior surface is rough and subcutaneous is separated from skin by prepatellar bursa. Apex pointed downwards, upper border is known as base. Patella tends to be displaced laterally. May be fractured by a direct blow.

TIBIA (अंतर जन्नास्थि)–

It is medial and strongest bone of the leg, It transmits the body weight from femur to the foot. It has following parts.

Upper end
Medial Condyle
Lateral Condyle
Tuberosity

Shaft
Three Borders
Three Surfaces

I. Upper end–

It is expanded having the two condyles, medial and lateral, which are articulates with lower end of femur forms the knee joint.

1. Medial condyle– It is larger than lateral condyle. Its superior surface articulates with medial condyle of femur. (Part of Knee Joint)

2. Lateral condyle– Its superior surface articulates with lateral condyle of femur, Posteroinferiorly it presents a fibular facet for the articulation with the head of the fibula. (Superior Tibiofibular Joint)

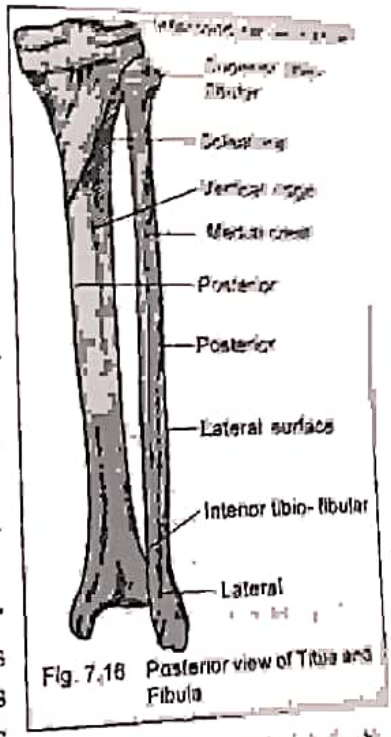


Fig. 7.16 Posterior view of Tibia and Fibula

3. Inter condylar area– It is rough area lies between the two condyles on superior aspect. It has two parts as anterior and posterior, it provides attachment to cruciate ligaments and ends of menisci.

4. Tibial tuberosity– It is prominent bony elevation on the anterior aspect, it gives attachment to the ligamentum patellae.

II. Shaft–

The medial surface is subcutaneous, its upper part

receives the insertions of sartorius, gracilis and semitendinosus muscles. The posterior surface have an oblique ridge is soleal line, which provides the origin to soleus muscle. Lateral surface gives origin of extensor muscles.

The tibia bone is also known as shine bone. The anterior border extends from the tuberosity above, up to the anterior margin of medial malleolus below. The anterior border is sharp and subcutaneous called as Shine.

III. Lower end–

It is expanded having five surfaces, from lateral surface presents a triangular fibular notch that articulates with fibula forms the inferior tibiofibular joint. The inferior surface articulates with dorsal surface of talus. The short strong bony process projects from the medial surface of lower end is known as medial malleolus.

FIBULA (बहिर् जङ्घास्थि)–

It is lateral and slender bone, it does not take part in weight transmission. It has the following parts. Upper and lower ends & shaft.

1. Upper end (ऊर्ध्व प्रान्त)–

It is expanded and overhangs the shaft, The superior surface presents a circular facet that articulates with fibular facet on the lateral condyle of tibia. The small blunt process upwards on postero-lateral aspect is apex of head it provides the fibular ligament attachment.

Neck (ग्रीवा)–

The slightly constricted part just below the head. The common peroneal nerve winds round the neck

2. Shaft–

It is middle part, having three borders and three surfaces.

3. Lower end (अधः प्रान्त)–

It projects downwards to lower level than the medial malleolus. It has four surfaces and projection known lateral malleolus.

The lateral surface is subcutaneous, smooth and convex. The medial surface has triangular facet which articulates with lateral surface of talus. The rough depression area behind the facet is malleolar fossa.

TARSAL BONES (पाद कूर्चास्थि)–

There are seven tarsal bones arranged in two rows, Proximal and Distal. The proximal row consists Talus and Calcaneus, the distal row consists Medial Lateral Intermediate Cuneiforms and cuboid. The navicular lies on medial side between two rows.

Calcaneus (पार्ष्णि अस्थि)–

It is strongest and largest tarsal bone. Which transmits the body weight to the ground, the laterally it is flat and medially it forms a shelf like projection known as "Sustentaculum tali".

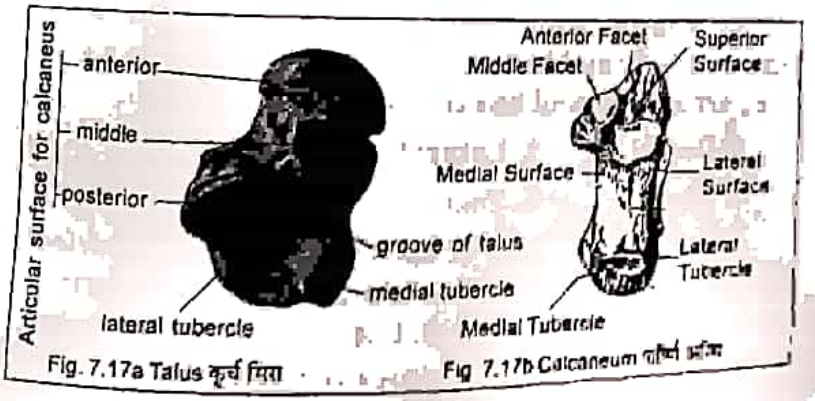


Fig. 7.17a Talus कूर्च सिरा

Fig. 7.17b Calcaneum पार्ष्णि अस्थि

It forms three important joints (1) Talo-Calcaneal (2) Calcaneo-Cuboidal (3) Calcaneo-Navicular joints. The dorsal surface articulated with the talus bone, anteriorly with the cuboid bone.

There are three tuberosity, in the planter surface namely medial, lateral and posterior tubercles, the posterior tubercle is called calcaneal tubercle. The Tendo-calcaneus attached to the posterior surface. It is a strongest tendon, formed by the union of soleus and Gastrocnemius muscles.

The dorsal surface articulates with planter surface of talus bone forms talo-calcaneal joint.

Talus (कूर्च सिरा)–

It is one of the tarsal bone, lies in between the two malleoli, the tibia and fibula bones above, the calcaneum below.

It has head, neck, and body parts. This bone has no any muscular attachment, but too many attachments of ligaments, because it forms the various number of joints.

Head is anterior, rounded part, it is smooth, oval and convex articulates with the navicular bone. It has three articular facets on the plantar surface.

Neck is the connecting constricted part between head and body and having the two surfaces. The posterior part is body and has five surfaces.

1. Dorsal 2. Lateral 3. Plantar
4. Medial 5. Posterior

Dorsal surface is articulated with inferior surface of tibia, medial surface has coma shaped facet articulates with medial malleolus. Lateral surface has triangular facet articulate with lateral malleolus.

Posterior surface consists two tubercles, lateral and medial. Planter surface is deep [illegible] and [illegible] and articulates with middle part of calcaneus.

Metatarsal Bones (पादागुलि पूर्व शलाका)-

There are five metatarsal bones numbered from medial to lateral side. These are long short bones. parts are Base - proximally, Head - Distally, Shaft - middle. Proximally articulates with cuneiform and cuboid bones, distally articulates with the phalanges.

Phalanges (पादाङ्गुल्यस्थि)-

There are 14 phalanges, two in big toe and 3 in other toes. These are placed as proximal, middle and distal. Parts are base, shaft and head.

SKULL BONES (शिर–संपुट अस्थि)-

The skull is formed by the articulations of number of bones, known as head or cranium. Skull includes 29 bones. (Facial bones - 14, Cranial bones - 14, Hyoid bone - 1) The most of the bones are fixed articulation.

The classification of skull bones are as follows-

Paired	Paired	Unpaired	Unpaired
Parietal	Temporal	Frontal	Occipital
Maxilla	Zygomatic	Sphenoid	Ethmoid
Nasal	Lacrimal	Mandible	Vomer
Palatine	Inferior nasal concha		

Different view of the skull-

1. Norma verticalis – Superior view,
2. Norma lateralis – Lateral view
3. Norma frontalis – Anterior view
4. Norma occipitalis – Posterior view
5. Norma basalis – Inferior view.

Features of Norma frontalis–

Coronal suture– lies between frontal and two parietal bones.

Sagittal suture– lies between two parietal bones.

Lambdoid suture– lies between the occipital and two parietal bones.

Metopic suture– lies between two halves of the frontal bone. Present only 3 to 8 % individuals.

Bregma– It is the meeting point of the sagittal suture with the coronal suture in between the frontal and parietal bones of the cranium. In foetal skull, this region is diamond-shaped, the membrane is filled the gap, that is known as anterior fontanelle, it is very soft before ossification.

Lambda– It is the meeting point between the sagittal and lambdoid sutures. In foetal life lambda presents a membranous gap known posterior fontanelle

Features of Norma Occipitalis–

External occipital protuberance– It is a thick eminence in the midline of the occipital bone.

Superior and inferior nuchal lines– These are curved ridges extending laterally from the external occipital protuberance and below to that inferior nuchal line.

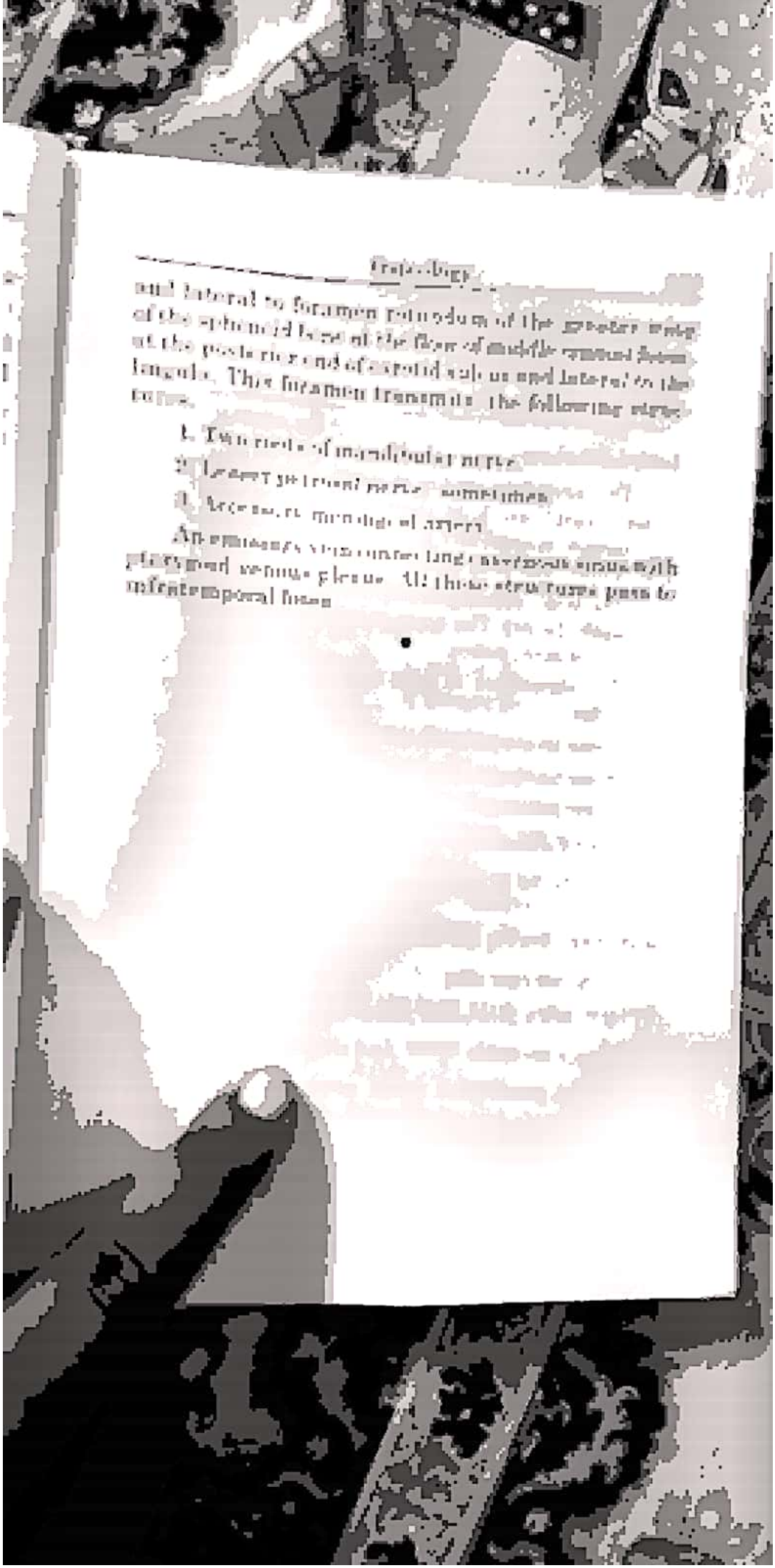
Features of Norma frontalis–

It presents two orbital and one nasal apertures. The superciliary arch is curved elevation above the medial part of orbit. Glabella is the median elevation between the two superciliary arch.

Features of Norma basalis–

Foramen Ovale of sphenoid Bone–

Foramen ovale is an oval opening situated behind



Chapter-8

ARTHROLOGY
(संधि शारीर)

Introduction–

The skeletal system consists of many separate bones. which are held together at joints by flexible connective tissue. All movements that change the positions of the bony parts of the body occur at joints.

The bony articulation in the body usually called as sandhi [joint]. The articulation may be in between the two or more bones.

The structures of joint determine how the joint functions.

Some joints permit no movement

Some joints permit slight movement.

Some joints permit free movement.

Types of Joints (सन्धि प्रकार)–

According to the movements the joints are classified into two types.-

सन्धि प्रकार– सन्धयस्तु द्विविधाश्चेष्टावन्तः स्थिराश्च ।

१. चेष्टावन्त (चल संधि) २. स्थिर (अचल संधि)

चल संधि– Moveable joints are further categorized into freely movable बहुचल. And slightly movable अल्पचल

चेष्टावन्तः सन्धयो द्विविधः बहुचेष्टा, अल्पचेष्टाश्चेति ।
तत्र शाखासु अधोहनुकूटयौश्च बहुचेष्टाः ।
पृष्ठवंशादिष्वल्पचेष्टाः अन्यत्रपुनरचेष्टाः ॥
शाखासु हन्वोः कटयां च चेष्टावन्तस्तु सन्धयः । (Su.Sha. 5)

The upper and lower limb joints and cervical joints are moveable.

अचल संधि– Immovable joints, these are fixed joints.

शेषास्तु सन्धयः सर्वे विज्ञेया हि स्थिरा बुधैः ॥ (Su.Sha. 5)

The skull and facial joints are immoveable joints in the body.

According to the rachana the joints are classify into eight types.

त एते सन्धयोऽष्टविध कोर उलूकल सामुद्ग प्रतर
तुन्नसेवनी वायसतुण्ड मण्डल शङ्खावर्ताः । (सु. शा.)

१. कोर संधि ३. सामुद्ग संधि ५. तुन्नसेवनी संधि ७. मण्डल संधि
२. उलूखल संधि ४. प्रतर संधि ६. वायसतुण्ड संधि ८. शङ्खवर्ताः

१. कोरसंधि–

The articular area of the bones seem to be slightly concave and convex. The outward appearance of the bone is smooth and concave or convex. Such articulation is known as kora sandhi.

Ex- तेषामङ्गुलि मणिबन्ध गुल्फ जानु कूर्परेषु कोराः सन्धयः ।

Ex - कूर्पर संधि (elbow joint), मणिबन्ध संधि (wrist joint), जानु संधि (knee joint), etc.

कोरसंधि प्रकार– Further the kora sandhi is classified into four types.

१. खल्लकोर संधि – Ex - Ankle joint
२. संदंशकोर संधि – Ex - Elbow joint
३. परम्परकोर संधि – Ex - Wrist joint
४. चक्रकोर संधि – Ex- Superior radio ulnar & Atlantoaxial joints

२. उलूखल संधि–

The articular area of the bones has more concave and convex, the one articular are is socket, the other one is ball shape, it appears like socket and ball, such joints are Ulukala sandhi.

Ex– कक्षा वङ्क्षणदशनेषु उलूखलाः। कक्षा संधि– shoulder joint, वङ्क्षण संधि– hip joint

३. सामुद्ग संधि–

The articular area of the bone is slightly irregular with concave and convex surfaces. The articulation between sacrum and pelvis is sacro pelvic joint. It is samudga type of sandhi.

Ex- अंसपीठगुदभगनितम्बेषु सामुद्गाः। Ex- sacro pelvic joint, symphysis pubis.

४. प्रतर संधि–

The articular area of the bones have plane surfaces, the two plane surfaces articulates and forms the pratara sandhi.. Ex- ग्रीवापृष्ठवंशयोः प्रतरः। The Inter vertebral joints are pratara, further classified into three types

१. चलप्रतर संधि २. दृढप्रतर संधि ३. युक्तप्रतर संधि

५. तुन्नसेवनि संधि–

The articular area of the bones have serrated, and joint appears like a suture. The cranial joints like sagittal, coronal, and lambdoid sutures, are known as tunnasevani sandhi. Ex- शिरःकटीकपालेषु तुन्नसेवन्यः।

६. वायसतुण्ड संधि–

The articular area of the one bone has beak like projection, and other articular area is concave (fossa).

Such articulation is vayastunda sandhi. Ex- हनुकपर्वतस्तु वायसतुण्डः। The temporomandibular joint. The head of the mandible articulates with the mandibular fossa of the temporal bone.

७. मंडल संधि–

The articular area of the bones have circular or semicircular shape. The joint appear circular or semi-circular.

Ex- कण्ठहृदयनेत्रक्लोमनाडिषु मण्डलाः – The tracheal rings articulation, the joints in the eye ball and the joints in the hradaya are mandal sandhi.

८. शङ्खावर्त संधि–

The articular area of the bones have complicated circular shape and it appears as shanka. The joints of ear ossicles are shankavarta sandhi.

Ex- श्रोत्रशङ्खाटकेषु शङ्खावर्ताः। तेषां नामभिरेवाकृतयः प्रायेण व्याख्याताः॥

(सु.शा.५/२७)

Number of joints– There are 210 joints in the body.

संधीनान्तु सहस्रेद्वे निजगादात्रि नंदनः। (वा.शा. ३/२६)

अस्थ्नां तु संधयो ह्येते केवलाः परिकीर्तिताः।

पेशीस्नायु सिराणां तु संधि संख्या न विद्यते॥ (सु.शा.अ. ५/२८)

ऐकैकस्य पादाङ्गुल्याम त्रयस्त्रयः द्वावङ्गुष्ठे ते चतुर्दशः जानुगुल्फवंक्षणेष्वैकैकः।

ऐवं सप्तदशैकस्मिन सक्थ्नि भवन्ति ऐतेनेतर सक्थ्नि बाहु च व्याख्यातौ।

त्रयः कटिकपालेषु. चतुर्विंशतिः पृष्ठवंशे तावन्त ऐव पार्श्वयोः उरस्यष्टौ।

तावन्त ऐव ग्रीवायां त्रयः कण्ठे नाडीषु हृदयक्लोम निबद्धास्त्वाएादश।

दन्तपरिमाणा दन्तमूलेषु ऐकः काकलके नासायां च द्वौ

वर्त्ममण्डलयोनेत्राश्रयौ गण्डकर्णशंखेष्वेकैकः द्वौ हनुसन्धौ द्वावुपरिष्टाद्भवोः।

शंखयोश्च पञ्च शिरकपालेषु ऐको मूर्ध्नि ।
सङ्ख्यातस्तु दशोत्तरे द्वे शते ।
तेषां शाखास्वष्टषष्टिः कोष्ठे ग्रीवां प्रत्यूर्ध्वं त्र्यशीतिः ॥ (सु.शा.५)

According to shadangatva the number of joints,

शाखा	–	Upper and Lover limbs	68
मध्यमाङ्ग	–	Abdomen and Thorax	59
जत्रूर्ध्व	–	Head and Neck	83
		Total	210

Classifications : (Modern concept)–

Functional aspect–

The functional classification of the joints is on the basis of the degree of movement, they permit.

The joints are classified into three types.

1. Synarthroses – Immovable joints.
2. Amphiarthroses – Slightly movable joints.
3. Diarthroses – Freely movable joints.

Structural aspect–

It is based on the presence or absence of the joint cavity [a space between the articulating area of the bones] and the kind of connective tissue that binds the bones together. The joints are classified as follows.

1. Fibrous joints–

In which, there is no joint cavity between the two articular areas, and the bones are held together by a fibrous connective tissue.

2. Cartilaginous joints–

In which there is no joint cavity between the two articular areas, and the bones are held together by cartilage such joint is cartilaginous joint.

3. Synovial joints–

In which there is a joint cavity and accessory ligaments unite the articular area of the bones forming the joint by a surrounding fibrous capsule.

1. Fibrous Joint–

It has lack of a joint cavity and the articulating bones are held together by fibrous connective tissue, they permit little or no movements.

The fibrous joints are classified in to three types.

- Sutures
- Gomphosis
- Syndesmosis

Sutures–

A thin layer of dense fibrous connective tissue unites the bones. Bones are held together by sutures. Since sutures are immovable, some sutures are present during growth. later they may replaced by bone. These are found in between the articulation of the skull bones.

E.g.– Sagittal Suture, Coronal Suture etc.

Syndesmosis–

The uniting fibrous connective tissue is present in a greater amount than in a suture, but the fit between the bones is not quite as tight. The fibrous connective tissue forms an interosseous membrane or ligament. These are slightly movable and some flexibility is permitted in the joints.

E.g.– Articulatation between the shaft of the ulna and radius by interosseous membrane, articulation between distal end of the tibia and fibula by a cartilage.

Gomphosis–

In which a cone- shaped peg fits into a socket. The intervening substance is the periodontal ligament.

E.g.– Articulations at the roots of the teeth with the sockets of the maxillae and mandible bones.

2. Cartilaginous joints–

It has no joint cavity: the articulating bones are tightly connected by cartilage. They allow little or no movement such joints are cartilaginous. There are two types of cartilaginous joints.

(1) Synchondrosis (2) Symphysis

Synchondrosis–

It is a cartilaginous joint, the connecting material is hyaline cartilage, these joints are temporary, after certain age the cartilaginous plate replaced by bone (ossification). These joints are immovable. The joint in between the epiphysis and diaphysis of a growing long bone.

E.g.– (1) The joint between the 1st rib and the sternum the cartilage in this joint undergoes ossification during the adult life. (2) The joint between body of the sphenoid and basilar part of the occipital bone.

Symphysis–

It is a cartilaginous joint: the connecting material in between the articular area is a broad and flat disc of fibro-cartilage. These are permanent joints and allow a limited movement.

E.g.– (1) The inter vertebral joint, a portion of the inter vertebral disc is cartilaginous material. (2) Symphysis pubis (3) Manubrio-sternal joint.

3. Synovial Joints–

There is a joint cavity or space in between the articulating bones. The space is called as synovial cavity, the synovial joints are freely movable. Joints are characterized by the presence of an articular

cartilage. The articular cartilage covers the surfaces of the articulating bones, but does not bind the bones together. The articular cartilage is hyaline cartilage. A sleeve like articular capsule, which encloses the joint cavity and unites the articulating bones and surrounds the joints. The fibrous capsule and accessory ligaments covers the joint.

The fibrous capsule is composed of two layers.

The outer layer- It consists of dense connective (collageneous) tissue. It is attached to the periosteum of the articulating bones at a variable distance. The fibers of some fibrous capsules are arranged in parallel bundles such fibers are called ligaments, and are given specific names. The strength of the ligaments is one of the principal factors in holding a bone to the other.

The inner layer– The synovial membrane forms the inner layer: it is composed of loose connective tissue with elastic fibers and variable amount of adipose tissue. It secretes the synovial fluid, which lubricates the joint and provides nourishment for the articular cartilage.

As per samhita, the fibrous capsule may be considered as one of the slesmadhara kala, among the seven kalas. The Slesmadhara kala is membranous layer which lies in the sandhi sthana and helps for free movements of the sandhi.

Synovial Fluid–

It consists of phagocytic cells that remove microbes and debris resulting from wear and tear in the joint. Fluid consists of hyaluronic acid and an interstitial fluid formed from blood plasma and is similar in appearance and consistency to egg white. The amount of synovial fluid varies in different joints of the body. The

amount present in each joint is sufficient only to form a thin film over the surfaces within an articular capsule.

As per samhita, the synovial fluid may be considered as shleshaka kapha, among the five type of kaphas, that helps as lubrication during the movements of joints and avoid the friction of the bones at the sandhi region.

Many synovial joints also contain accessory ligaments, which are called extra capsular ligaments and intra capsular ligaments. Extra capsular ligaments are outside of the capsule, an example - fibular collateral ligament of the knee joint. Intra capsular ligaments occur within the capsule, example - cruciate ligaments of the knee joint. Inside some synovial joints there are pads of fibrocartilage and are attached by the margins to the fibrous capsule. These are articular discs ex- menisci.

Bursae–

The sac like structures are situated in the body tissues, to reduce the friction, which are created during the movement of the body between moving parts. These sacs resemble joints; their walls consist of connective tissue lined by a synovial membrane. Bursae are located between the skin and bone in places where skin rubs over bone. They are also found between tendons and bones; muscles and bones; and ligaments and bones.

The synovial joints are similar in structure; variations exist in the shape of the articulating surfaces.

The synovial joints are divided into six types.

1. Gliding joints
2. Hinge joints
3. Pivot joints.
4. Ellipsoid joints.
5. Saddle joints.
6. Ball and socket joints.

Gliding Joint–

The articulating surfaces of bones are usually flat and plain, only side to side and back-and-forth movements are permitted. This joint allows movements in two planes, and it is called biaxial. Twisting and rotation are inhibited at gliding joints generally because ligaments or adjacent bones restrict the range of movement.

E.g.– The joints between carpal bones; tarsal bones; the sternum and clavicle and acromio clavicular joint.

Hinge Joint–

The convex surface of one-bone fits into the concave surface of another bone, Movement is primarily in a single plane [uni axial], the motion is similar to that of a hinged door. Movements are usually flexion and extension.

E.g.– Elbow joint, Ankle joint, and Inter phalangeal joints

Pivot Joint–

A rounded, pointed, or conical surface of one bone articulates within a ring formed partly by bone and partly by a ligament. The primary movement permitted is rotation.

E.g.– Atlantoaxial joint; and proximal radioulnar joint.

Ellipsoid Joint–

An oval shaped condyle of one bone fits into an elliptical cavity of another bone. This joint permits side-to-side, back and forth movement. It is biaxial joint.

E.g.– Wrist joint [Radio carpal joint]

Saddle Joint–

The articular surfaces of both bones are saddle

shaped, that is concave in one direction and convex in the other, the joint is biaxial.

E.g.– The joint in between trapezium and metacarpal of the thumb.

Ball and Socket Joint–

Ball like surface of one bone fitted into a cuplike depression of another bone is known as ball and socket joint. It is tri axial joint. The movements are flexion, extension, abduction, adduction and rotation.

E.g.– Shoulder joint and Hip joint.

UPPER LIMB JOINTS (उर्ध्व शाखागत सन्धि)–

Shoulder Joint (अंस सन्धि/कक्ष सन्धि)–

The shoulder joint is formed by the articulates, the head of the humerus with the glenoid cavity of the scapula. It is a weak joint but having great mobility. The head of the humerus is smooth and convex as ball, the glenoid cavity is concave with less diameter comparative to head of the humerus.

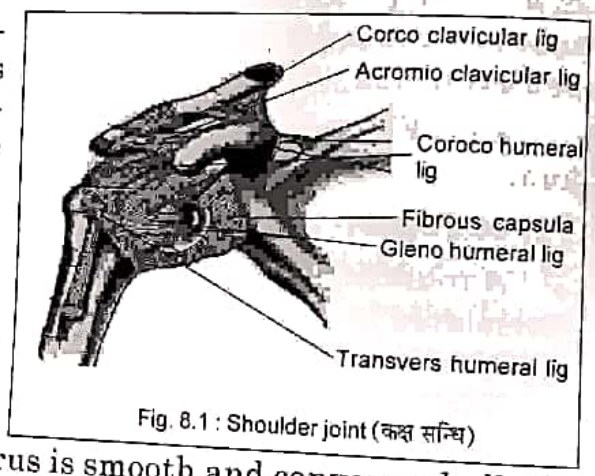


Fig. 8.1 : Shoulder joint (कक्ष सन्धि)

Joint type - Synovial variety; and subtype is ball and socket. As per samhita it is उलूखल सन्धि

Ligaments–

1. The Fibrous Capsule– Loose fibrous sac that completely covers the joint which extends from the cir-

cumference of the glenoid cavity to the anatomical neck of the humerus. Inferiorly it is weak, the fibrous capsule is lined by synovial membrane. It permits free movements

2. Coracohumeral ligament– It is a strong and broad ligament which gives strength to the fibrous capsule, that extends from the root of the coracoid process of the scapula up to the greater tubercle of the humerus and covers the neck.

3. Glenohumeral Ligament– There are three thickening fibrous bands of the articular capsule over the anterior aspect of the fibrous capsule, the ligament is a part of capsule.

4. Transverse Humeral Ligament– There is a narrow sheet of fibres extending from the greater tubercle to the lesser tubercle of the humerus. It bridges the intertubercular sulcus. The long head of biceps passes deep to the ligament.

5. Glenoid labrum– It is a narrow rim of fibro cartilage around the edge of the glenoid cavity. It increases the depth of the glenoid cavity.

Bursae associated with Joint–

Subscapular Bursa– It lies in between the tendon of the subscapularis muscle and the underlying joint capsule.

Subdeltoid Bursa– It lies in between the deltoid muscle and joint capsule.

Subacromial Bursa– It lies in between the acromion process of scapula and joint capsule.

Subcoracoid Bursa– It either lies between the coracoid process and joint capsule or appears as an extension from the subacromial bursa.

Movements–

1. Flexion and extension.
2. Abduction and adduction.
3. Medial and lateral rotation
4. Circumduction

Blood supply– Anterior and posterior circumflex humeral, Supra scapular, and subscapular vessels.

Elbow Joint (कूर्पर संधि)–

It is formed by the articulation of the lower end of the humerus and upper end of the radius and ulna bones. It is synovial, sub type hinge variety, it is a compound uniaxial joint, according to samhita संदंश कोर संधि,

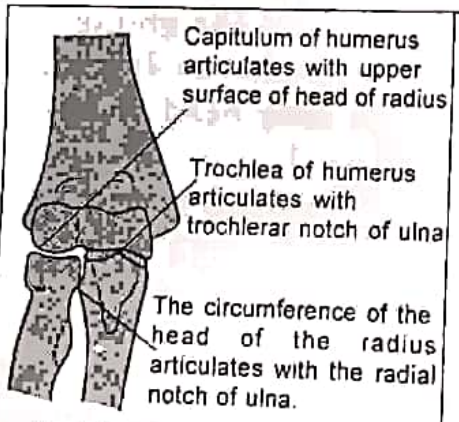


Fig. 8.2 : The elbow and superior radioulnar joints. (कूर्पर संधि)

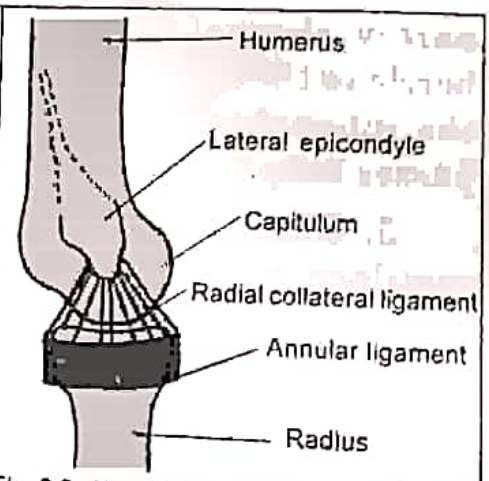


Fig. 8.3 : Elbow joint medial view (कूर्पर संधि)

Articular surfaces–

Superiorly the capitulum and trochlea of the humerus, articulates inferiorly with the upper surface of the head of the radius, and trochlear notch of the ulna. The disk of the radius articulates with the radial notch of the ulna bone and forms as superior radioulnar joint, it is a type of pivot joint चक्र कोर संधि all together is known as elbow joint.

Ligaments–

1. Capsular ligament– Superiorly it is attached to the lower end of the humerus and it covers the capitulum, trochlea, radial fossa, coronoid fossa, and olecranon fossa. Inferomedially margin of the trochlear notch of the ulna and laterally attached to the annular ligament .

2. The anterior and posterior ligaments– These are thickenings the fibrous capsule anteriorly and posteriorly.

3. The Ulnar collateral ligament (Medial ligament)– It is a thick and triangular shaped ligament, superiorly it is attached to the medial epicondyle of the humerus and inferiorly to the ulna.

4. The radial collateral ligament (Lateral ligament)– It is a fan shaped ligament that extending from the lateral epicondyle of the humerus up to the annular ligament

5. Annular ligament– It is a strong band which encircles the head of the radius, it helps to rotate the head within the ulnar notch. This ligament anteriorly and posteriorly attached to the anterior and posterior margin of the radial notch.

Blood supply– Anastomosis round the elbow joint.

Movements– Flexion, extension, medial and lateral rotation of the forearm

Carrying angle– The extended forearm is not in straight line with the arm, makes an angle of about 163 degrees with it. The transverse axis of the elbow is directed downwards and medially. This is known as carrying angle.

Wrist Joint (मणिबन्ध संधि)–

This joint is formed by the articulation of inferior end of the radius and ulna with the carpal bones. It is a synovial joint, subtype is ellipsoid and it is biaxial joint. As per Samhita it is प्रतर संधि

Articular surfaces–

Superiorly inferior surface of the lower end of the radius and articular disc of the inferior radioulnar joint inferiorly with scaphoid, lunate and triquetral bones.

Ligaments–

1. The fibrous capsule– Above it is attached to the lower end of the radius and ulna, inferiorly to the proximal row of carpal bones. It surrounds the joint and supported anteriorly by radio and ulnar palmar carpal strong ligaments, posteriorly by dorsal radiocarpal weak ligament.

2. The radial collateral ligament– It extends from the tip of the styloid process of the radius to the lateral side of the scaphoid bone.

3. The ulnar collateral ligaments– It extends from the tip of the styloid process of the ulna to the triquetral and pisiform carpal bones.

Blood supply– Anterior and posterior carpal arches.

Movements– Flexion extension, abduction, adduction and circumduction.

Joints of the hand–

The joints in the hands are formed by the articulations between carpal, metacarpal and phalangeal bones. The joints between these are as follows, namely the intercarpal joints, carpometacarpal joints, inter-

metacarpal joints, metacarpophalangeal joints and interphalangeal joints.

LOWER LIMB JOINTS (अध शाखागत सन्धि)–

Hip Joint (वंक्षण सन्धि)–

It is connection between lower limb and trunk region. It is the strongest, freely movable joint. This joint is formed by the articulation of the head of the femur with the acetabulum of the hipbone. The head is convex, smooth and becomes as ball, the acetabulum is concave, depression and forms as socket. The acetabular cavity is articulated with head, acetabular fossa is non articular filled with fat, and acetabular notch is bridged by transverse ligament. Type : The synovial type, and subtype is ball and [illegible]. According to the samhita it is [illegible].

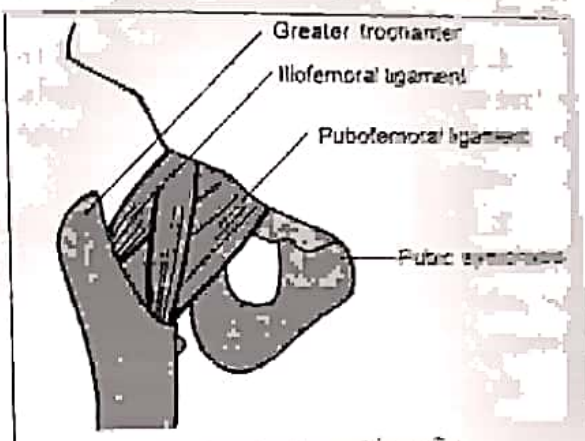


Fig. 8.4: The hip joint (वंक्षण सन्धि)

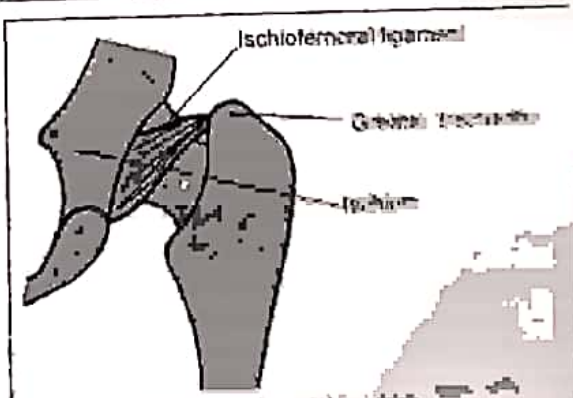


Fig. 8.5 : The ischiofemoral [illegible]

Ligaments–

1. Fibrous Capsule– It extends [illegible]

the acetabulum to the neck of the femur. It is one of the strongest ligament of the body, the capsule consists of circular and longitudinal fibers. The circular fibers, called the zona orbicularis, form a collar around the neck of the femur. The accessory ligaments, like Iliofemoral ligament; the pubofemoral ligament; and the ischiofemoral ligament, reinforce the longitudinal fibers.

2. Iliofemoral Ligament– It is thickened portion of the articular capsule that extends from the anterior inferior iliac spine of the hipbone up to the intertrochanteric line of the femur.

3. Pubofemoral Ligament– It is thickened portion of the articular capsule that extends from the pubic part of the rim of the acetabulum to the neck of the femur.

4. Ischiofemoral Ligament– It is the thickened portion of the articular capsule that extends from the ischial wall of the acetabulum to the neck of the femur.

5. Ligament of the head of the femur– It is a flat triangular band and strong that extends from the fossa and transverse ligament of the acetabulum to the head of the femur.

6. Acetabular Labrum– It is C shaped fibrocartilage rim attached to the peripheral margin of the acetabulum and gives strength.

7. Transverse Ligament of the Acetabulum– It is strong ligament, which crosses over the acetabular notch, converting it to a foramen. It supports part of the acetabular labrum and is connected with the ligament of the head of the femur and the articular capsule.

Blood supply– Branches of medial and lateral circumflex femoral, obturator, superior and inferior gluteal vessels.

Movements– Flexion, extension, abduction, adduction, medial and lateral rotation.

Knee Joint (जानु सन्धि)–

It is the largest and complex joint of the body, formed by the articulations in between patella and the patellar surface of the femur. "Femuropatellar joint" and in between the lateral and medial condyles of the femur, with the lateral and medial condyles of the tibia "femorotibial joint"

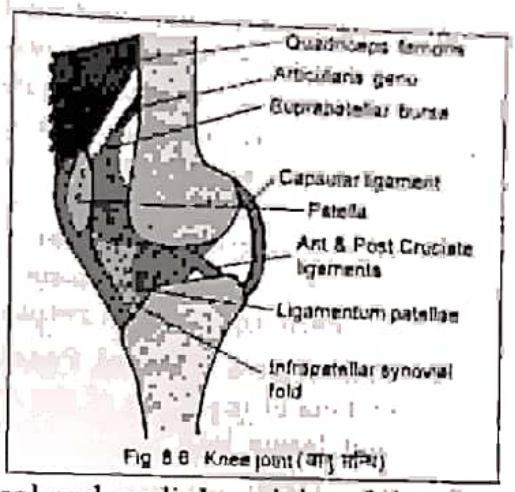


Fig 6.6 Knee joint (जानु सन्धि)

Articular surfaces–

Condyles of femur, Patella, Condyles of tibia.

Type–

It is compound synovial variety, and subtype is hinge variety between femur and tibia. Saddle variety between femur and patella. According to the Samhita it is - it is the कोर सन्धि and the sub type is मंदंश कोर सन्धि

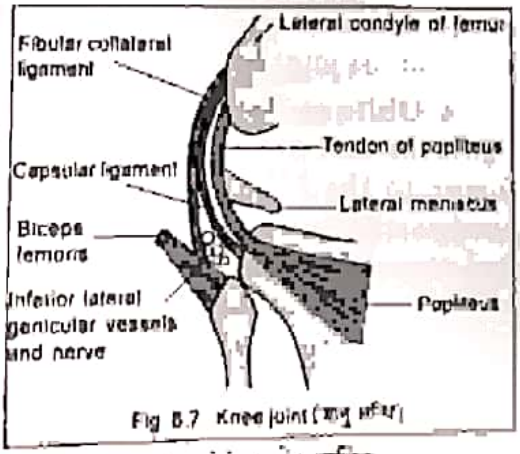


Fig 6.7 Knee joint (जानु सन्धि)

Ligaments–

1. Fibrous Capsule– It is incomplete, independent capsule uniting the articular part of the bones. The ligamentous sheath surrounding the joint consists mostly of muscle and tendons. However some capsular fibers connecting the articulating bones. It is thin and deficient anteriorly, it is attached $^1/_2$ to 1 cm above the margins of articular area of femur, encloses popliteus muscle posteriorly and below $^1/_2$ to 1 cm beyond articular margins of the tibia. Some parts of the capsule are applied as some terms like coronary ligaments, short lateral ligament and patellar retinaculum.

2. Medial and Lateral Patellar Retinacula– Fused tendons of insertion of the quadriceps femoris muscle and fascia lata that strengthen the anterior aspect of the joint.

3. Patellar Ligament or ligamentum patella– It is central portion of common tendon of the insertion of the quadriceps femoris muscle that extends from the patella to the tibial tuberosity. This also strengthens the anterior surface of the joint. The posterior surface of the ligament is separated from the synovial membrane of the joint by an infra-patellar pad of fat.

4. Oblique Popliteal Ligament– It is broad, flat ligament that connects the intercondylar fossa of the femur to the head of the tibia. The tendon of the semimembranosus muscle is superficial to the ligament and passes from the medial condyle of the tibia to the lateral condyle of the femur. The ligament and tendon afford strength for the posterior surface of the joint.

5. Arcuate Popliteal Ligament– It extends from the posterior border of inter condylar area of the femur to the styloid process of the head of the fibula.

6. Tibial Collateral Ligament– It is long broad, ligament on the medial surface of the joint that extends from the medial epicondyle of the femur to the medial condyle of the tibia. Inferiorly it has two bands as anterior band is about 10 cm long and 1.25 cm broad; the posterior band is small blends with capsule.

7. Fibular Collateral Ligament– It is also strong, rounded ligament on the lateral surface of the joint that extends from the lateral epicondyle of the femur to the lateral side of the head of the fibula in front of the apex. The tendon of the biceps femoris muscle covers the ligament.

8. Intra Articular Ligaments– Ligaments are lies within the capsule that connect the tibia and femur.

9. Anterior Cruciate Ligaments– It has thick fibrous bands and strong ligament of knee. It extends posteriorly and laterally from the area anterior to the inter condylar eminence of the tibia to the posterior part of the medial surface of the lateral condyle of the femur.

10. Posterior Cruciate Ligament– It is thick fibrous bands and strong ligament of knee. It extends anteriorly and medially from the posterior intercondylar area of the tibia and lateral meniscus to the anterior part of the lateral surface of the medial condyle of the femur.

11. Articular Discs– Fibrocartilage semilunar discs, lies in between the tibial and femoral condyles, and helps deepen the articular surfaces and covers the peripheral margin of superior surfaces of medial and lateral condyles of tibia. These are two menisci These acts as shock absorbers and lubricating the joint, that also carries the proprioreceptive impulses. There are

two ends attached to the tibia and two surfaces as superior and inferior.

12. Medial Meniscus– Semicircular piece of fibrocartilage lies in between the medial condyles of the femur and tibia. Anterior end is connected with transverse ligament.

13. Lateral Meniscus– Circular piece of fibrocartilage lies in between the lateral condyles of the femur and tibia. The posterior end attach to femur through menisco-femoral ligaments. The transverse ligament connects the medial and lateral menisci, to each other.

Bursae associated with Joint–

Pre patellar bursa– Lies in front of the patella and it is subcutaneous.

Deep infra-patellar bursa– It lies posterior and deep to the patella.

Supra patellar bursa– It lies above the patella and posterior to the quadriceps tendon between tendon and bone.

Blood supply– Five genicular branches of popliteal artery, descending branches and recurrent branches.

Movements– Flexion, extension, medial and lateral rotation of flexed leg.

Ankle Joint (गुल्फ संधि)–

It is the joint between the leg and foot region, this joint is strong and more stability, interlocking by bones, strong collateral ligaments, and tendons which cross the ankle joint.

Articular surfaces–

The inferior surface of the lower end of the tibia,

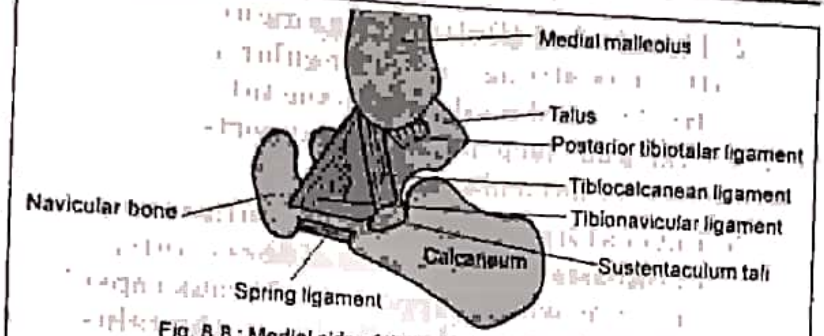


Fig. 8.8 : Medial side of the ankle joint (गुल्फ सन्धि) showing the parts of deltoid ligament

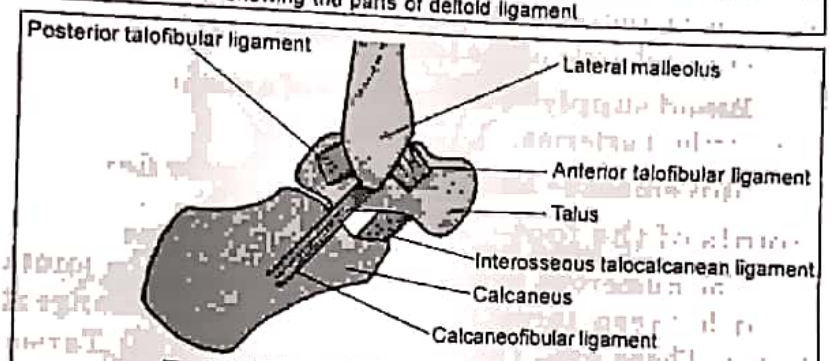


Fig. 8.9 : Lateral side of the ankle joint (गुल्फ सन्धि) showing the lateral ligament.

medial and lateral malleolus with upper surface, medial and lateral articular facets of the talus bone.

Type–

Synovial and sub type hinge variety.

According to samhita it is कोर सन्धि

Ligaments–

1. The fibrous capsule– It surrounds the articular areas of the joint and lined by synovial membrane. The anterior part of capsule thin and consist transverse fibres. The capsule extends superiorly from distal end of tibia up to the neck of the talus anteriorly and to the body of talus posteriorly.

2. The Medial (Deltoid) ligament (Medial collateral)– It is strong and triangular ligament connected from medial malleolus to the talus bone. It has superficial and deep parts. It supports to hold the calcaneus and navicular bones.

3. Lateral ligament (Fibular collateral)– This ligament consists of three bands of fibres, anterior and posterior bands which support the fibrous capsule. It extends from the lateral malleolus to the talus. The posterior bands are strong, and are connected to the posterior tubercle of the talus.

Blood supply– The branches of anterior and posterior tibial arteries.

Movements– Dorsiflexion and Planter flexion.

Joints of the foot–

The numerous joints in the foot region, the joints occur between tarsal, meta tarsal, and phalangeal bones. These are– (1) Inter tarsal joints, (2) Tarso-metatarsal joints, (3) Inter-metatarsal joints, (4) Metatarsophalangeal joints, (5) Interphalangeal joints.

Movements At Inferior Extremity Joints

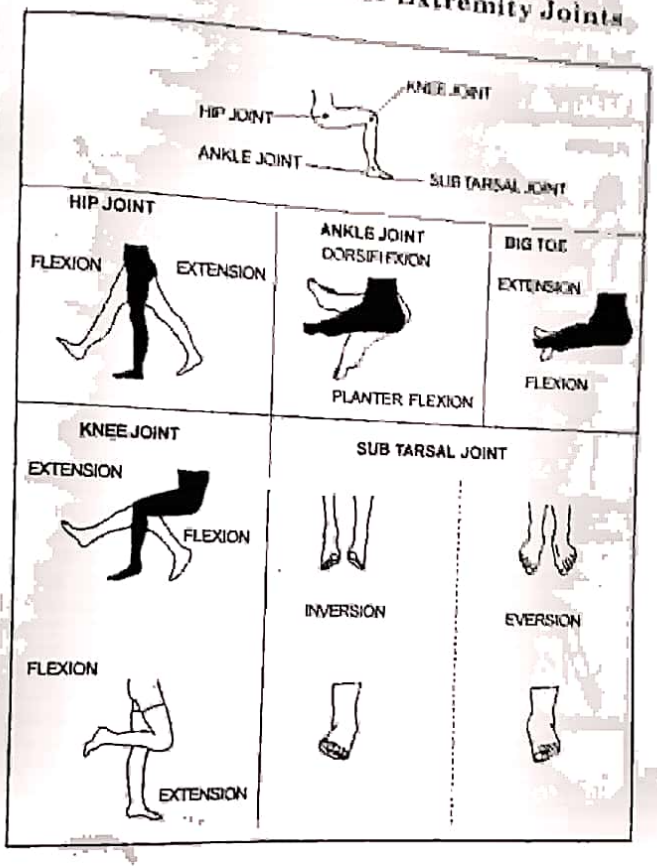


Fig 8.10

Movements At Superior Extremity Joints

Shoulder Joint

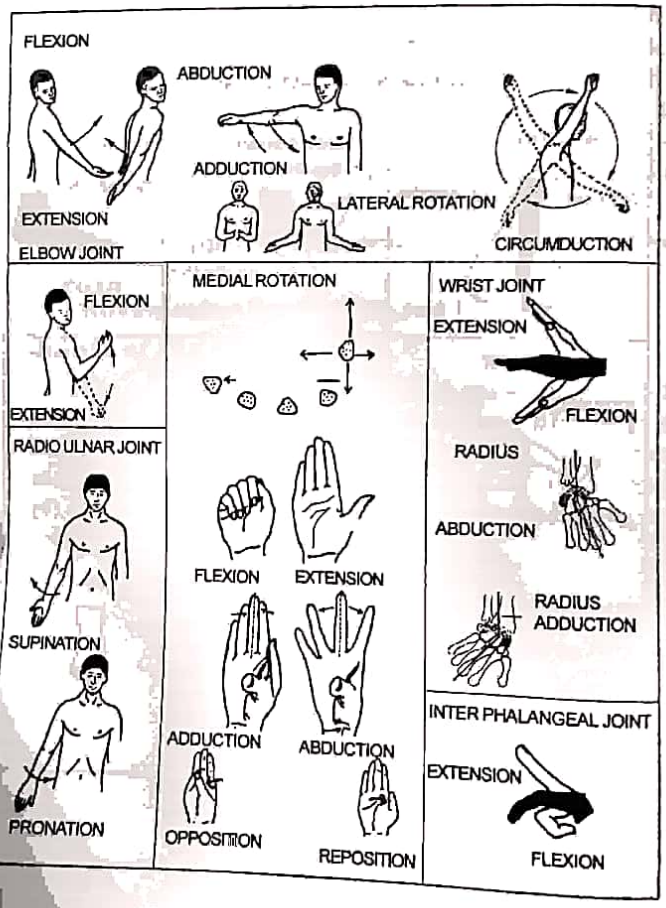


Fig. 8.11 :

Chapter-9

MUSCULAR SYSTEM
(पेशि शारीर)

Introduction–

The body is consisting of large number of muscles (Mamsa Dhatu). The muscles have fleshy, reddish, and contractile tissue (one or more heads or bellies), most muscles have white non contractile portions (Tendons) provide means of attachment. Skeletal muscles are attached directly or indirectly to bones, cartilages and / or ligaments. Some muscles are attached to an organ (The eye ball) which brings movement of that organ. The muscles may be named on the basis of their action, shape, size and region in which they lie.

Attachments of muscles are commonly explained as the origins and insertions. The origin is the proximal end of the muscle, which remains fixed during muscular contraction. The insertion is the distal end of the muscle, which is movable. However this is not always the case.

Types of Muscles (peshi)–

There are three types of muscles, S

1. Skeletal Muscles – (Striated / Voluntary)
2. Cardiac Muscles – (Striated / Involuntary)
3. Smooth Muscles – (Nonstriated / Involuntary)

1. Skeletal Muscles–

These are most profuse, found attached to the bones. These are supplied by somatic nerves, hence these are voluntary. Each muscle fiber is a multinucleated cylindrical cell containing a group of muscle

fibrils. The muscle fiber's arrangement varies according to the direction. The muscle may be Unipennate, Bipinnate, and/or multipinnate.

2. Cardiac Muscles–

These form the myocardium of the heart, show striations but are involuntary. It is intended for automatic and regular contractions. Each muscle fiber has a single nucleus.

3. Smooth Muscles–

These muscle fibers are elongated spindle shaped cells with a single nucleus, length is variable. These are found in the wall of Gastrointestinal, Respiratory, Urogenital tracts. The nerve supply is by autonomic nerves hence they are involuntary in function.

Mamsadhara kala–

It is connective membrane surrounds each muscle fibre. Similar membrane covering each bundle of muscle, such membrane is known as Mamsa Dhara Kala, such membrane is called as endomysium.

Blood supply–

The arteries branch frequently to form arteriole and capillaries in the muscle.

Nerve supply–

Muscle is supplied by both motor and sensory components, and autonomic fibers.

Definition of Peshi–

पेशी मांस खण्डः । (डल्हण)

मांसवयवसंघातः परस्परविभक्तः पेशीत्युच्यते । (डल्हण)

पेश्यः पुनः स्नाय्वाकृतयो मांसमध्यः ।

पेशी दीर्घ मांस पेश्याकाराः । (चक्रपाणि)

The mamsha dhatu, which is fleshy piece known as peshi, the mamsha dhatu forms in compact and fibers arrangement side by side and separated with each other is called as peshi. The peshi are lengthy and have fleshy appearance.

Peshi Swaroopa (पेशि स्वरूप)–

तासां बहुल पेलवस्थूलाणु पृथुवृत्त ह्रस्वदीर्घस्थिरमृदुश्लक्ष्ण कर्कशभाव
संध्यस्थिसिरास्नायुपच्छादकाशयधाप्रदेशं स्वभावतएव भवति ॥

[illegible]

The muscles are named and shapes as according to the place where they are situated, the muscle shapes are as follows.

बहल (large)	पेलव (small)	अणु (minute)
स्थूल (thick)	पृथु (expanded)	वृत्त (round)
ह्रस्व (short)	दीर्घ (long)	स्थिर (hard)
मृदु (soft)	श्लक्ष्ण (smooth)	कर्कश (rough)

The muscles covere the bones, joints, ligaments, and the organs. They also lines the middle and inner [illegible] of the organs. The blood vessels and nerve fibers are innervated within the muscles. The muscles help in the movement of the bones and organs. So the muscles are named as according to their location in the body.

Formation of Peshi–

यथार्थमूष्मणा युक्तो वायुः स्रोतांसि दारयेत ।
अनुप्रविश्य पिशितम् पेशीर्विभजते तथा ॥
पिशितमनुप्रविश्य पेशीर्विभजते अनिलः ॥

At the time of development The vayu [illegible] along with the ushma guna helps to form the [illegible] and also it enters mamsa and helps to develop the [illegible] dhatu.

Functions of Peshi (पेशि कार्य)–

मांसं शरीरपुष्टिम् मेदसश्च । (सु.सू. १५)
सिरास्नायु अस्थि पर्वाणि संधयश्च शरीरिणां ।
पेशेभिः संवृतान्यत्र बलवंति भवंत्यतः ॥ (सु. शा. ५/३८)
मांसपेशी बलायस्युः अवष्टम्भाय देहिनाम् ।
प्रसाराकुञ्चनयोरङ्गानां कण्डरामता । (शा. सं)

The mamsha dhatu makes body built and gives strength, it facilitates for contraction and relaxation of mamsha dhatu and it maintains the movement of joints. The sira, snayu, asthi and sandhi are covered and strengthened by the mamsha dhatu. By observing the similarity of these properties the mamsha dhatu may be considered as the muscles are the built and help for movement of the body. The mamshadahra kala which lies in between the mamsha dhatu may considered as intermuscular septum, it is that fascia which lies in between the two muscles.

Number of Peshi–

पञ्च पेशी शतानि, तासां चत्वारि शतानि शाखासु,
कोष्ठे षट्षष्टिः, ग्रीवांग्रत्यूर्ध्व चतुस्त्रिंशत् ॥ (सु.शा.५)
स्त्रीणां तु विंशतिरधिका ।
दश तासां स्तनयोः एकैकस्मिन् पञ्च पञ्चेति, यौवने तासां परिवृद्धिः
अपत्यपथे चतस्रः–तासां प्रसृते अभ्यन्तरतो द्वे, मुखाश्रिते बाह्ये च वृत्ते द्वे,
गर्भच्छिद्रसंश्रितास्तिस्रः, शुक्रार्तव प्रवेशिन्यस्तिस्रः एव ॥ (सु.शा. ५)

There are 500 peshi in the body, the females consisting twenty extra peshi. There are 500 muscles in the males and 520 muscles in the females.

1. Urdhva and Adha shakha [upper & lower limbs]–

तासां चत्वारि शतानि शाखासु –

अधशाखा, उर्ध्वशाखा पेशि Total – 100 X 4 - limbs = 400

पादाङ्गुलि	3 x 4 = 15			गुल्फ जानु मध्य	20
प्रपद	10		जानु 05	गुल्फ पादतल	10
पाद कूर्चा	10		ऊरु 20	वंक्षण	10

2. Madhyamanga [thorax and abdomen]–

कोष्ठे षट् षष्टिः– Total-66 in the Thorax and Abdomen

गुद	३	नाभि	१	मेढ (शिश्न)	१
पृष्ठोपरि	१०	सेवनी (मेढ्)	१	पार्श्व	६
वृषण	२	वक्ष (उरस)	१०	नितंब	१०
अक्षक, अंस	७	बस्ति शिर	२	उदर	५
हृदय, आमाशय	२	यकृत, प्लीह, उण्डुक	६		

3. Shiro greeva [head and neck]–

ग्रीवां प्रत्यूर्ध्वं चतुस्त्रिंशत्– total - 34 in the Head and Neck

ग्रीवा – ५	नासा – २	तालु – २	कर्ण – २
हनु – ८	नेत्र – २	जिह्वा – १	ललाट – ४
शंख – ४	ओष्ठ – २	शिर – १	कृकाटिका – १

4. In females–

Each sthana [breast] 5×2 = 10;

Garbhashaya [uterus] = 10

स्त्रीणां तु विंशातिराधिका– total – 20 more in females

स्तन– 10; अपत्यपथ– 5; गर्भाछिद्रसंश्रित– 3; शुक्रार्तव प्रवेशिन्यः– 3.

Muscles of the Upper Limbs–

Muscles of the Pectoral region– These muscles are Pectoralis major, Pectoralis minor and Subclavius.

Pectoralis Major (उरच्छदा गुर्वि पेशि)–

It is muscle of pectoral region, fan shaped and powerful muscle lies superficially.

Origin– It is originated by three regions

1. Anterior surface of half of the sternum and 2nd to 6th costal cartilage.
2. Anterior surface of medial half of the clavicle.
3. Aponeurosis of the external oblique abdominous.

Insertion– That is U shaped tendon twisted and inserted in the lateral lip of the bicipital groove.

Nerve– Medial and Lateral pectoral nerve.

Action– Abduction, Medial rotation of shoulder, Flexion of arm and Climbing

Pectoralis Minor (उरच्छदा लघ्वि पेशि)–

It is deeper triangular muscle lies below the pectoralis major muscle, clinically it divides the axillary artery into three parts, as proximal to muscle 1st part, posterior to muscle 2nd part, and distal to muscle 3rd part.

Origin– It is originated from the 3rd to 5th ribs, near the costochondral joint.

Insertion– Medial border and upper surface of the coracoid process of the scapula.

Nerve– Medial and Lateral pectoral nerve.

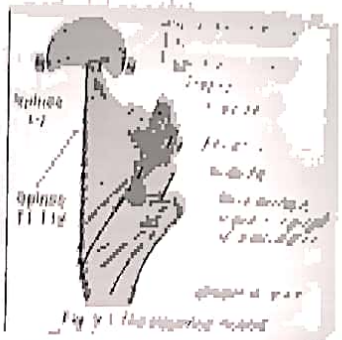
Action– Draws the scapula forward, Depresses the shoulder and helps is inspiration.

Muscles of the back of thorax–

The Trapezius, Latissimus dorsi, Levator scapulae and Rhomboideus major and minor muscles are connecting the upper limb with the vertebral column.

Trapezius (पृष्ठच्छदा पेशि)

It is triangular muscle lies and covers the posterior part of cervical and back of the thorax. The right and left muscles together form a trapezium



Origin– It is originated by

1. Medial one-third of superior nuchal line
2. External occipital protuberance
3. Ligamentum nuchae
4. T1 to T12 spine and corresponding supra spinous ligament.

Insertion– Posterior border of lateral one-third of clavicle, medial margin of acromion, and upper lip of the crest of spine of the scapula.

Nerve– Accessory nerve, Proprioception from C3 and C4.

Action– Elevate, retract, and rotate the scapula

Latissimus Dorsi (कटि पार्श्वच्छदा पेशि)–

In strict sense this muscle is not in the region of upper limb. It is a broad sheet, converging on the teres major and winding round the inferior border of this muscle. It forms the posterior axillary fold.

Origin– It is originated by

1. Lower six thoracic spines and supra spinous ligaments.
2. Thoraco lumbar fascia

3. Posterior part of the iliac crest and lower three or four ribs.

Insertion– In the floor of intertubercular sulcus.

Nerve– Thoracodorsal nerve

Action– Abductor of the humerus, Depressor of the shoulder, Climbing, and helps in retraction and medial rotation of the scapula. It also helps in pulling, folding the arm behind the back,

Rhomboideus Minor (अंसापकर्षणि लघ्वि पेशि)–

It is deep to the trapezius muscle; connect the vertebral column to scapula.

Origin– Lower part of the ligamentum nuchae and spines of C7 and T1

Insertion– Base of the triangular area at the root of the spine of the scapula.

Nerve– Dorsal scapular nerve (C5)

Action– Retract and steady of the scapula.

Rhomboideus Major (अंसापकर्षणि गुर्वी पेशि)–

It is deep to the trapezius muscle; connect the vertebral column to scapula.

Origin– Spines of T2, 3, 4, 5 and supraspinous ligaments.

Insertion– Medial border of scapula below the root of the spine.

Nerve– Dorsal scapular nerve (C5)

Action– Retract and steady of the scapula.

Muscles of The Scapular Region–

These are the Deltoid, Supraspinatus, Infraspinatus, Teres minor Subscapularis and the Teres major.

Deltoid Muscle (अंसच्छदा पेशि)–

It is V shaped thick powerful muscle which covers the shoulder region anterior, posterior, and laterally.

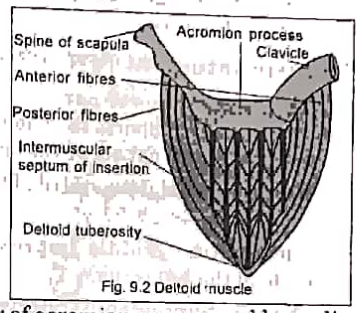


Fig. 9.2 Deltoid muscle

Origin–

1. Lateral one third of anterior border of clavicle

2. Lateral border of acromion process and lower lip of the spine of scapula.

Insertion– The deltoid tuberosity of the humerus.

Nerve– Axillary nerve

Action– Acromial fibers are powerful abductors of the arm, anterior fibers are flexors and medial rotators of the arm, posterior fibers are extensors and lateral rotators of the arm. It is the muscle for intramuscular injection.

Supraspinatus (अंस पृष्ठिका उत्तरा पेशि)–

It is deep to the deltoid muscle, which connects the scapula to the humerus. It lies dorsal aspect above the spinous process of the scapula, and covers the shoulder posteriorly gives strength to the shoulder joint and prevents the dislocation of shoulder joint posteriorly.

Origin– Originated by medial two-third of the supra spinous fossa of the scapula.

Insertion– Upper part of the greater tubercle of the humerus.

Nerve– Suprascapular nerve. (C5-6)

Action– Abduction of the arm and steadies the head of the humerus.

Infraspinatus (अंस पृष्टिका अधर पेशि)–

It lies at the lower part of the spinous process of the scapula and supports the shoulder joint posteriorly. Covers the dorsal aspect of the scapula

Origin– Medial two-third of the infraspinous fossa of the scapula

Insertion– Middle impression of the greater tubercle of the humerus.

Nerve– Suprascapular nerve. (C5-6)

Action– Lateral rotator of arm and same as supraspinatus.

Teres Minor (अंसाधरिका लघ्वि पेशि)–

It is a small muscle, which supports the posterior wall of the axilla.

Origin– Upper two-thirds of the posterior surface of the lateral border of the scapula

Insertion– Lowest impression of the greater tubercle of the humerus

Nerve– Axillary nerve (C5-6).

Action– Same as infraspinatus

Teres Major (अंसाधरिका बृहति पेशि)–

It is inferior to the teres minor muscle, and supports the posterior wall of the axilla. The muscle gives strength to the shoulder joint. The lower border of this muscle forms the margin of the axillary artery and vein.

Origin– lower one-third of the dorsal surface of the lateral border and inferior angle of the scapula.

Insertion- Medial lip of the bicipital groove of the humerus

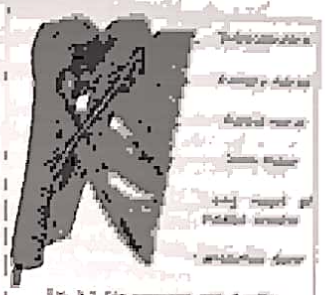
Action- Flexor of subscapularis

Subscapularis

This muscle covers most of the ventral surface of the scapula

Origin- Medial two third of the subscapular fossa

Insertion- Lesser tubercle of the humerus



Nerve- Upper and lower subscapular nerves

Action- Medial rotator and adductor of the arm

Muscles of the Anterior Compartment of the Arm

These are Coracobrachialis, Biceps brachii, Brachialis

Coracobrachialis

This muscle is pierced by the musculocutaneous nerve; the brachial artery passes from the medial side of the arm to its anterior aspect.

Origin- The tip of the coracoid process of the scapula along with the short head of the biceps

Insertion– The middle of the medial border of the humerus

Nerve– Musculocutaneous nerve (C5-7)

Action– Flexes the forearm at the elbow region.

Biceps Brachii (द्विशिरस्का बाहुवि पेशि)–

Origin– It has long and short heads, the long head arises from the supraglenoid tubercle of the scapula, the tendon is intracapsular and comes out and lies in the bicipital groove. The short head arises from the tip of the coracoid process along with the coracobrachialis.

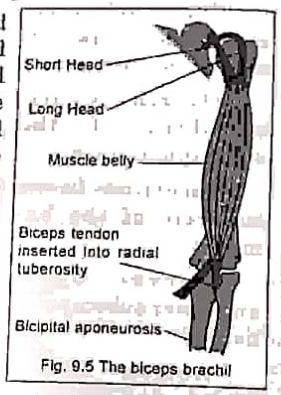


Fig. 9.5 The biceps brachii

Insertion– Rough part of the radial tuberosity and the tendon gives an extension known as bicipital aponeurosis that merges with the deep fascia of the forearm.

Nerve– Musculocutaneous nerve (C5-7)

Action– Supinator, screwing movements, and flexor of the elbow,

Brachialis (कूर्परद्वारिका पेशि)–

Origin– Lower half of the front of the humerus, Medial and lateral intermuscular septa.

Insertion– Ulnar tuberosity, and anterior surface of the coronoid process of the ulna.

Nerve– Musculocutaneous nerve (C5-7)

Action– Flexes forearm at the region of elbow.

Muscles of the Posterior Compartment of the Arm–

Triceps Brachii (त्रिशिरस्का बाहुवि पेशि)–

This muscle lies in the posterior aspect of the humerus, It has three heads and lies in the posterior part of the arm. Inter muscular injections may be given in this muscle.

Origin– The long head arises from the infraglenoid tubercle of the scapula, and it is the longest head. The lateral head arises from the upper part of the posterior surface above the radial groove. The medial head arises from the large triangular area on the posterior surface below the radial groove of the humerus.

Insertion– The long and lateral heads fuse to form the superficial and cover the medial head, later fuse and inserted in the superoposterior part of olecranon process of the ulna.

Nerve– Each head receives separate branch from the radial nerve.

Action– Powerful extensor of the elbow. It supports the shoulder joint at the lower aspect while arm is abducted.

Muscles of the Front of the Fore Arm–

The anterior compartment muscles mainly belong to the flexor group and cause the flexion of elbow and wrist joints. Muscles are arranged as superficial and deep. The tendons of flexor compartment are held in position at the wrist joint by fibrous band called as flexor retinaculum.

Superficial muscles–

All muscles have common origin from the medial epicondyle of the humerus. Thus these are identified as common flexor origin.

There are five superficial muscles–

1. Pronator Teres – करनिवर्तनी दीर्घ पेशि –
2. Flexor carpi radialis – मणिबंध संकोचनी बाहिस्था पेशि –
3. Palmaris longus – करतल प्रसारणी पेशि–
4. Flexor carpi ulnaris – मणिबंध संकोचनी अंतस्था पेशि–
5. Flexor digitorum superficialis – अंगुलि संकोचनि मध्य पर्विका पेशि

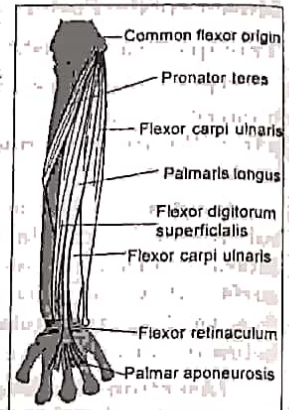


Fig 9.6 The Superficial muscles of the front of the forearm

Deep muscles– There are three deep muscles

1. Flexor digitorum profundus – अंगुलि संकोचनी अग्र पर्विक पेशि
2. Flexor pollicis longus – अंगुष्ट संकोचनी दीर्घा पेशि
3. Pronator quadratus – करविवर्त्तनि चतुरस्रा पेशि

Carpal tunnel–

Flexor retinaculum is a thick fibrous band (modified deep fascia) at the proximal part of the hand. Laterally it is attached to scaphoid and trapezium bones. Medially it is attached to pisiform and hamate bones. The space deep to the flexor retinaculum is known as carpal tunnel. Which the space consist flexor tendons and the median nerve, the compression of the median nerve in this area leads to carpal tunnel syndrome.

Muscles of Back of the Fore Arm–

The posterior compartment muscles mainly belong to extensor group. Muscles are arranged as superficial

and deep groups. These are responsible for extension of wrist joint. These muscles are supplied by the radial nerve and its branch known as posterior interosseus nerve. (Paralysis of these muscles causes wrist drop). The tendons of these muscles are held in their position at the wrist by a fibrous band identified as extensor retinaculum

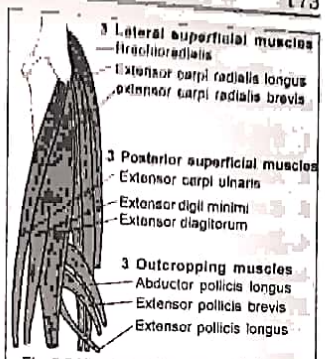


Fig 9.7 Muscles on the back of the forearm

Superficial muscles–

There are seven superficial muscles, cross the elbow and commonly take origin from the lateral epicondyle of the humerus (common extensor origin)

1. Anconeus – कूर्पर पृष्टिका पेशि – extends the elbow
2. Brachioradialis – करोत्ताननि दीर्घ पेशि – flexes the elbow
3. Extensor carpi radialis longus – extends and abducts the wrist
4. Extensor carpi radialis brevis – extends and abducts the wrist
5. Extensor digitorum – It divides into four tendons for medial four fingers.
6. Extensor digiti minimi – Extends the little finger
7. Extensor carpi ulnaris – Extends and adducts the wrist joint.

Deep muscles–

These muscles arise from radius, ulna and interosseous membrane.

1. Supinator – कूर्परानि ह्रस्व पेशि
2. Abductor pollicis longus
3. Extensor pollicis brevis
4. Extensor pollicis longus
5. Extensor indicis

Muscles of the Hand–

There are 20 muscles in the hand, these help for gripping, carrying and skilled movements of the hand and fingers.

1. Thenar eminence and muscles–

This is the elevation proximal to the thumb in the palmar region, consists of the following muscles. These muscles act on the thumb movements.

1. Abductor pollicis brevis, supplied by median nerve
2. Flexor pollicis brevis, supplied by median nerve
3. Opponens pollicis, supplied by median nerve
4. Adductor pollicis, supplied by ulnar nerve

2. Hypothenar eminence and muscles–

This is the elevation at the medial side of the hand, consists of the following muscles, they act on the little finger (except palmaris brevis). They are supplied by the ulnar nerve.

1. Palmaris brevis – (lies under the skin)
2. Abductor digiti minimi
3. Flexor digiti minimi
4. Opponens digiti minimi

3. Lumbrical muscles

These are four in number counting from lateral to medial as 1st, 2nd, 3rd and 4th, the 1st and 2nd are supplied by median nerve, and 3rd and 4th are supplied by ulnar nerve. These are attached to the tendon of flexor digitorum profundus.

4. Interosseous muscles–

There are two groups of interosseous muscles, supplied by ulnar nerve. (Injury to the ulnar nerve results "claw hand" that is hyper extension at the metacarpophalangeal joint and flexion at the interphalangeal joint)

1. **Palmar interossei muscles–** four in number, counting from the lateral to medial side as 1st, 2nd, 3rd and 4th, these are responsible to adduction of fingers.

2. **Dorsal interossei muscles–** Four in number, counting from the lateral to medial side as 1st, 2nd, 3rd and 4th, these are responsible to abduction of fingers.

Muscles of the lower Limbs–

Muscles of the Front of the Thigh–

The muscles are Sartorius, Quadriceps femoris, and Articularis genu. The muscles which belong to other region like, the iliacus, the psoas major, the pectineus and the adductor longus may also be considered in the region of femoral triangle.

Sartorius Muscle (दीर्घायाम पेशि)–

It is anterior compartment of the thigh muscle. It is narrow and ribbon like, it runs downwards and medially across the front of the thigh. It is the longest muscle in the body and It is known as "Tailoring Muscle".

Origin– Arises from anterior superior iliac spine and upper half of the notch below the Anterior superior iliac spine.

Insertion– Medial surface of the shaft of the tibia.

Nerve Supply– Branches from the femoral nerve, [$L_{2,3,4}$]

Action– Abductor and lateral rotator of the thigh; and flexor of the leg. The action is mainly involved in assuming the position in which tailors sit and work.

Fig. 9.8 Sartorius

Quadriceps Femoris (चतुः शिरास्का उर्वि पेशि)–

It is a bulky muscle in front of the thigh, this consist four muscles namely Rectus femoris, Vastus medialis, Vastus lateralis and Vastus intermedius. The rectus femoris is fusiform runs vertically on the front of the thigh superficial to the vasti muscles. The three vasti are wrapped around the femur medially, laterally and inter medially. All four muscles are supplied by the posterior division of femoral nerve. Quadriceps femoris is powerful extensor of the knee; in addition the rectus femoris it helps to flex the hip joint

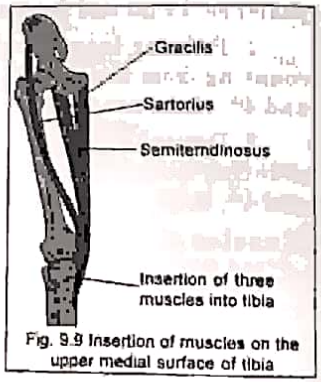


Fig. 9.9 Insertion of muscles on the upper medial surface of tibia

Rectus Femoris (ऊरु दंडिका पेशि)–

It lies in the front of the thigh and having two heads, the straight and the reflected head.

Origin– The straight head arises from upper half of the anterior inferior iliac spine, the reflected head

arises from groove above the acetabulum and capsule of the hip joint.

Insertion– inserted on the base of the patella

Nerve supply by femoral nerve.

Vastus Lateralis (ऊरु प्रसरणि बाह्य पेशि)–

It is the lateral muscle of the thigh, lies anteriorly.

Origin– Originates from lateral part of gluteal tuberosity, upper half of lateral lip of linea aspera, greater trochanter, and inter troanchteric line.

Insertion– Lateral part of the patella,

Vastus Medialis (ऊरु प्रसारिणि अंतस्था पेशि)–

It is medial muscle of the thigh includes in the quadriceps femoris.

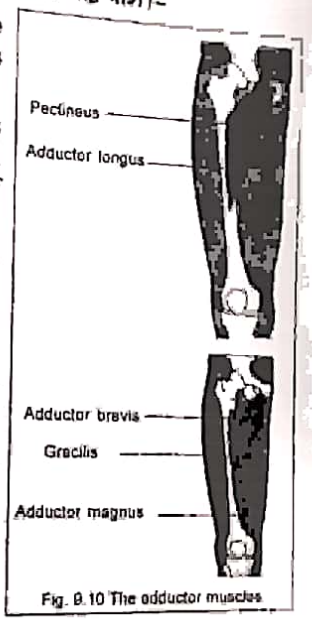


Fig. 9.10 The adductor muscles

Origin– Intertrochanteric line, spiral line, medial lip of linea aspera and medial supra condylar line.

Insertion– medial side of the patella.

Nerve supply femoral nerve

Vastus Intermedius (ऊरु प्रसारणि मध्यस्था पेशि)–

It lies between vastus lateralis laterly and vastus medialis medially.

Origin– Upper three fourths of the anterior and lateral surfaces of shaft of the femur.

Insertion– Base of the patella, all the four tendons unite to form a common tendon known as quadriceps tendon.

Nerve supply- by femoral nerve.

Muscles of the Medial Compartment of Thigh–

The following muscles lie in the medial side of the thigh region

1. Adductor longus
2. Adductor brevis
3. Adductor magnus
4. Gracilis
5. Pectineus

All muscles help in adduction of the thigh at the hip joint and all are supplied by obturator nerve. The part of adductor magnus taking origin from ischial tuberosity is included in the hamstring group and it is supplied by the tibial part of sciatic nerve. So the adductor magnus muscle is called as hybrid muscle, as it is innervated by obturator and sciatic nerves.

Muscles of the Gluteal Region–

The Gluteus maximus, the gluteus medius, the gluteus minimus, the piriformis, the superior and inferior gemelli, the obturator internus, the obturator externus and the quadratus femoris, the Tensor fascia latae lie on the lateral side of the thigh.

Gluteus Maximus (नितंब पिण्डिका गरिष्ठा पेशि)–

It is the most thickest and superficial muscle of the gluteal region.

Origin– It is originated from the gluteal surface of the ilium above and behind the posterior gluteal line, thoracolumbar fascia, dorsal surface of the sacrum, and sacro tuberous ligament.

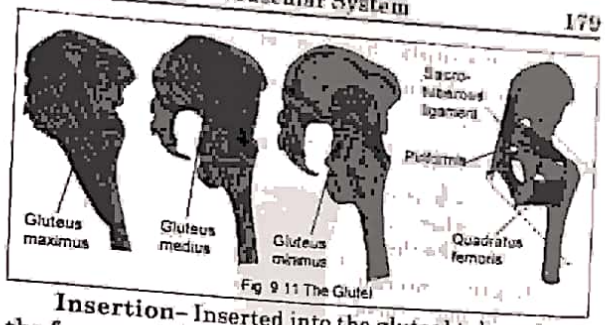


Fig. 9.11 The Glutei

Insertion– Inserted into the gluteal tuberosity of the femur, and iliotibial tract

Nerve supply– Inferior gluteal nerve

Action– Extension of the hip joint, lateral rotator and abductor of the hip joint.

Gluteus Medius (नितंब पिण्डिका मध्यमा पेशि)–

It is fan shaped, deep to maximus and covers the lateral surface of the ilium.

Origin– It is originated between the anterior and posterior gluteal line of the gluteal surface of ilium.

Insertion– Lateral surface of greater trochanter of the femur.

Nerve supply– Superior gluteal nerve

Action– Abduction of hip joint, medial rotators of the hip joint,

Gluteus Minimus (नितंब पिण्डिका लघ्वि पेशि)–

It is fan shaped lies deep to the gluteus medius

Origin– It is originated from gluteal surface of ilieum between the anterior and inferior gluteal lines.

Insertion– inserted into the anterior surface of the greater trochanter of the femur.

Nerve supply– Superior gluteal nerve

Action– Abduction of hip joint, medial rotators of the hip joint,

Tensor Fasciae Latae (ऊरु कंचुकाकर्षणी पेशि)–

This lies between gluteal region and then front of the thigh.

Origin– anterior 5 cm of the outer lip of iliac crest

Insertion– Iliotibial tract 3-5 cm below the level of greater trochanter.

Nerve supply– Superior gluteal nerve

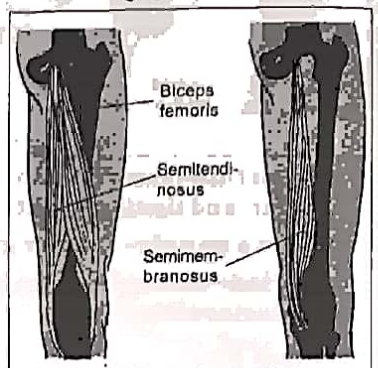


Fig. 9.12 Hamstring muscles

Action– Abductor and medial rotator of the thigh, and extensor of knee joint.

The Piriformis, Gemellus superior, Gemellus inferior, Obturator internus, Obturator externus, and the Quadratus femoris muscles are considered in the one group. All these muscles belong to similar functions that is help in lateral rotation of the thigh.

Muscles of the Back of the Thigh–

There are three muscles in the back of thigh, they are semimembranosus, semitendinosus and biceps femoris. The semimembranosus, semi tendinosus, long head of the biceps femoris, and ischial head of the adductor magnus are known as hamstring muscles. All these muscles have common origin, nerve supply and functions.

Semitendinosus (कण्डरा कल्प पेशि)–

This superficial muscle lies posteromedially in the thigh region. It has long tendon at its insertion.

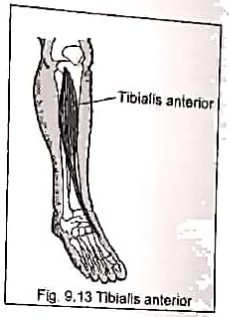


Fig. 9.13 Tibialis anterior

Origin– It is inferomedial on the upper part of the ischial tuberosity along with long head of biceps femoris muscle.

Insertion– upper part of the medial surface of the tibia behind the sartorius and the gracilis.

Nerve supply– Tibial component of sciatic nerve

Action– Flexion of knee and extension of hip joint.

Semimembranosus (कला कल्पा पेशि)–

It is deep to semitendinosus muscle lies posterior medially, and has flat tendon.

Origin– Supero lateral impression on the upper part of the ischial tuberosity, It is membranous in its upper part and lower part is fleshy.

Insertion– Posterior surface of the medial condyle of the tibia

Nerve supply– Tibial component of sciatic nerve

Action– Flexion of knee and extension of hip joint.

Biceps Femoris (द्विशिरस्का उर्वि)–

It is the muscle of the back of the thigh which arises by two heads, long and short, Long head belongs to hamstring group of muscles.

Origin– Long head arises in common with the semitendinosus from the lower and medial part of quad-

rilateral area of ischial tuberosity. Short head originates from the lateral lip of linea aspera and lateral supra condylar line of the femur.

Insertion– The two heads meet at deep surface and is inserted into the head of fibula in front of the styloid process and provides a slip of attachment to the lateral condyle of tibia. Action - Hamstring group of the muscles direct flexor of the knee and weak extensor of the hip, particularly in walking.

Nerve supply– Long head is supplied by tibial division of sciatic nerve. Short head by common peroneal division of sciatic nerve.

Muscles of Anterior Compartment of the Leg–

The muscles are Tibialis anterior; Extensor hallucis longus; Extensor digitorum longus and peroneus tertius. All these muscles pass into the dorsum of the foot and help in dorsi flexion of the foot at the ankle joint. The deep peroneal nerve supplies to these muscles.

Muscles of Lateral Compartment of the Leg–

There are two muscles namely Peroneus longus and Peroneus brevis. These muscles are supplied by superficial peroneal nerve, and these are elevators of the foot

Muscles of the back of the Leg–

The muscles are classified into two groups as superficial and deep groups

Superficial group– Gastrocnemius, the soleus, and the plantaris.

Deep Muscles– Popliteus, the flexor digitorum longus, the flexor hallucis longus and the tibialis posterior.

Tendocalcaneus–

A common tendon which is formed by the union of soleus and gastrocnemius muscles of the lower region is called as tendocalcaneus. It extends in the lower part of the posterior aspect of the leg. Inferiorly it is attached to the calcaneus. Both muscles help in walking, contraction of the muscles help in venous blood return, so the soleus is known as peripheral heart.

Sole of the Foot–

The muscles are arranged in four layers, the tendons and muscles are maintaining the arches of the foot.

First layer–

Consists of three muscles

1. Flexor digitorum brevis
2. Abductor hallucis
3. Abductor digiti minimi

Second layer–

1. Flexor digitorum accessorius
2. Lumbricals– Four muscles
3. Flexor digitorum longus tendon
4. Flexor hallucis longus tendon

Third layer–

1. Flexor hallucis brevis
2. Flexor digiti minimi brevis
3. Adductor hallucis

Fourth layer–

1. Planter interossei– Three muscles
2. Dorsal interossei– Four muscles

Abdomen Muscles–

Diaphragm Muscle (महा प्राचिर पेशि)–

It is dome-shaped muscle forming the partition between the thoracic and abdominal cavities.

Origin– 1. Sternal part arises from the back of the Xiphoid process.

2. Costal part arises from the inner surfaces of the cartilage and adjacent parts of lower six ribs on each side, interdigitating with the transversus abdominis.

3. Lumbar part arises from the medial and lateral lumbocostal arches, and from the lumbar vertebra by right and left crura, the fibres run upwards and inwards to form the right and left domes. In general all fibres converge towards the central tendon for their insertion.

Insertion– All the muscular fibers are inserted in the central tendon of the diaphragm which lies below the pericardium, the inferior surface of the heart rests

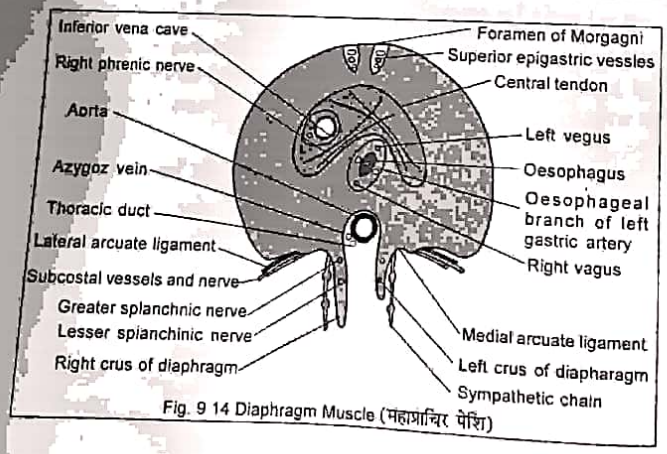


Fig. 9 14 Diaphragm Muscle (महाप्राचिर पेशि)

on the central tendon, it is trilobed in shape, made up of three leaflets. The middle leaflet is triangular, right and left leaflets are tongue shaped.

It has three openings–

1. Inferior venacaval opening.
2. Oesophageal opening.
3. Aortic opening.

Nerve Supply– Phrenic nerve [motor] $C_{3, 4, 5}$ & lower six thoracic nerves (sensory)

Action– 1. Muscle of inspiration.

2. Muscle of abdominal string [evacuate the pelvic contents, acts in all expulsive acts to give additional power to each effort].

3. Weight lifting muscle.

Muscles of the anterior Abdomen Wall–

There are four major muscles on either side of the midline, each muscle forms a aponeuroses on both side and meets at the midline to form a median band called the linea alba. There are two small muscles the cremaster and the pyramidalis

Major muscles–

1. External oblique muscle
2. Internal oblique muscle
3. Transversus abdominis muscle
4. Rectus abdominis muscle

External Oblique Muscle (उदरच्छदा आदिम पेशि)–

It is the outer most muscle, covers the anterior and lateral abdominal wall.

Origin– It arises by eight slips from the middle of the shaft of the lower eight ribs, the fibers run downwards, forwards and medially.

Insertion– The muscle forms in a broad aponeurosis and inserted into the xiphoid process, the linea alba, the pubic symphysis, the pubic crest, and anterior two thirds of the outer lip of iliac crest. The lower free border of aponeurosis forms a fold between the anterior superior iliac spine and pubic tubercle is called as inguinal ligament.

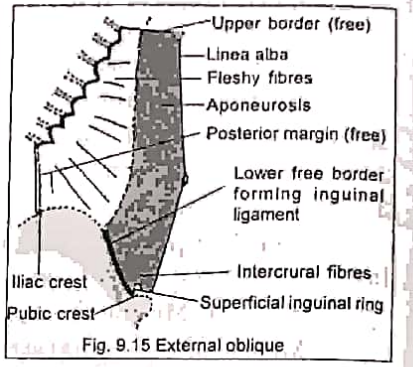


Fig. 9.15 External oblique

Nerve supply– Lower six thoracic nerves.

Internal Oblique Muscle (उदरच्छदा मध्यम पेशि)–

It is deep to external oblique and covers the anterior and lateral abdominal wall.

Origin– Lateral two thirds of the inguinal ligament, anterior two thirds of the intermediate area of the iliac crest, and thoraco lumbar fascia. The fibres run upwards forwards and medially

Insertion– The upper fibres are inserted into the lower three or four ribs and their cartilages. The lower fibres end in a aponeurosis inserted into the 7^{th}, 8^{th}, 9^{th}, costal cartilages, xiphoid process, linea alba, the pubic crest and pectineal line.

Nerve supply– Lower six thoracic and first lumbar nerves.

Action– Support for abdominal viscera, expulsive nature, forceful expiratory acts and movements of the trunk.

Transversus Abdominis Muscle (उदरच्छदा चरमा पेशि)–

It is inner most muscle deep to internal oblique muscle.

Origin– Lateral one third of inguinal ligament, anterior two thirds of the inner lip of the iliac crest, the thoraco lumbar fascia, and inner surfaces of lower six costal cartilages. The fibres are directed horizontally forwards.

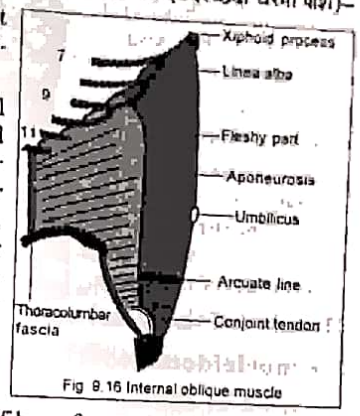


Fig. 9.16 Internal oblique muscle

Insertion– The fibres form an aponeurosis inserted into the xiphoid process, linea alba, the pubic crest and the pectineal line. The lower fibres fuse with the lowest fibres of the internal oblique to form the conjoint tendon.

Nerve supply– Lower six thoracic and first lumbar nerves.

Action– Support for abdominal viscera, expulsive nature, forceful expiratory acts and movements of the trunk.

Rectus Abdominis Muscle (उदर दण्डिका पेशि)–

This muscle runs vertically on either side of the linea alba. It is enclosed in a sheath formed by the aponeuroses of the external, internal oblique and transverse abdominis muscles.

Origin– It has two head, Lateral head arises from the lateral part of the pubic crest. Medial head from the anterior pubic liganient.

Insertion– Wall of the thorax, xiphoid process, and 7th, 6th, and 5th costal cartilages.

Nerve supply– Lower six thoracic nerves.

Actions– Support for abdominal viscera, expulsive nature, forceful expiratory acts and movements of the trunk.

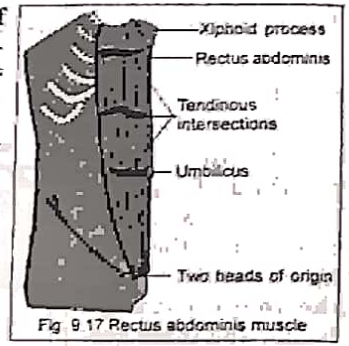


Fig. 9.17 Rectus abdominis muscle

Muscles of the Head and Neck–

Sternocleidomastoid Muscle (उरकर्णमूलिका पेशि)–

It is a cervical muscle which lies obliquely from the mastoid process of temporal bone and superior nuchal line upto the manubrium sternum and sternal end of the clavicle. It is supplied by the spinal root of the accessory nerve.

Origin– Sternal head arises from superolateral part of the front of manubrium sterni. Clavicular head arises from medial $^1/_3$ of the superior surface of the clavicle. The clavicular head passes deep to the sternal head. The two heads blend below the middle of the neck, between the two heads there is a small triangular depression is known as supra clavicular fossa.

Insertion– It is inserted by thick tendon into the lateral surface of the mastoid part of temporal bone and into the lateral half of superior nuchal line of the occipital bone.

Motor-supplied by spinal accessory nerve. Sensory-ventral rami of C_2

Supra Hyoid Muscles	Infra Hyoid Muscles
1. Mylohyoid	1. Sternohyoid
2. Digastric	2. Sternothyroid
3. Stylohyoid	3. Thyrohyoid
4. Geniohyoid	4. Superior belly of Omohyoid

Supra hyoid muscles lie above the hyoid bone, and Infra hyoid muscles lie below the hyoid bone, both muscles are attached to the body of the hyoid bone.

Extraocular Muscles (बाह्य नेत्र पेशि)–

There are six muscles lies within the orbital bony cavity and attached to the external layer of the eyeball. These muscles help for the movements of the eyeball.

1. Four recti muscles– Superior, Inferior, Medial and Lateral
2. Superior oblique muscle
3. Inferior oblique muscle

Recti muscles–

Arise from a common tendinous ring which is situated close to the apex of the orbit, the muscles extend forward and are inserted into the sclera.

Nerve supply– The Superior, inferior and medial rectus muscles are supplied by Oculomotor nerve. The lateral rectus is supplied by Abducent nerve (6th cranial nerve).

Action– Superior rectus - elevation of the eyeball, medial rotation, and intortion.

Inferior rectus– depression of the eyeball, medial rotation of the eyeball and extortion

Medial rectus– medial rotation (adduction) of the eyeball.

Lateral rectus– lateral rotation (abduction) of the eyeball

Superior oblique muscle–

It arises from the inferomedial part of the body of the sphenoid bone. Its tendon passes through a fibrous pulley (the trochlea), then extends backward is inserted into the sclera.

Nerve supply– Trochlear nerve (4th cranial nerve)

Action– Depression and lateral rotation of the eyeball, and intortion

Inferior oblique muscle– It arises from the infra orbital margin of the maxilla on the medial side, it passes backward and inserted into the sclera.

Nerve supply– Oculomotor nerve (3rd cranial nerve)

Action– Elevation and lateral rotation of the eyeball, and extortion.

Intra Ocular Muscles (अभ्यंतर नेत्र पेशि)–

These are nonstriated muscles lying within the eyeball.

Ciliaris– It is present in the ciliary body, helps in the lens adjustment.

Sphincter pupillae– It is present in the iris, it constricts the pupil when light falls on the eye.

Dilator pupillae– It dilates the pupil.

Cubital Fossa (कूर्पराग्र खात)–

It is a triangular hollow space on the front of elbow.

Boundaries–

Laterally– It is formed by medial border of the brachioradialis.

Medially– It is formed by lateral border of the pronator teres.

Base– Directed upwards and formed by an imaginary line joining the two epicondyles of the humerus.

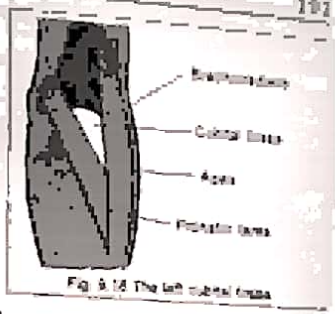


Fig. 9.16 The left cubital fossa

Apex– Directed downwards and formed by the meeting point of the lateral and medial boundaries.

Roof– Formed by skin, superficial fascia containing the median cubital vein lateral and medial cutaneous nerves of the forearm and deep fascia.

Floor– It is formed by brachialis and the supinator muscles.

Contents–

1. Median nerve – it leaves the fossa by passing between the two heads of pronator teres.
2. Termination of brachial artery into radial and ulnar arteries.
3. Tendon of biceps with the bicipital aponeurosis.
4. Radial nerve appears in between the brachialis medially and brachioradialis, and extensor carpi radialis longus laterally.

Clinical importance–

It is the site for intravenous injections through the median cubital vein.

The blood pressure recorded by auscultating the brachial artery in front of the elbow.

Femoral Triangle (ऊर्वी त्रिकोण खाता)–

It is triangular depression on the upper one-third of the front of the thigh region.

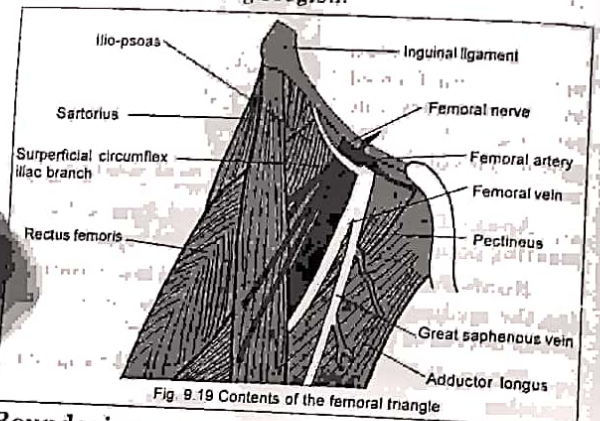


Fig. 9.19 Contents of the femoral triangle

Boundaries–

Laterally– By the medial border of sartorius muscle.

Medially– By the medial border of the adductor longus muscle

Base– Formed by inguinal ligament, directed upwards.

Apex– Directed downwards, and formed by meeting point of medial and lateral borders.

Roof– It is formed by skin, superficial fascia containing the superficial inguinal lymph nodes, genitofemoral nerve (branch of femoral nerve), ilioinguinal nerve branches, superficial branches of femoral artery and veins, terminal part of the great saphenous vein, and deep fascia having the saphenous opening and cribriform fascia.

Floor– Formed by medially, adductor longus and pectineus, and laterally by the iliacus and psoas major muscles.

Contents– Femoral artery and its branches, and femoral vein and its tributaries, femoral nerve and its branches and deep inguinal lymph nodes.

Femoral sheath– It is a funnel shaped fascial sheath enclosing the upper 3 to 4 cm of the femoral vessels.

The sheath is the extension of two layers of the fascia of the abdomen. The anterior wall is formed by extended fascia transversalis, posterior wall is formed by extended fascia iliaca, and inferiorly the sheath merges with connective tissue surrounding the femoral vessels.

The sheath is divided into three compartments.

1. The lateral compartment for femoral artery and genitofemoral nerve.

2. The middle compartment for femoral vein.

3. The medial compartment for lymphatic vessels and this is known as femoral canal.

Femoral canal– It is a conical shape canal and medial compartment of femoral sheath. It is wide above and narrow below, and about 1.5 cm long. The upper end is known as femoral ring bounded anteriorly by the inguinal ligament, posteriorly by the pectineus and its fascia, medially by lacunar ligament, laterally by the septum separating by femoral vein. The femoral ring is covered by extra peritoneal connective tissue. The canal consists lymph nodes, lymphatics and areolar tissue.

The femoral hernia is a condition when abdominal contents may bulge out through femoral canal as it is an area of weakness in the abdominal wall A femoral hernia is more common in females than in males, due to wider femoral canal and pelvis in females.

Popliteal fossa (जानु पृष्ट खाता)–

Popliteal fossa is a diamond shaped fossa, bounded by muscles, skin, fascia and bony surfaces.

- It lies posterior to the knee joint.
- Popliteal surface of the femur.
- Posterior surface of medial and lateral condyles of the tibia.

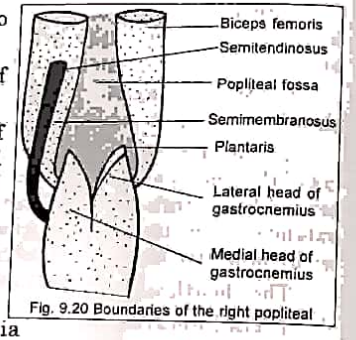


Fig. 9.20 Boundaries of the right popliteal

Boundaries–

Roof– It is formed by the skin fascia, superficial and deep fascia

Floor– It is formed by the popliteal surface of femur, capsule of the knee joint, popliteal fascia, posterior surface of two condyles of tibia and popliteus muscle.

Superolaterally– Formed by the biceps femoris muscle.

Superomedially– Semimembranosus, Semitendinosus. Supported by Gracilis, Sartorius and Adductor magnus muscles.

Inferomedially– Formed by the medial head of Gastrocnemius

Inferolatterly– Lateral head of Gastrocnemius muscles.

Contents–

1. Popliteal artery and its brs.
2. Popliteal vein and its tributaries.
3. Tibial nerve and its branches.

4. Common peroneal nerve.
5. Fat.
6. Lymph nodes.
7. Small saphenous vein, it joins the popliteal vein.

Popliteal Artery–

It is the continuation of the femoral artery, begins at the opening of adductor magnus, reaches upto the lower border of popliteal muscle, where it divides into two terminal branches as anterior tibial and posterior tibial arteries.

Popliteal Vein–

It is a vein which is formed by the union of anterior and posterior tibial veins, at the lower border of popliteus muscle, it ascends and continues as femoral vein at the level of opening of the adductor magnus muscles.

Inguinal Ligament–

It is one of the ligament formed by the extension of lower border of external oblique aponeu-rosis, (which is thickened and folded backwards) extends from anterior superior Iliac spine to pubic tubercle and forms the base of the femoral triangle.

The following structures are attached to the inguinal ligament.

1. Lateral $^{2}/_{3}$; attached by origin of internal oblique,
2. Fascia lata is attached to the lower border,
3. Lateral $^{1}/_{3}$; attached by origin of trans-versus abdominis,

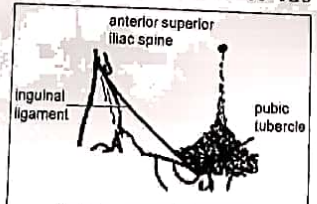


Fig. 9.21 The Inguinal ligament

4. Cremaster muscle from its middle part.

Inguinal Canal–

This is an oblique passage through the anterior abdominal wall. It is a canal which lies in lower part of the anterior abdominal wall just above the medial half of inguinal ligament and extends from deep inguinal ring to superficial inguinal ring. It is about 4 cms long. The deep inguinal ring is an oval opening in the transversalis fascia, situated 1.2 cm above the mid inguinal point. The superficial inguinal ring is a triangular gap in the external oblique aponeurosis. It has four boundaries.

Anterior Wall	Posterior Wall
1. Fleshy fibers of internal oblique.	1. Fascia transversalis.
2. Aponeurosis of external oblique.	2. Conjoint tendon.
3. Skin and superficial facia	3. Reflected part of inguinal ligament.

Floor– Upper surface of the inguinal ligament lacunar ligament fascia trans-versalis.

Roof– Fibres of the internal oblique

Contents–

1. Spermatic cord in males.
2. Round ligament of uterus in female
3. Ilioinguinal nerve in both sexes.

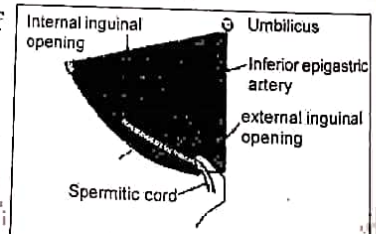


Fig. 9.22 Inguinal Ccanal

Section-2
Shareera Rachana Vignana
Paper-II

Chapter-1
KOSTA SHAREERA
(कोष्ठ शारीर)

Panchadasa Kostanga (पञ्चदश कोष्ठाङ्ग)–

Kosta is the region, one among the six regions of the body, it is also known as "मध्यमाङ्ग" The region below the root of the neck including the pelvis. Acharya Sushruta has explained where the kostangas are located, that region is known as kosta, according to the Acharya Sushruta the kostangas are as follows.

स्थानान्यामाग्नि पक्वानां मूत्रस्य रुधिरस्य च।
हृदुण्डुकः फुप्फुसश्च कोष्ठ इत्यभिधीयते॥ (सु.चि.२/१२)

१. आमाशय (आम)	४. मूत्राशय (मूत्र)	७. उन्डुक
२. अग्न्याशय (अग्नि)	५. रक्ताशय (रुधिर)	८. फुप्फुस
३. पक्वाशय (पक्व)	६. हृदय	

According to Acharya Charak there are fifteen kostangas and these are as follows

पञ्चदश कोष्ठाङ्गानि; तद्यथा– नाभिश्च, हृदयं च, क्लोम च, यकृतश्च, प्लीहा च, वृक्कौ च बस्तिश्च, पुरीषाधारश्च, आमाशयश्च, पक्वाशयश्च, उत्तरगुदं च, अधरगुदं च, क्षुद्रान्त्रं च, स्थूलान्त्रं च, वपावहनं चेति॥ (च.शा.७/१०)

१. नाभि	५ प्लीहा	९. आमाशय	१३. क्षुद्रांत्र
२. हृदय	६. वृक्क	१०. पक्वाशय	१४. स्थूलान्त्रं
३. क्लोम	७. वस्थि	११. उत्तर गुद	१५. वपावहन
४. यकृत	८. पुरीषाधार	१२. अधर गुद	

Umbilicus (नाभि)–

It is scar formed by the remnants of the root of

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१. आमाशय (आम)
२. अग्न्याशय (अग्नि)
३. पक्वाशय (पक्व)
४. मूत्राशय (मूत्र)
५. रक्ताशय (रुधिर)
६. हृदय
७. उन्दुक
८. फुप्फुस

According to Acharya Charak there are fifteen kostangas and these are as follows

पञ्चदश कोष्ठाङ्गानि; तद्यथा– नाभिश्च, हृदयं च, क्लोम च, यकृतश्च, प्लीहा च, वृक्कौ च बस्तिश्च, पुरीषाधारश्च, आमाशयश्च, पक्वाशयश्च, उत्तरगुदं च, अधरगुदं च, क्षुद्रान्त्रं च, स्थूलान्त्रं च, वपावहनं चेति॥ (च.शा.७/१०)

१. नाभि
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६. वृक्क
७. बस्थि
८. पुरीषाधार
९. आमाशय
१०. पक्वाशय
११. उत्तर गुद
१२. अधर गुद
१३. क्षुद्रांत्र
१४. स्थूलान्त्रं
१५. वपावहन

Umbilicus (नाभि)–

It is scar formed by the remnants of the root of

nabhi nala [umbilical cord]. It lies in the anterior median line at the level between L_3 and L_4 vertebra It is derived from the 10th intercostal nerve, early in foetal life the region is marked by a large gap in the anterior abdominal wall. The gap gradually becomes smaller as the wall grows towards the centre from above, below and sides. At this stage the several structures are passes through the gap. Sushruta stated that it is one of the sadya prana hara and kostagata sira marma measuring 4 anguli pramana. In foetal life it is very important region, through which the umbilical vessels enters and comes out. The nourishment supplies through the umbilical vessels from the mother to foetus, waste material comes back from foetus to mother. It has the following anatomical importance.

Importance–

1. The lymph and venous blood drainage do not cross the water shed line at the level of umbilicus.
2. T_{10} spinal nerve supplied to the skin.
3. Area of portocaval anastomosis.

Embryological Importance–

1. Umbilicus is the site of Nabhinala [umbilical cord].
2. Clinical– Vittelo intestinal duct may persist, the vitello-intestinal duct connects the embryonic gut to the yolk sac. In the normal course of development this duct disappears. If the duct remains patent, there is a channel through which intestinal contents flow out.
3. Umbilicus is the meeting point of the four [two lateral, head & tail] folds of embryonic plate.
4. Umbilicus is the meeting point of three systems namely, the digestive [vittelo intestinal duct] the excretory [urachus] and vascular [umbilical vessels].

Digestive system–

We all know that food is vital to life. It is required for the chemical reactions that occur in every cell. The digestion is a biochemical and mechanical process, which carries the breaking down of the food molecules for use by body cells is called digestion and the organs, which collectively performs this digestion.

Food intake is regulated by two sensations.

1. Hunger– Implies a strong desire for food in general.

2. Appetite– Means desire for a specific food.

Food control center is the hypothalamus. A cluster of nerve cells in the lateral hypothalamus called the appetite centre discharge impulses that result in increased food intake.

A cluster of nerve cells in the medial hypothalamus constitutes the satiety centre. When this center is stimulated, food intake is inhibited. According to one theory, A low blood glucose level stimulates the appetite center. A high blood glucose level inhibits it. Decreased amounts amino acids and fatty acids seem to have the same effect.

Digestive process–

Prepares food for consumption by the cells through five basic activities.

1. Ingestion– taking food [eating].

2. Peristalsis– the movement of food along the digestive tract.

3. Digestion– the breakdown of food by chemical and mechanical.

4. Absorption– the passage of digested food from the digestive tract into the Cardio Vascular and lymphatic systems for distribution to cells.

5. Defecation– The elimination of waste and indigestible substance from the body.

6. Chemical digestion– It is series of catabolic reactions that break down the large carbohydrate, lipid and protein molecules.

7. Mechanical digestion– Consists of various movements that aid chemical digestion.

The teeth prepare food, before it can be swallowed. Then the smooth muscles of the stomach and small intestine churn the food so it is thoroughly mixed with the enzymes that catalyze the reactions.

The G. I. Tract contains the food from the time it is eaten until it is digested and prepared for elimination. Muscular contractions in the walls of the G. I. Tract break down the food physically by churning it, secretions produced by cells along the tract break down the food chemically.

Two main group of organs involving in the digestion.

1. Gastro intestinal tract or Alimentary canal.

It is a continuous tube, extending from the mouth to the anus. The length of a tract is about 9 meter [30 ft.]

(A) **Organs composing the gastro intestinal tract :**

1. Mouth
2. Pharynx
3. Oesophagus
4. Stomach
5. Small Intestine
6. Large Intestine

(B) **Accessory structures :**

1. The teeth
2. Tongue
3. Salivary glands
4. Liver
5. Gall bladder
6. Pancreas

Histology–

The wall of G. I. Tract from the oesophagus to the anal canal has the same basic arrangement of tissue. The four coats from inside to out side.

Four Coats

1. Mucosa
2. Sub mucosa
3. Muscularis
4. Serosa

Mucosa

Inner lining of the tract, is a mucous membrane attached to a thin layer of visceral muscle. Two layers compose the membrane

1. Epithelium Which is in direct contact with the contents of G. I. Tract

2. Lamina propria An underlying layer of loose connective tissue.

3. Muscularis Mucosae Under the lamina propria is visceral muscle called the *muscularis mucosae*.

(a) Epithelial layer is composed of non keratinized cells.

(i) **Stratified epithelium**- in the mouth and oesophagus, the functions are protection and secretion.

(ii) **Simple epithelium**- throughout the rest of G. I. Tract, it has secretion and absorption functions.

(b) **Lamina Propria**- Under lying layer of loose connective tissue containing many blood and lymph vessels, supports the epithelium, binds it to the muscularis mucosae, and provides it with a blood and lymph supply.

(c) Muscularis mucosae contains smooth muscle fibers, it helps to forms small folds, which increase the digestive and absorptive area.

Sub Mucosa-

Consists of loose connective tissue that binds the mucosa to the muscular layer. Highly vascular and sub

mucous plexus. [A.N.S.]. This plexus is important in controlling secretion of the G. I. Tract.

Muscularis–

Mouth pharynx and oesophagus: consists in part of skeletal muscles that produces voluntary functioning that is swallowing. Throughout the rest of tract consist smooth inner circular fibers and outer longitudinal fibers. Contractions of the smooth muscles help to break down food physically mix it with digestive secretions. This layer contains major nerve supply to the tract; Myenteric plexus which controls G. I. Motility.

Serosa–

It is serous membrane composed of connective tissue and epithelium. This layer is also known as visceral peritoneum.

Mouth Oral/Buccal Cavity–

The mouth formed by cheeks, hard and soft palates and tongue; lateral walls of the oral cavity are the cheeks [muscular structures]. Covered externally by skin and lined by non-keratinized stratified squamous epithelium. The anterior portions of the cheeks terminate in the superior and inferior lips.

The Lips - Labia–

The lips are fleshy folds surrounding the orifice of the mouth. Covered externally by skin and on the inside by a mucous membrane. The inner surface of each lip is attached to its corresponding gum by a midline fold of mucous membrane called the labial frenulum. As superior labial frenulum and inferior labial frenulum.

The orbicularis oris muscle and connective tissue lie between the skin and mucosa. During chewing, the

cheeks and lips help to keep food between the upper and lower teeth. They also help in speech.

Vestibule–

It is entrance to a canal. Bounded – externally by cheeks and lips internally gums and teeth

Oral Cavity Proper–

It is a space that extends from the gums and teeth to the fauces [the opening between the oral cavity and pharynx].

Hard Palate–

Anterior portion of the roof of the mouth formed by the maxillae and palatine bones. Covered by mucous membrane and forms bony portion between oral and nasal cavities.

Soft Palate–

Posterior part of roof of the mouth. It is an arch shaped muscular partition between the oropharynx and nasopharynx lined by mucous membrane.

Uvula–

Conical muscular process hanging from the free border of the soft palate. During the swallowing soft palate and uvula drawn superiorly and closing the nasopharynx. Prevents entering of food into nasal cavities. On either side of the base of the uvula are two muscular folds that run down the lateral side of the soft palate. Anteriorly the palatoglossal arch extends side of the pharynx. Posteriorly palatopharyngeal arch extends side of the pharynx between the arches the palatine tonsils are lies. Lingual tonsil is situated at the base of the tongue at the posterior border of the soft palate, the mouth opens into the oropharynx through the fauces.

Nerve supply to the Oral Cavity–

1. **Roof**– Supplied by greater palatine and nasopalatine nerve.

2. **Floor**– (i) Lingual nerve branch of mandibular nerve. (ii) Taste fibers travel in the chorda tympani nerve, branch of facial nerve.

3. **Cheek**– (i) Buccal nerve, branch of the mandibular nerve.

Tongue (जिह्वा)–

It is one of the jnanendriya among the five indriyas, its artha is rasa. The tongue is a muscular organ situated in the floor of the mouth. The tongue along with its associated muscles forms the floor of the oral cavity. It is an accessory and sensory structure of the system composed of skeletal muscle covered with mucous membrane. It is associated with the function of taste, speech, mastication and deglutition. A middle fibrous septum divides the tongue into right and left halves. Each half contains four intrinsic and four extrinsic muscles. The intrinsic muscles occupy the upper part of tongue, and are attached to the submucous fibrous layer and to the median fibrous septum. They alter the shape of the tongue. The extrinsic muscles are attached to the tongue and to the, styloid process and soft palate bone- above; Mandible and hyoid bone - below.

It has an oral part anterior $^{2}/_{3}$ lies in the mouth, and a pharyngeal part posterior $^{1}/_{3}$ lies in the pharynx. Oral and pharyngeal parts are separated by a V- shaped sulcus known as sulcus terminalis, the two limbs of the V meet at median pit, named as foramen caecum.

External Features–

1. Root. 2. Tip.

3. Body has upper surface [dorsum] and inferior surface.

Root– It is attached to the mandible above and to the hyoid bone below.

Tip– It forms the anterior free end.

Body– It has superior surface called dorsum. It has oral and pharyngeal part. The inferior surface has only oral part.

Oral Part–

It lies in the floor of the mouth. Its margins are free and in contact with the gums and teeth. The superior surface of the oral part shows a median furrow and its covered with papillae. the inferior surface is covered with a smooth mucous membrane, which shows a median fold known as frenulum linguae on either side lies deep lingual veins. More laterally there is a fold called the plica fimbriate.

Pharyngeal Part–

Behind the sulcus terminalis part is pharyngeal part. The base [posterior surface] forms the anterior wall of the oropharynx. The mucous membrane has no papillae, but has many lymphoid follicles. The posterior part of the tongue is connected to the epiglottis by three folds of mucous membrane.

Papillae–

There are projections of mucous membrane lies on the anterior $^{2}/_{3}$ part of the tongue, there are three types of papillae.

1. Vallate /Circumvallate papillae– Large in size [1-2 mm in diameter] and are 8-12 in number lies immediately in front of the sulcus terminalis all of them contain taste buds.

2. **Fugiform Papillae**– These are numerous near the tip and margins of the tongue, smaller than the vallate papillae, and are mushroom like.

3. **Filiform Papillae**– These are the smallest and most numerous conical projections, cover the pre sulcal area of the dorsum of the tongue, no taste buds.

Muscles of the Tongue–

A middle fibrous septum divides the tongue into right and left halves. Each half contains four intrinsic and four extrinsic muscles.

Intrinsic Muscles–

Attached to the sub mucous, fibrous layer and median fibrous septum.

1. Superior longitudinal– shortens, and makes dorsum concave.
2. Inferior longitudinal– shortens, makes dorsum convex.
3. Transverse– extends from the median septum, makes narrow and long.

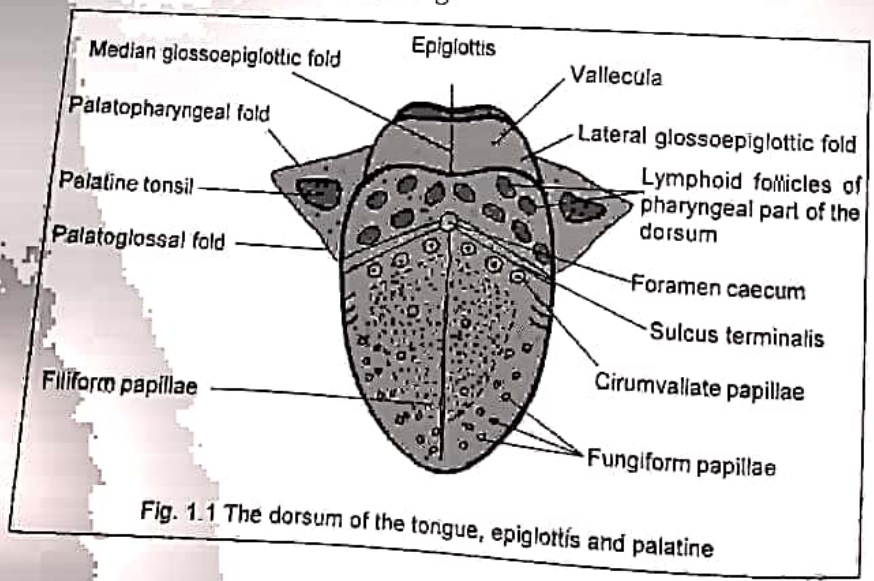


Fig. 1.1 The dorsum of the tongue, epiglottis and palatine

4 Vertical– borders of anterior part of the tongue, make it broad and flattened.

Extrinsic Muscles–

1 Genioglossus– connect the tongue to the mandible.
2 Hyoglossus– connect the tongue to the hyoid bone.
3. Palatoglossus– connect the tongue to the palate.
4 Styloglossus– connect the tongue to the styloid process.

Blood Supply–

1 Lingual artery a branch of the external carotid artery.
2 Tonsillar and ascending pharyngeal arteries.

Nerve Supply - Motor Nerves–

1. Hypoglossal nerve except palatoglossus muscle.
2 Palatoglossus muscle by the cranial part of the accessory nerve.

Sensory Nerves–

1. Lingual nerve [General Sensitive];
2. Chorda tympani nerve [nerve of taste];
3. Glossopharyngeal nerve [for both general sensations and taste for posterior 1/3];
4. Vagus nerve– Most of the posterior part.

Teeth (दन्त)–

In samhita the teeth is considered as bone under the variety of ruchakasthi. The teeth are accessory and masticatory apparatus located in sockets of the alveolar processes of the mandible and maxillae. The alveolar processes are covered by the gums, which extend slightly into each socket forming by the gingival sulcus. The sockets are lined by the periodontal ligament, which consists of dense fibrous connective tissue and is attached to the socket walls and chemical surface of the roots.

Eruption- Every one has two sets of tooth.

The First Set- Milk or Deciduous teeth or baby teeth.

Begin to erupt about 6 months of age and one pair appears at about each month thereafter until all 20 are present. At the end of second year all teeth becomes erupt. Lower jaw teeth erupt earlier than the upper jaw.

[Upper jaw – 5 × 2 = 10 and
Lower jaw – 5 × 2 = 10 Total 20 teeth]
2 incisors + 1 canine + 2 molars.
Upper central incisors – at the age of 6 month.
Lower central incisors – at the age of 7 month.
Lateral incisors – at the age of 8-9 month.
1st molar – at the age of 1st year.
Canines – at the age of 18 months.
2nd molar – at the age of 2nd year.

The Second Set : Permanent teeth

All the deciduous teeth are lost – generally between 6 and 12 years of age- and are replaced by the permanent teeth. The permanent tooth contains 32 teeth that appear between the age of 6 and adult-hood.

[Upper jaw – 8 × 2 = 16 and
Lower jaw – 8 × 2 = 16 Total 32 teeth]
2 incisors + 1 canine + 2 premolars + 3 molar.
Medial Incisors – at the age of 7 years.
Lateral incisors-at the age of 8 years.
Canines – at the age of 11 years.
1st pre molar – at the age of 9 years
2nd pre molar – at the age of 10 years.
1st molar – at the age of 6 years
2nd molar – at the age of 12 years.
3rd molar – at the age of 17-25 years(Wisdom teeth)

Parts of the Teeth–

A typical tooth consists of three principal portions

The crown– projecting part above the gum.

A Neck– lies between the crown and root & surrounded by the gum.

A Root– embedded in the jaw beneath the gum.

Composed of–

1. The pulp in the centre.
2. The dentin surrounding pulp.
3. Enamel covering the projecting part of dentin.
4. The cementum, surrounding the embedded part of the dentin.
5. The periodontal membrane.

1. Pulp–

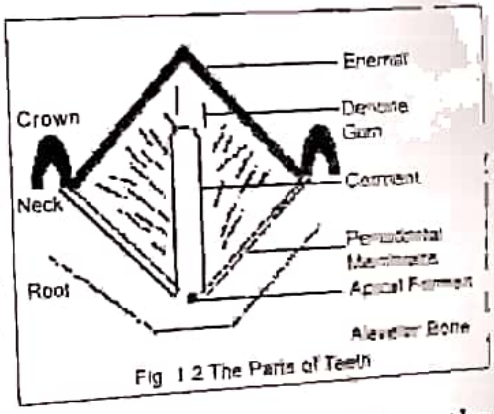


Fig 1.2 The Parts of Teeth

Loose-fibrous connective tissue contains blood vessels, nerves and lymphatics. Narrow extensions of the pulp cavity run through the root of the tooth and are called root canals. Each root canal has an opening at its base, the apical foramen. Through foramen enter the blood vessels bearing nourishment, lymphatics affording protection and nerves providing sensation.

2. Dentine–

It is bone like substance that gives the tooth its basic shape and rigidity. The dentin encloses a cavity.

Calcified material containing spinal tubules radiating from the pulp cavity. Calcium and organic matter are on the same proportion as in bone.

3. Enamel–

The dentin of the crown is covered by enamel. It is hardest substance in the body and protects the tooth from the wear of chewing. It consists primarily of calcium phosphate and calcium carbonate.

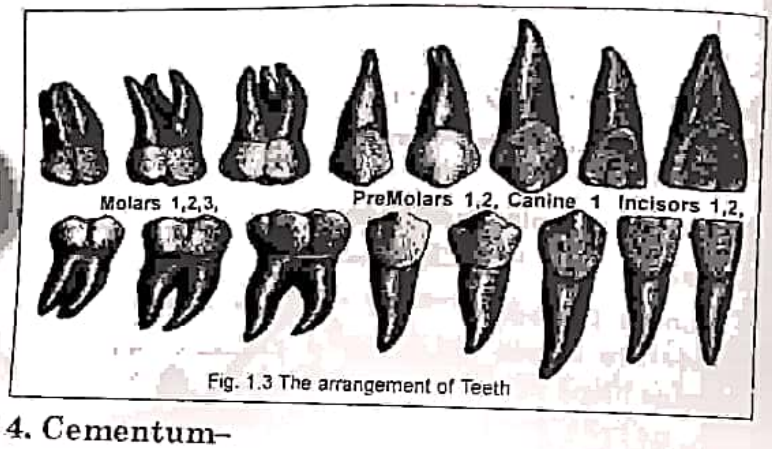


Fig. 1.3 The arrangement of Teeth

4. Cementum–

The dentin of the root is covered by cementum. Which attaches the root to the periodontal ligament. Resembles bone structure it has neither blood supply nor nerve supply.

5. Periodontal membrane–

Holds the root in its socket it acts as a periosteum.

Shape of tooth is adapted to its function–

1. Incisors– cutting teeth with chisel like crown.
2. Canines– holding and tearing teeth with conical and rugged crowns.
3. Premolar– two cusps called bicuspid tooth.

4. Molars – grinding teeth with square crown.

Incisors + canines + premolars – have single root with exception of 1st upper premolar, which has bifid root.

Upper molar have 3 roots. Lower molar have 2 roots.

Nerve Supply–

Upper teeth– Posterior superior alveolar nerve; Middle superior alveolar nerve and Anterior superior alveolar nerve.

Lower teeth– Inferior alveolar nerve.

Pharynx–

It was funnel shaped wide muscular tube lies behind the nose, mouth and just anterior to the cervical vertebrae. Clinically it is the part of upper respiratory passages where infections are more common. Its wall is composed of skeletal muscles and lined with mucous membrane. The functions of the pharynx are to serve as a passage for air and food and to provide a resonating chamber for speech sounds.

Features–

Length – 12 cm.

Width – upper widest 3.5 cm non collapsible.

Middle part – narrow. Lower part – narrowest.

It is made up of three layers –

Internal mucous layer, Middle fibrous layer and Outer muscular layer

Mucous–

Upper part is lined by ciliated columnar epithelium, lower part by stratified squamous epithelium.

Fibrous– Lies between mucous and muscle layer.

Muscularis–

Consists of the superior, middle and inferior constrictor muscles.

Boundaries–

Superior– Base of the skull.

Inferior– Continuous with the oesophagus at the level of 6th cervical vertebra.

Posterior– Prevertebral fascia.

Anterior– Communicates with the nasal cavity, oral cavity and larynx.

On Each Side–

1. Medial pterygoid plate.
2. Pterygomandibular plate.
3. Mandible.
4. Tongue.
5. Hyoid bone.
6. Thyroid and cricoid cartilage.

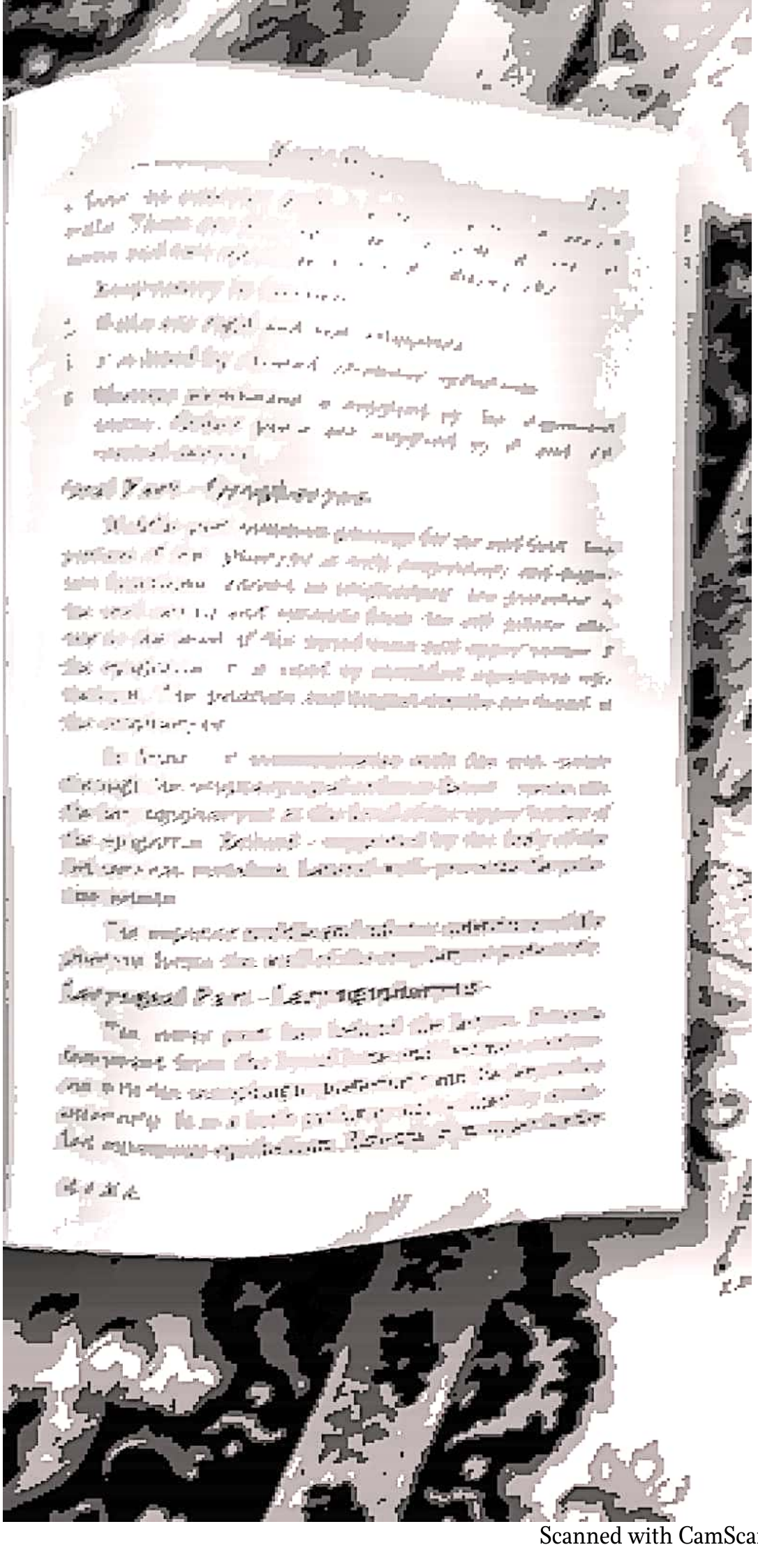
On either side related with, (a) Styloid process with muscle and (b) Common carotid; internal, external carotid arteries and cranial nerves.

Interior of the Pharynx– It is divided into three parts

1. Nasal [Nasopharynx] – Upper part.
2. Oral [Oropharynx] – Middle part.
3. Laryngeal [Laryngopharynx] – Lower part.

Nasal Part - Nasopharynx–

It is upper part transmits, only air and is called nasopharynx lies posterior to the internal nasal cavity and extends to the plane of the soft palate. It has roof,



of the epiglottis to the lower border of the cricoid cartilage. It has an anterior wall, a posterior wall, and lateral walls.

Blood supply–

1. Ascending pharyngeal branch of external carotid artery
2. Ascending palatine and tonsillar branches of facial artery.
3. Dorsal lingual branch of lingual artery.
4. The greater palatine, pharyngeal and pterygoid branches of the maxillary artery.
5. Veins drain into the pharyngeal venous plexus, which drains into the internal jugular vein.
6. Lymph drain directly into the deep cervical lymph nods.

Nerve Supply–

1. Pharyngeal, plexus.
2. Pharyngeal branch of the Vagus nerve,
3. Pharyngeal branch of the glossopharyngeal nerve.

Motor Fibres–

Accessory nerve through Vagus nerve, supply all muscles of the pharynx, except the stylopharyngeus.

Salivary Glands (स्रोत्र ग्रन्थि)–

Three pairs of salivary glands–

1. Parotid glands. 2. Sub mandibular glands.
3. Sub lingual gland

Parotid Gland (कर्ण मूलिका ग्रन्थि)–

It is the largest salivary gland. Its weight about 15 gm It lies in front and below of the ears between the

ramus of the mandible and sternomastoid. It is covered by the skin. The investing layer of the deep cervical fascia forms a capsule for the gland. The fascia splits between angle of the mandible and mastoid processa to enclose the gland.

External Features–

The gland resembles like three-sided pyramid, it has three surfaces, three borders and one duct.

Four surfaces	Three borders
1. Superior surface	1. Anterior border
2. Superficial surface	2. Posterior border
3. Antero medial surface	3. Medial border
4. Postero medial surface	

Structures Deep to with in the Parotid Gland–

1. Arteries– external carotid artery maxillary artery, superficial temporal vessels, posterior auricular artery.
2. Veins– Retro mandibular vein.
3. Facial nerve

Parotid Duct–

It is thick walled duct about 5 cm long; it emerges from the middle of anterior border of the gland and at the anterior border of the masseter. It runs medially and pierces the buccal pad of fat, buccinator muscle and buccoparyngeal fascia, the duct turns medially and opens into the vestibule of the mouth opposite the crown of the upper second molar tooth.

Blood supply–

External carotid and its branches, external jugular vein and its tributaries

Nerve Supply–

Parasympathetic– Secreto motor (through 9th cranial nerve)

Sympathetic– Vaso motor from plexus.

Sensory nerve– Auriculo temporal nerve.

Applied–

1. Mumps.
2. Parotid swelling g.
3. Parotid abscess.
4. Facial nerve precaution while surgery of gland.

Sub Mandibular Gland–

It is also one of the large salivary gland lies in the anterior part of the digastric triangle beneath the base of the tongue in the posterior part of the floor of the mouth. It is roughly "J" shaped having mainly two parts.

1. Superficial part
2. Deep part

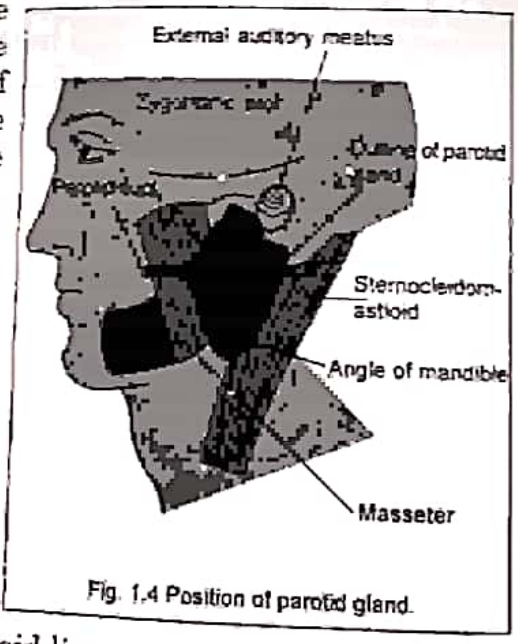


Fig. 1.4 Position of parotid gland.

The superficial part fill the digastric triangle, it extends upward deep to the mandible up to the mylohyoid line.

Deep part is small in size it lies deep to the mylohyoid muscle.

Duct–

Thin walled about 5 cm long, it emerges at the anterior end of the deep part of the gland. Duct runs forward on the hyoglossus. It opens on the floor of mouth, on the summit of sublingual papilla, at the side of frenulum of tongue.

The duct is supplied by lingual artery. Nerve supply - the branches from the submandibular ganglion. Superficially under the mucosa on either side of the midline of the floor of the mouth and enter the oral cavity proper just behind the central incisors.

Blood Supply–

The submandibular gland is supplied by facial artery. The veins drain into the common facial or lingual vein.

Nerve Supply–

Branches from the submandibular ganglion. Sensory fibres from the lingual nerve.

Sub Lingual Gland–

This is smallest salivary gland. It is almond - shaped and weighs about 3 to 4 g. It lies above the mylohyoid below the mucosa of the floor of the mouth, medial to the sublingual fossa of the mandible and lateral to the genioglossus.

Duct–

About 15 ducts emerge from the gland most of them open directly into the floor of the mouth. A few of them join the submandibular duct. It is supplied by lingual and submandibular arteries.

Saliva–

It is a fluid secreted by the glands in or near the mouth. Keep the mucous membranes of the mouth

moist. When food enters, secretion increases, so the saliva can lubricate, dissolve, and begin the chemical breakdown of the food. The mucous membrane lining the mouth contains many small glands, the buccal glands that secrete small amounts of saliva. The major portion of saliva is secreted by the salivary glands.

Composition of saliva–

Average about daily vary considerably but range from 1000 to 1500 ml saliva is secreted. Chemically It is 99.5 % water + 0.5 % solutes, like Sodium chloride, Sodium bicarbonates, Sodium phosphates, and Potassium. Some dissolved gases and various organic substances including urea and uric acid. Serum albumin and globulin, mucin, the bacteriolytic enzyme lysozyme and the digestive enzyme salivary amylase are also present

The saliva producing glands are supplies different ingredients to saliva.

The Parotids contain cells that secrete a watery serous liquid containing the enzyme salivary amylase.

The sub mandibular glands contain cells similar to those found in the parotids plus some mucous cells. They secrete fluid that is thickened with mucus quite bit of enzyme.

Sub lingual glands contain mucous cells they secrete a much thicker fluid and small amount of enzyme to the saliva.

1. Water in saliva provides a medium for dissolving foods.
2. A chloride in the saliva activates the salivary amylase.
3. Bicarbonates and phosphates keep the saliva slightly acidic P H of 6.35 to 6.85.

4. Mucin is a protein that forms mucus when dissolved in water. Mucus lubricates the food so it can be easily turned in the mouth formed into a ball, & swallowed.
5. The enzyme lysozyme destroys bacteria.

Secretion of Saliva-

Salivation is entirely under control of nervous system, normally moderate amounts of saliva continuously secreted in response to parasympathetic stimulation to keep the mucous membranes moist and lubricate the movements of the tongue and lips during speech.

The saliva swallowed and reabsorbed to prevent fluid loss. Dehydration causes the salivary and buccal glands to cease secreting saliva to conserve water. The subsequent feeling of dryness in the mouth promotes sensations of thirst. This phenomenon is also noted during fear or anxiety, when sympathetic stimulation dominates.

Food stimulates the glands to secrete heavily; chemicals in the food stimulate receptors in taste buds on the tongue, and impulses are conveyed from the receptors to two salivary nuclei in the brain stem called the superior and inferior salivatory nuclei. Nuclei are lies at the junction of medulla and pons.

The smell, sight, touches or sound of food preparation also stimulates increased saliva secretion. These Stimuli constitute psychological activation and involve learned behavior. Cortex sends impulses to the nuclei in the brain stem via extra pyramidal pathways, and the salivary glands are activated. Salivation also occurs in response to swallowing irritating foods. Saliva continues to be secreted heavily some time after food swallowed; it helps to washes out the mouth.

Digestion in the Mouth–

Mechanical–

Through chewing or mastication, tongue manipulates the food. The teeth grind it and mixed with saliva, as a result food is reduced to a soft flexible bolus that is easily swallowed.

Chemical–

Enzyme salivary amylase initiates the breakdown of starch break the chemical bonds at carbohydrates.

Deglutition–

Swallowing/Deglutition is mechanism, that moves food from the mouth to the stomach. It is facilitated by saliva and Mucus, involves the mouth, pharynx and oesophagus.

Three stages of swallowing–

(a) Voluntary Stage – bolus is moved into the oropharynx

(b) Pharyngeal Stage – involuntary passage through the pharynx into the oesophagus.

(c) Oesophageal Stage - involuntary passage through the oesophagus into the stomach.

1. Swallowing starts when the bolus is forced to the back of the mouth cavity by the movement of the tongue upward and backward against the palate.
2. When bolus into the oropharynx, the respiratory passage way close temporarily. The bolus stimulates receptors in the oropharynx send impulses to the deglutition center in the medulla and lower pons to the brain stem.

The soft palate and uvula are to move upward to close off the nasopharynx. The larynx is pulled forward

and upward widens the opening between the laryngo-pharynx and oesophagus. The bolus passes and enters oesophagus in 1 to 2 seconds

Oesophagus (अन्न नलिका)–

It is a narrow muscular, collapsable tube lies behind the trachea. It is about 23 to 25 cm long, begins at the end of the laryngopharynx, passes through the mediastinum and anterior to the vertebral column, it pierces the diaphragm at the level of 10th Thoracic vertebra passes through oesophageal hiatus and terminates in the stomach.

Structure– There are four layers forms the oesophagus

1. Mucosa– Consists of non-keratinized stratified squamous epithelium , lamina propria and muscularis mucosae.

2. Sub Mucosa– Contains mucus secreting glands, connective tissue and blood vessels.

3. Muscularis- Upper third is striated, middle third is striated and smooth, lower third is smooth outer longitudinal coat and inner circular coat.

4. Connective- Outer layer loose connective tissue, with capillaries. It dose not produce digestive enzymes and does not carry any absorption. It secretes mucus and transports food to the stomach. At the entrance of the oesophagus is regulated by a sphincter called the upper oesophageal sphincter. During the swallowing food is pushed through the oesophagus by involuntary muscular movements called peristalsis Peristalsis is a function of the muscularis and is controlled by the medulla.

The contraction constricts the oesophageal wall and squeezes the bolus downward. The contractions are

repeated in a wave that moves down the oesophagus, pushing the food towards the stomach.

Solid or semisolid food from mouth to the stomach takes 4 to 8 seconds, very soft food or liquid pass through in about 1 second. The lower oesophagus sphincter relaxes during swallowing; the bolus passes from oesophagus into the stomach.

Constrictions–

Normally the oesophagus shows 4 constrictions at the following levels.

1. At its beginning
2. Where it is crossed by the aortic arch
3. Where it pierces the diaphragm.
4. Where it is crossed by the left branches.

Blood Supply–

1. The cervical part by the interior tyroid arteries.
2. The Thoracic part by the oesophageal branches of the aorta.
3. The Abdominal part by the oesophageal branches of the left gastric artery.

Venous Drainage–

1. Upper part by brachiocephalic vein.
2. Middle part by azygos veins
3. Lower part by left gastric vein.

Nerve Supply–

1. Parasympathetic– by the recurrent laryngeal & oesophageal plexus.
2. Sympathetic– by middle cervical ganglia & upper four thoracic ganglia.

Stomach (आमाशय)–

Anatomy of the Stomach–

As per the Samhita it is one of the ashaya among the seven ashayas known as Amashaya.

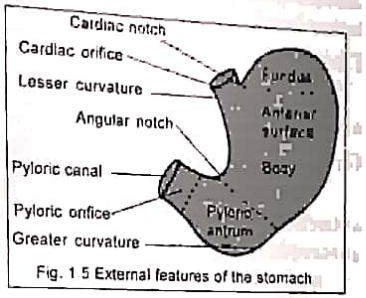


Fig. 1 5 External features of the stomach

It is "J" shaped hallow muscular organ below the diaphragm in the epigastric, umbilical, and left hypochondriac regions of the abdomen. The superior portion is a continuation of the oesophagus and inferior portion continuation with duodenum.

It is divided into three parts – Fundus, Body and Pylorus.

Two openings – Cardiac and Pyloric orifices, Two curvatures – Greater and lesser curvatures

Two surfaces – Anterior and Posterior surfaces

Fundus–

The rounded dome shaped portion above and left of the cardiac orifice is fundus.

Body–

Middle and below the fundus part is body, which extends from the cardiac orifice up to the incisura angularis.

Pylorus–

Tubular narrow inferior part is pylorus. The pylorus communicates with the duodenum.

The cardiac orifice is joined by the lower end of the

oesophagus lies at the level vertebra T_{11}. The pyloric orifice opens into the duodenum lies at the level of the lower border of vertebra L_1.

Lesser Curvature–

The concave medial border is lesser curvature is attached by lesser omentum.

Greater Curvature–

The convex lateral border is greater curvature is attached by greater omentum, gastrosplenic and gastrophrenic ligament.

The cardiac orifice surrounds the lower esophageal sphincter. Pyloric orifice opens into duodenum and is formed by the pyloric canal, which is about 2.5 cm long and guarded by a sphincter called the pyloric sphincter.

Relations–

Anteriorly	Posteriorly [forms as stomach bed]
• Anterior abdominal wall • Left costal margin • Left lobe of liver • Diaphragm	• Lesser sac • Diaphragm • Spleen and Splenic artery • Left suprarenal gland • Upper part of left kidney • Pancreas • Transverse colon and mesocolon

Histology– The stomach is composed of four layers.

Mucosa–

Internal layer lies in large folds called rugae made up of columnar epithelium containing many pits having gastric glands. Several types of secreting cells like zymogenic, parietal and mucous. The zymogenic cells

secrete gastric enzyme. The parietal cells secrete hydrochloric acid, the mucous cells secrete mucus. Secretions of the gastric glands are called gastric juice. The rugae are longitudinal along the lesser curvature and are irregular elsewhere. The rugae are flattened in a distended stomach.

Submucosa–

It is composed of loose areolar connective tissue, arterioles and nerve plexus.

Muscularis–

Three layers of smooth muscle; an outer longitudinal layer, mainly along the curvatures. A middle circular layer encircle the body and are thickened at pylorus to form pyloric sphincter., and an inner oblique layer which loop over the cardiac notch. Some fibres spread in the fundus and body of stomach. Rest form a well developed ridge on each side of the lesser curvature. These fibres on contraction form "gastric canal" for the passage of fluids.

Serosa–

It is part of the visceral peritoneum.

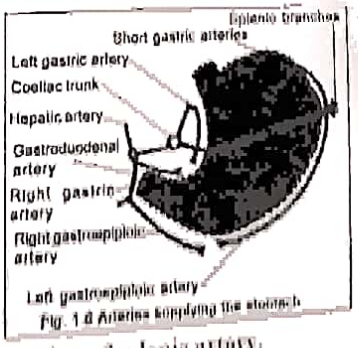


Fig. 1.8 Arteries supplying the stomach

Blood supply–

- Left gastric artery branch of coeliac trunk,
- Right gastric artery branch of common hepatic,
- 5 to 7 short gastric arteries branches of splenic artery.

- Left gastroepiploic artery branch of splenic artery.
- Right gastroepiploic artery branch of gastro duodenal artery.
- Veins drain into the portal vein.

Nerve Supply–

Coeliac and hepatic plexus of the sympathetic and Vagus nerve parasympathetic.

Stomach Bed–

The posterior surface of the stomach is related to the organs and forming the stomach bed all of which are separated from the stomach by the cavity of the lesser sac. The structures are as follows–

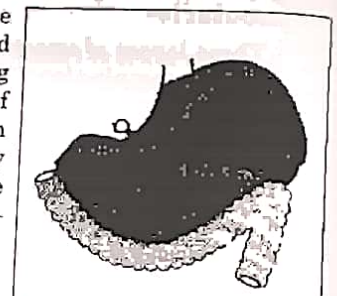


Fig. 1.7 Stomach Bed

- Spleen [Sometimes]
- The Splenic Artery
- The Diaphragm.
- The Pancreas.
- The Left Suprarenal Gland.
- The Transverse Mesocolon.
- The Left kidney.
- The Splenic Flexure of the Colon.

Functions–

1. The stomach acts as a reservoir of food.
2. It softens and mixes the food with gastric juice.
3. The gastric glands produce the gastric juice, which contains enzymes and play an important role in digestion of food.

4. The lining cells produce mucus which protects the gastric mucosa.
5. Alcohol, water, salt and few drugs are absorbed in the stomach.
6. The gastric glands produce hydrochloric acid which destroy many organisms present in the food and drink.

Digestion Mechanism in Stomach–

Mechanical–

Mixing waves pass over the stomach every 15 to 20 seconds. These waves mix the food with gastric juice and reduce it to a thin called chyme. Foods may remain in the fundus for an hour or more without becoming mixed with gastric juice. During this time salivary digestion continues.

Chemical–

Chemical activity is to begin the digestion of proteins digestion is achieved primarily through the enzyme pepsin secreted by zymogenic cells. Pepsin is most effective in the very acidic environment of the stomach. It becomes inactive in an alkaline environment.

1. First, pepsin is secreted in an inactive form called pepsinogen. Pepsin becomes active, when it is mixed with hydrochloric acid secreted by the parietal cells.
2. Second, the mucosa is protected by mucus especially after pepsin has been activated. The mucosa to form a barrier between it and the gastric juice.
3. Another enzyme of the stomach is gastric lipase. Gastric lipase splits the butter fat molecules found in milk. This enzyme operates best at a pH of 5 and 6 and has a limited role in the adult stomach. The infant stomach secretes rennin, it is important in the digestion of milk.

Regulation of Gastric Secretion-

Stimulation-

Regulated by both nervous and hormonal mechanisms parasympathetic impulses from nuclei in the medulla are transmitted via vagus and stimulate the gastric glands to secrete pepsinogen, hydrochloric acid, mucus and stomach gastrin.

1. Cephalic (Reflex) Phase- A gastric secretion occurs before food enters the stomach and prepares the stomach for digestion.

2. Gastric phase- Once the food reaches that gastric secretion continues.

3. Intestinal phase- When partially digested proteins leave the stomach and enter the duodenum then secretion starts. The stomach empties all its contents into the duodenum within the 2 to 6 hours after ingestion. Food rich in carbohydrate leaves the stomach in a few hours. Protein foods are somewhat slower. fat food emptying is slowest.

Absorption-

Stomach wall is impermeable to the passage of most materials into the blood, no absorption. Any have absorption of water, electrolytes, certain drugs, and alcohol takes place.

Pancreas ([illegible])-

According to Ayurveda, it is considered as a one of the ashaya and Known as Agnyashaya. It is also ubhayata sravigranthi i.e., Anta sravi and Bahira sravi. It secretes hormones, like insulin, glucagon and pancreatic juice.

The pancreas is a soft organ about 15 to 20 cm long, 2.5 to 3.8 cm broad and 1.2 to 1.8 cm thick and weight

about 100 g. It lies transversely across the posterior abdominal wall. The retro organ lies posterior to the stomach separated from it by the lesser sac at the level of L_1 & L_2 vertebra.

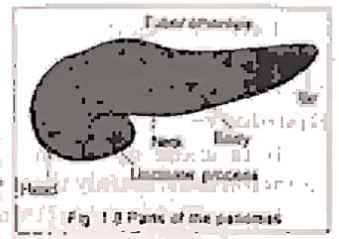


Fig. 1.8 Parts of the pancreas

The pancreas is linked with duodenum through the duct. The pancreatic duct lies near the posterior surface of the pancreas. It begins at the tail, runs towards the right through the body and bends at the neck to run downwards and backwards.

With in the head of the pancreas the pancreatic duct is related to the bile duct. The two ducts enter the wall of the second part of the duodenum and joins to form the hepatopancreatic ampulla. The ampulla opens in the serzind part of the duodenal mucosa known as the duodenal papilla.

About 10 cm below the pylorus of the stomach, an accessory duct may also lead from the pancreas and empts into the duodenum about 2.5 cm above the ampulla. The lumen is about 3 mm in diameter.

It is divided into four parts from right to left.

1. Head 2. Neck 3. Body 4. Tail

Head– It is expanded portion lies with in the concavity of the duodenum.

Neck– It is slightly constricted part next to the head, directed forwards, upwards and to the left.

Body– Elongated extends from the neck to the tail slight upward. It is triangular has three borders. A little to the left of the neck there is projection called tuber omental.

Tail- The narrow terminal part lies in the lienorenal ligament together with the splenic vessels and related with hilum of the spleen

Histology-

It is made up of small clusters of glandular epithelial cells, mainly there are two types of calls.

Islets of Langerhans [1% of cells] are small isolated masses of cells distributed throughout the pancreas – form the endocrine portion of the pancreas. Consists alpha cells with subtype A1 and A2 [about 20% of the cell population], they secretes pancreatic gastrin, serotonin and glucagon. Beta cells [80 % of the cell population], they produce insulin.

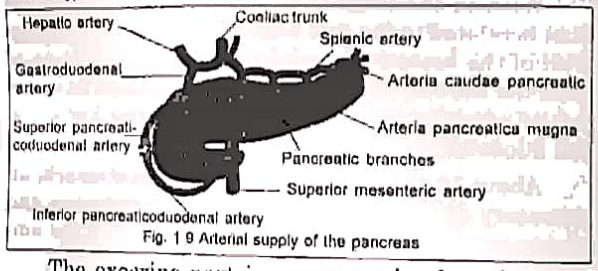


Fig. 1 9 Arterial supply of the pancreas

The exocrine part is a serous gland made up of another cells [99 % of cells] called acini, secrete the digestive enzyme called pancreatic juice.

It is supplied by pancreatic artery branches of splenic artery, superior pancreaticoduodenal artery inferior pancreaticoduodenal artery a branch of superior mesenteric artery.

Nerve supply–

Vagus or parasympathetic and splanchnic or sympathetic through the plexuses around the arteries. Sympathetic nerves are vasomotor, Parasympathetic nerves control pancreatic secretion.

Pancreatic Juice–

Daily about 1200 to 1500 ml pancreatic juice produces. It is clear colorless liquid. It consists mostly water, some salts, sodium bicarbonate and enzymes. The sodium bicarbonate gives a slightly alkaline pH 7.1 to 8.2 other carbohydrate-digesting enzymes called pancreatic amylase, protein digesting enzyme trypsin, fat digesting enzyme pancreatic lipase etc, are presents in the juice. Regulation of pancreatic secretion is same as of the stomach.

Functions–

Digestive enzyme contains many digestive enzymes, like trypsin breaks down proteins to lower peptides. Amylase hydrolyses starch and glycogen to disaccharides. Lipase breaks down fat into fatty acids and glycerol.

Endocrine–

Carbohydrates are the immediate source of energy. Insulin helps in utilize action of sugar in the cells. Deficiency of insulin results in hyperglycaemia. The disease is called diabetes mellitus.

Pancreatic juice–

It provides appropriate alkaline medium [pH 8] for the activity of the pancreatic enzymes.

Liver (यकृत्)–

It is one of the metabolic and largest gland, located under the diaphragm and occupies most of the right hypochondrium,

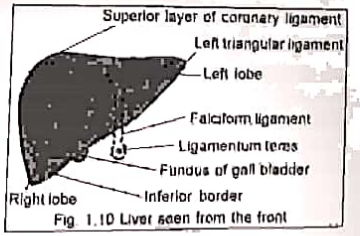


Fig. 1.10 Liver seen from the front

epigastrium and extends in to left hypochondrium of the abdomen. It is almost covered by peritoneum and dense connective tissue layer that lies beneath the peritoneum. Most of the liver is covered by ribs and costal cartilage.

Features– Weights about 1600 g in males and 1300 g in females.

Shape– Wedge shape; Five surfaces - Anterior, Posterior, Superior, Inferior and Right. The inferior border is sharp, anterior part is marked by the notch for the ligamentum teres and a cystic notch for fundus of the gall bladder.

It is divided into main two lobes (1) Right lobe (2) Left lobe each lobe separated by the falciform ligament, associated with the right lobe are the inferior quadrate lobe and posterior caudate lobe.

The right lobe is larger and forms $^{5}/_{6}$ part, left lobe is small $^{1}/_{6}$ part. Caudate lobe lies on the posterior surface in between groove for inferior venacava and fissure for the ligamentum venosum. Quadrate lobe lies on the inferior surface in between anteriorly inferior border, posteriorly porta hepatis.

The porta hepatis is a deep, transverse fissure about 5 cm long, situated on the inferior surface of the right lobe of the liver. It lies between the caudate lobe above and the quadrate lobe below and in front. The portal vein, hepatic artery, and the hepatic plexus of nerves enter the liver through the porta hepatis, while the right and left hepatic ducts and a few lymphatics leave it.

Peritoneal relations–

Most of the liver is covered by peritoneum, the following areas are not covered by peritoneum,

1. Triangular bare area on the posterior surface of the right lobe.
2. The groove for inferior venacava on the posterior surface of right lobe.
3. The fossa for the gall bladder.
4. The coronary ligament having superior and inferior layers.

The falciform ligament is a reflection of the parietal peritoneum, which extends from the under surface of the diaphragm to the superior surface of the liver, and also from the anterior surface of the liver to the anterior abdomen wall, in the free border of the falciform ligament at the inferior border of the liver there is the ligamentum teres, which extends from the liver to the umbilicus. It is a fibrous structure derived from the left umbilical vein of foetal life. The left umbilical vein (गर्भनि सिरा) is modified into ligamentum teres after the birth.

Ligaments of the Liver–

A number of peritoneal folds are attached to the liver these folds are called ligaments.

Following are the peritoneal ligaments–

(a) Falciform ligament– Connecting anterio superior surface of liver to the anterior abdominal- wall and under surface of diaphragm.

(b) Left triangular ligament– Connecting the superior surface of left lobe to diaphragm.

(c) Right triangular ligament– Connects the lateral part of posterior surface of right lobe to diaphragm.

(d) Coronary ligament– Encloses the bare area of the liver, with superior and inferior layers.

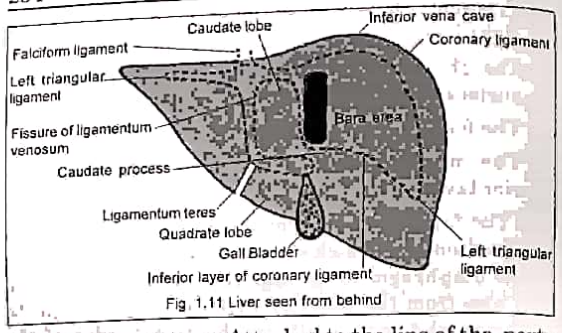


Fig. 1.11 Liver seen from behind

(e) Lesser omentum– Attached to the lips of the porta hepatis.

Ligamentum Venosum–

The ligamentum venosum lies in the fissure for the ligamentum venosum of the liver. It is the remanent of ductus venosus (संवहनि सेतु सिरा) of foetal life, it is connected above to left branch of the hepatic vein near its entry into the inferior venacava and below to the left branch of portal vein, ductus venosus forming a by pass root for blood circulation into the inferior venacava during the foetal life.

Histology–

It is made up of numerous functional units called lobules; a lobule consists of cords of hepatic cells arranged in a radial pattern around a central vein. Between the cords are endothelial – lined spaces called sinusoids, through which blood passes. The sinusoids are also partly lined with phagocytic cells, termed stellate reticuloendothelial cells.

Liver secretes daily about 800 to 1000 ml of bile, a yellow, brownish, liquid. It has a pH of 7.6 to 8.6. Con-

sists - water and bile salts, cholesterol and phospholipid called lecithin, bile pigments and several ions.

The principal bile pigment is bilirubin. When red blood cells are broken down, the iron, globin, and bilirubin are released. The iron and globins are recycled, but some of the bilirubin is excreted into the bile ducts. Bilirubins broken down in the intestine one of its breakdown products [urobilinogen] give feces their color.

The liver receives 20% of its blood supply through the hepatic artery, and 80 % through the portal vein.

The hepatic sinusoids drain into interlobular veins, which joins to form sub lobular veins. These in turn unite to form the hepatic veins which drain directly into the inferior venacava.

The nerve supply from the hepatic plexus which contains both sympathetic and parasympathetic or vagal fibres.

Functions–

1. Manufactures of bile salts which are used in the small intestine for the emulsification and absorption of fats,
2. Manufactures the anticoagulant heparin and other plasma proteins such as prothrombin, fibrinogen and albumin.
3. The stellate reticulo endothelial cells of the liver phagocytose worn-out red and white blood cells and some bacteria.
4. The cells contain enzymes that either break down poisons or transform them in to less harmful compounds.
5. Newly absorbed nutrients are collected in the liver,

depending on the body's needs, it can change any excess monosaccharides into the glycogen or fat.

6. Stores glycogen, copper, iron and vitamins A, D, E, & K.
7. Liver and kidneys participate in the activation of vitamin D.

Spleen (प्लीहा)–

It is soft, highly vascular and dark purple in colour. It is one of the major lymphatic organ, which acts as a filter for blood and plays an important role in the immune responses of the body.

It is wedge shaped organ; size and weight of the spleen are variable; on an average 1 inch thick; 3 inch breadth; 5 inch length; Weight 7 ounce.

Location–

It is lying in the left hypochondrium and partly in the epigastrium. Obliquely along the long axis of the 10th rib, related to 9th to 11th ribs, normally spleen is not palpable.

External Features–

Two ends	Three borders	Two surfaces
1. Anterior end	1. Superior border	1. Diaphragmatic
2. Posterior end	2. Inferior border	2. Visceral
		3. Intermediate border

Anterior End– It is expanded, directed downwards and forwards laterally

Posterior End– Round, directed upwards, backwards and medially

Superior Border– It is notched near the anterior end, Inferior and intermediate borders are rounded.

Surfaces

Diaphragmatic surface is convex and smooth, related to the diaphragm. Visceral surface is concave and irregular related to the fundus of stomach, anterior surface of the left kidney, splenic flexure of the colon and tail of the pancreas.

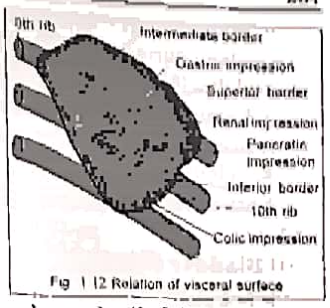


Fig. 1.12 Relation of visceral surface

Ligaments–

1. Gastro splenic. 2. Lienorenal.
3. Phrenico-colic ligaments.

Relations–

Peritoneal Relations–

Surrounded by peritoneum and is suspended by ligaments.

1. Gastrosplenic Ligament– Extends from hilum of the spleen to the greater curvature of the stomach, it contains short-gastric vessels & sympathetic nerves.

2. Lienorenal Ligament– Extends from hilum of the spleen to anterior surface of the left kidney. It contains the tail of pancreas, the splenic vessels and sympathetic nerves.

3. The Phrenico Colic Ligament– It is not attached but supports its anterior end. Extending from the splenic flexure of the colon to the diaphragm.

Functions–

1. Phagocytosis– Spleen is an important component of the reticulo endothelial system.

2. Hemopoiesis– Spleen is an important hemopoietic organ during foetal life. The lymphocytes manufactured in it take part in immune response of the body.

3. Immune Responses 4. Storage of RBC's

Blood Supply– Splenic artery branch of coeliac trunk; Splenic vein.

Nerve Supply– Sympathetic fibres from coeliac plexus.

Gall Bladder (पित्ताशय/पित्तकोष)–

It is a pear shaped sac about 7 to 10 cm long and breadth 3 cm. and its capacity is about 30 to 50 ml. It is located in a fossa of the visceral surface of the liver. It is reservoir of bile. It has three parts.

1. Fundus 2. Body 3. Neck.

Fundus–

It projects beyond the inferior border of the liver. It is entirely surrounded by peritoneum, anteriorly it is related to the anterior abdominal wall.

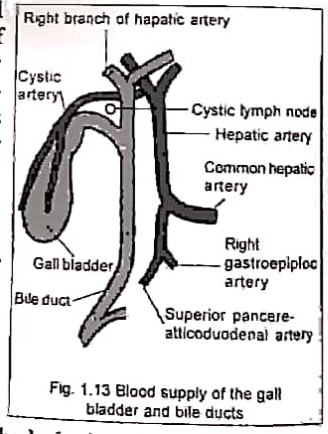


Fig. 1.13 Blood supply of the gall bladder and bile ducts

Body–

It lies in the fossa for the gall bladder of the liver. The upper narrow end of the body is continuous with the neck, at the right end of the porta hepatis, the superior surface of the body is devoid of peritoneum. The inferior surface is covered with peritoneum.

Neck–

It is the narrow upper end of the gall bladder, lies near the right end of the porta hepatis, and then it is continuous with the cystic duct. Its junction is marked by a constriction.

Blood Supply–

It is supplied by cystic artery, branch of right hepatic artery.

Functions–

It is to store and concentrate the bile until it is needed in the small intestine in the concentration process. Water and many ions are absorbed by the gallbladder mucosa. Secretion of mucin, Bile excreted by liver has pH 8.2. The gall bladder changes the pH 7.5 - 7.2.

The muscularis must contract to force bile into the common bile duct and sphincter of the hepatopancreatic ampulla must relax.

Biliary apparatus–

It collects bile from the liver, stores in the gall bladder and transmits it to the second part of the duodenum. The following structures are biliary apparatus.

1. Right and left hepatic ducts
2. The common hepatic duct
3. The gall bladder
4. The cystic duct
5. The bile duct

Hepatic Duct–

The right and left hepatic ducts emerges from the right and left lobes of the liver at the porta hepatis.

Common Hepatic Duct–

It is formed by the union of right and left hepatic ducts, runs downwards about 3 cm and is joined on its right side by the cystic duct to form the bile duct.

Cystic Duct–

It is about 3 to 4 cm long, begins at the neck of the gall bladder runs downwards, backwards and to the left, and ends by joining the common hepatic duct at an acute angle to form the bile duct.

Bile Duct–

It is formed by the union of the cystic and common hepatic ducts near the porta hepatis. It is 8 cm long and 6 mm diameter. It runs downwards and backwards in the free margin of the lesser omentum, then behind the 1st part of duodenum and lastly behind the head

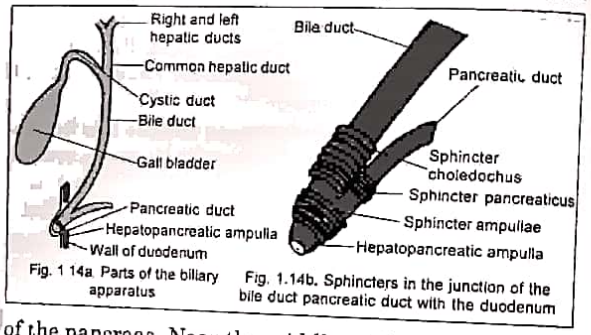


Fig. 1.14a. Parts of the biliary apparatus

Fig. 1.14b. Sphincters in the junction of the bile duct pancreatic duct with the duodenum

of the pancreas. Near the middle of the second part of the duodenum, it comes in contact with the pancreatic duct and accompanies it through the wall of duodenum, then two ducts unite to form the hepatopancreatic ampulla or ampulla of "vater".

Sphincters related to the bile and pancreatic ducts are as follows–

1. Terminal part of the bile duct covered by sphincter choledochus, [bile duct].
2. Terminal part of the pancreatic duct covered by sphincter pancreaticus [not always present).

3. Surrounds the hepatopancreatic ampulla, called the sphincter ampullae.

Small Intestine (क्षुद्रान्त्र)–

Major portions of digestion and absorption of nutrients occurs in the small intestine. Small intestine begins at the pyloric end of the stomach and later opens into the large intestine. Averages - 2.5 cm in diameter and 6.35 meter in length

Anatomy–

It is divided into three parts.

(1) Duodenum (2) Jejunum (3) Ileum

Duodenum–

The duodenum is shortest part, starts from the pyloric end of the stomach, it is about 25 cm long and further continues as jejunum.

Jejunum–

It is about 2.5 - meter long middle part and continues with ileum.

Ileum–

The ileum last portion measures about 3.6 meter joins with the caecum of large intestine at the ileocaecal valve.

Duodenum (ग्रहणि)–

It is the shortest, widest and most fixed part of the small intestine which lies in between stomach and jejunum, above the level of umbilicus against $L_{1,3}$ extending $1/2$ inch to the right. 1 inch to the left of median plane. It is about 10 inches long, curved around the head of the pancreas in the form of "C" and divided into four parts. It is mostly retroperitoneal and fixed except of its two ends where it is suspended by folds of peritoneum.

1. Superior Part [1st part] 2 inches long.
2. Descending Part [2nd part] 3 inches long.
3. Horizontal Part [3rd part] 4 inches long.
4. Ascending Part [4th part] 1 inch long.

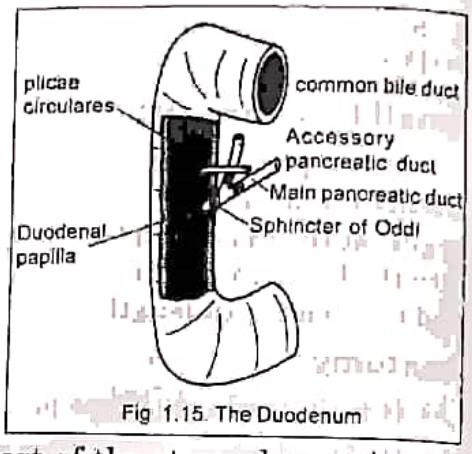


Fig 1.15. The Duodenum

The First Part being at the pylorus part of the stomach, proximal 1 inch is movable, it is attached to the lesser omentum above and to the greater omentum below, distal 1 inch is fixed, and retroperitoneal.

Second Part is about three inches long, downwards and curved. This part shows the following internal features

1. The major and minor duodenal papilla.
2. The hepato pancreatic ampulla opens.

Third Part is about 4 inches long, it passes almost horizontally infront of the inferior venacava.

Fourth Part is 1 inch long, it runs upwards and continues with the jejunum.

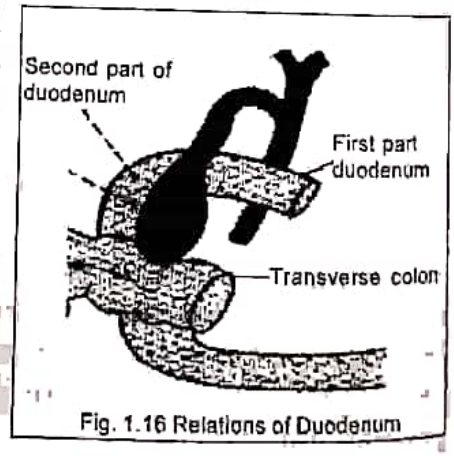


Fig. 1.16 Relations of Duodenum

Blood Supply–

Superior and Inferior pancreatico duodenal artery and branches of right gastric and right gastroepiploic artery.

Jejunum and Ileum–

These two are suspended by mese-ntery, the mesentery attached to posterior abdominal wall, so these having mobility. The jejunum consist the upper two fifth part, the ileum consist lower three fifth part of the small intestine. The jejunum begins at the duodenojejunal flexure. The ileum terminates at the ileocaecal junction.

Fig. 1.17 The Blood supply of duodenum

Blood Supply– Superior mesenteric artery and its branches.

Difference Between Jejunum and Ileum–

Jejunum	Ileum
1. The wall is thicker and more vascular.	1. The wall is thinner and less vascular.
2. Lumen is wider and often empty.	2. Narrower and often loaded.
3. Mesentery having windows.	3. Mesentery having no windows.
4. Less fat in Mesentery.	4. More fat in Mesentery.
5. Arterial arcades 1 or 2	5. Arterial arcades 3 or 6.
6. Vasa recta longer and less.	6. Vasa recta shorter and more
7. Mucosal folds more.	7. Mucosal folds less.
8. Villi are large, more and thick.	8. Villi are shorter thinner and less.
9. Payer's patches absent.	9. Payer's patches present.
10. Solitary lymphatic follicles less.	10. Solitary lymphatic follicles more.

Histology of Small Intestine-

The small intestine is made up of four layers. However both the mucosa and submucosa are modified to allow the small intestine to complete the processes of digestion and absorption.

The mucosa contains many pits lined with glandular epithelium. These pits are the intestinal glands, Secrete the intestinal digestive enzymes, called intestinal juice. Submucosa of the duodenum contains Burner's glands, which secrete alkaline mucus to protect the wall of the small intestine.

The mucosa consists of simple columnar epithelium. These epithelial cells contain microvilli, finger like projections of the plasma membrane. Larger amounts of digested nutrients diffuse into the intestinal wall.

The mucosa lies in series of villi, projections 0.5 to 1 mm height, and the enormous number of villi about 4 to 5 million, vastly increases the surface area of the epithelium. Each villus has a core of lamina propria arteriole, a venule, a capillary network, and lacteal are embedded in this lamina propria [connective tissue layer].

Nutrients are able to pass through the capillary walls, and the lacteal, and then enter the cardiovascular and lymphatic systems.

The one more set of projections called plicae circularis further increases the surface area for absorption and digestion. These are permanent deep folds in the mucosa and sub mucosa. The plicae circularis improve absorption by causing the chyme to spiral, rather than moving in a straight line.

The muscularis consists of two layers of smooth muscle, the outer layer thinner contains longitudinally

arranged fibers. The inner layer thicker contains circularly arranged fibers.

Intestinal Juice–

It is a clear yellow fluid secreted in amounts of about 2 to 3 liters a day, it has pH of 7.6 slightly alkaline, and contains water, mucus, and several enzymes.

Three carbohydrate– digesting enzymes called maltase, sucrase and lactase, protein digesting enzymes called peptidases and two nucleic acid digesting enzymes ribonuclease and deoxyribonuclease.

Digestion in the small intestine–

Mechanical–

Movements are two types–

(1) Segmentation (2) Peristalsis

1. Segmentation– It is major localized contraction in areas containing food. It mixes chyme with digestive juice and brings the particles of food into contact with the mucosa for absorption. The contraction is repeated 12 to 16 times a minute, parasympathetic impulses increase motility; and sympathetic impulses decrease intestinal motility.

2. Peristalsis– Propels the chyme onward through the intestinal tract. Chyme moves through the small intestine at a rate of about 1 cm/ min. Chyme remains in the small intestine for 3 to 5 hours. Both movements are controlled by autonomic nervous system.

Chemical–

The partially digested carbohydrate, proteins, and undigested lipids are entering in small intestine. The completion of the digestion of carbohydrates, proteins, and lipids is collective effort of pancreatic juice, bile, and intestinal juice in the small intestine.

Carbohydrates–

Three enzymes in the intestinal juice digest the disaccharides into monosaccharides. Maltase splits into molecules of glucose. Sucrase splits into molecules of glucose and fructose. Lactase digest lactose into molecule of glucose and galactose

Proteins–

Protein convert into peptides by pepsin in stomach; by Trypsin and chymo trypsin in pancreatic juice. Whole proteins convert into peptides; protein digestion is completed by the peptidases. Aminopeptidase acts an peptides.

Lipids–

Almost all lipid digestion occurs in the small intestine.

Nucleic acids–

Intestinal juice and pancreatic juice contain nucleases that digest nucleotides.

Absorption–

All the chemical and mechanical phases of digestion from the mouth down through the small intestine are directed toward changing food into forms that can pass through the epithelial cells lining the mucosa into the underlying blood and lymph vessels. These forms are monosaccharides [glucose, fructose and gelatos] amino acids, fatly acids, and glycerol glycosides. Passage of these digested nutrients from the alimentary canal into the blood or lymph is called absorption.

About 90% of all absorption of nutrients takes place throughout the length of the small intestine. The other 10 % occurs in the stomach and large intestine. Absorption of materials occurs specifically through villi

and depends on diffusion, facilitated diffusion, osmosis and active transport.

Large Intestine–

The Large Intestine is the terminal portion of alimentary canal. Its length is about 1.5 meter and diameter is about 6.5 cm.

It extends from the ileum to the anus and is attached to the posterior abdominal wall by its mesocolon. It is divided into four parts.

1. Caecum 2. Colon 3. Rectum 4. Anal canal

Caecum (उण्डुक)–

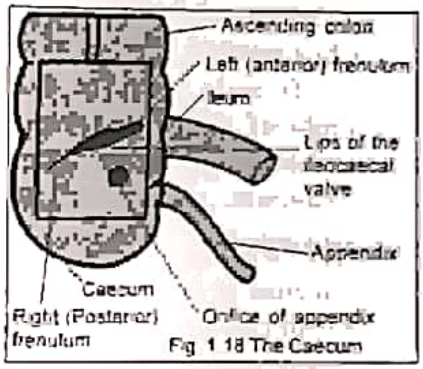


Fig 1.18 The Caecum

Acharya Sushruta said that it is the organ which separates the ahara ras into sara and kitta bhaga known as Unduka. It is consisting maladhara kala which helps for separation of mala [faecal]. The Acharya Sushruta explained the maladhara kala lies in the unduka region.

उण्डुकस्थं विभजते मलम् मलधरा कला ॥ (सु. शा.)

Caecum is a large blind sac situated in the right iliac fossa above the lateral half of inguinal ligament. It communicates with ascending colon superiorly, medially with ileum and posteromedial with the appendix.

Caecum is proximal part of the colon. Terminal part of the ileum joins with the caecum, ileum opens into the caecum and guarded by a fold of mucous membrane called the ileocaecal valve. This allows chyme

from the ileum to caecum. Acharya Vagbhata used the term as "Argal" for ileocaecal valve

It is wider than length, and it is one of those organs of the body that have greater width than the length. It is about 6 cm long and 7.5 cm breadth. It may have

1. Conical Type [13%] 2. Intermediate Type [9%]
3. Ampullary Type [78%]

Ileocaecal Valve–

The ileocaecal opening is guarded by the ileocaecal valve, the valve has two lips and two frenula. The upper lip is horizontal, the lower lip is longer and concave. The two frenula are formed by the fusion of the lips at the ends of the aperture. The valve is closed by sympathetic nerves, mechanically closed by distension of the caecum.

Blood supply–

Caecum is supplied by the ileocolic artery, veins drain into the superior mesenteric vein.

Nerve supply - Sympathetic - T_{11} - L_1 segment, Parasympathetic - Vagus

Vermiform appendix–

It is a worm like diverticulum arising from the posteromedial wall of the caecum, about 2 cm below the ileocaecal orifice. It is about 2 to 20 cm [varies] long, average - 9 cm. Longer in children, about 5 mm in diameter. It lies in the right lilac fossa, the base is fixed, the tip can point in any direction.

Peritoneal relations–

It is suspended by a small triangular fold of peritoneum, called the mesoappendix. The fold passes up-

wards behind the ileum and attached to the left layer of the mesentery.

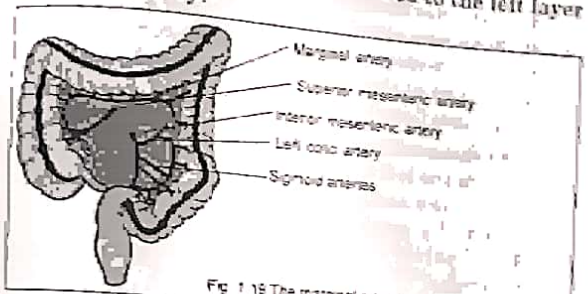


Fig. 1.16 The marginal artery

Blood supply– It is supplied by appendicular artery branch of the ileocolic artery. Appendicular vein drains in to the portal vein.

Nerve supply– Sympathetic – T9 - 10 Segments through the coeliac plexus. Parasympathetic - forms vagus nerve.

Inflammation of the appendix is known as appendicitis.

Colon–

It is continuation part of the caecum it is divided into ascending colon, transverse colon, descending colon, and sigmoid colon.

The ascending colon ascends on the right side of the abdomen, it is about 12.5 cm long and extends from the caecum reaches the under surface of the right lobe of the liver, and turns abruptly to the left, here it forms the right colic (hepatic) flexure. Usually it is retroperitoneal.

The colon continues across the abdomen to the left side as the transverse colon. It is about 50 cm long and extend across the abdomen from the right colic flexure

to the left colic flexure. It is suspended by the transverse mesocolon attached to the anterior border of pancreas, and a wide range of mobility. It curves beneath the lower end of the spleen on the left side as the left colic [splenic] flexure.

The descending colon is about 25 cm long and extends from the left colic flexure to the sigmoid colon, it runs vertically and downwards up to the iliac crest. It runs medially anterior to iliacus and psoas major to reach the pelvic brim then it is continuous with the sigmoid colon, usually it is retroperitoneal.

The sigmoid colon is about 37.5 cm long, and extends from the pelvic brim to the third piece of the sacrum, where it becomes the rectum. It forms a sinuous loop, and hangs down in the pelvis over the bladder and utorus. It is suspended by the sigmoid mesocolon and is covered by the coils of small intestine.

Histology–

The wall of the large intestine differs from that of the small intestine in several respects. No villi and no permanent circular folds are found in the mucosa; however, contain simple columnar epithelium with numerous goblet cells. These cells secrete mucus that lubricates colonic contents. Solitary lymph nodules also are found in the mucosa.

The submucosa is similar to that in the rest of the alimentary canal, and contains solitary lymphoid follicles with the Meissner's plexus of nerves.

The muscularis consists of an external layer of longitudinal muscles and an internal layer of circular muscles. The longitudinal muscles do not form a continuous sheet around the wall, but are broken up in to three flat bands called taeniae coli. Each band runs

the length of most of the large intestine. Contractions of the bands gather the colon into a series of pouches called haustra.

The serosa is part of the visceral peritoneum. Small pouches of visceral peritoneum filled with fat are attached to taeniae coli and are called epiploic appendages.

Taeniae Coli–

These are ribbon like longitudinal muscular band present in outer layer of large intestine starting from caecum to terminal part of sigmoid colon. There are three ribbon like muscular bands known as

1. Taenia libera [anterior].
2. Taenia mesocolica [posteromedial].
3. Taenia omentatis [posterio lateral].

Proximally the taeniae converge at the base of the appendix and distally they spread out on the terminal part of the sigmoid colon. The longitudinal muscles are shorter than the length of large intestine.

Digestion in the large intestine–

The overall functions of the large intestine are as follows–

1. Completion of absorption.
2. The manufacture of certain vitamins.
3. The formation and expulsion of feces.

Mechanical Digestion–

The chyme passes from the ileum into the cecum by gastroileal reflex. This reflex starts immediately following a meal. Movements of colon begin when substance enter through the ileocecal valve. One movement characteristic of the large intestine is haustral

churning, and peristalsis also occurs at a slower rate. [3 to 12 contractions per minute]. A final type of movement is mass peristalsis usually takes place three or four times a day, during a meal or immediately after.

Chemical Digestion–

Last stage of digestion occurs through bacterial, not by enzymatic action. The glands but no enzymes secrete mucus. Chyme is prepared for elimination by the action of bacteria. These bacteria ferment any remaining carbohydrates and release hydrogen, carbon dioxide and methane gas; these gases contribute to flatus in the colon.

They also convert remaining proteins to amino acids, amino acids into simpler substance indole, skatole, hydrogen sulfide and fatty acids. Some of the indole and skatole is carried off in the feces and contributes to its odor. Bacteria also decompose bilirubin to simpler pigments (urobilinogen), which give faces their brown color, several vitamins needed for normal metabolism, including some B vitamins and vitamin K, are synthesized by bacterial action and absorb

Absorption and Feces Formation–

Chyme remains in the large intestine about 3 to 10 hrs and becomes solid or semisolid as a result of absorption and is now known as feces. The absorption is greater in the caecum and ascending colon. It also absorbs electrolytes, including sodium and chloride.

Defecation–

Mass-peristaltic movement push fecal material into the rectum, the resulting distension at the rectal wall stimulates pressure-sensitive receptors, initialing a reflex for defecation, which is emptying of the rectum. The pressure along with voluntary contractions of the

diaphragm and abdominal muscles forces the sphincters open, and the feces are expelled through the anus.

Rectum (गुद)–

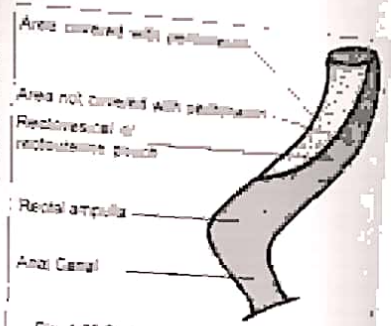


Fig. 1.22 Peritoneal relations of the rectum

It is the terminal part of the colon. The rectum ends by becoming continuous with anal canal at the anorectal junction. It does not have any colic features, it lies within true pelvis in front of lower part of sacrum and coccyx, posterior to the bladder in male; posterior to the uterus in female. It is about 12 cm length. In the upper part it has the same diameter of 4 cm as that of the sigmoid colon, but in the lower part it is dilated to form the rectal ampulla. The upper one third is covered by peritoneum in front and on the sides. Middle third is covered by peritoneum only anteriorly. Lower one third is not covered by peritoneum. It has four layers.

1. Serous layer.
2. Muscular layer– Longitudinal and Circular.
3. Submucous.
4. Mucous.

Interior of Rectum–

It consists two types of mucosal folds namely

1. Horizontal folds.   2. Longitudinal folds

The horizontal folds are known as "Houston's valves" It has four valves out of four valve first and

third are constant, but second and fourth [usually absent] are inconstant.

1. The Upper fold lies near the upper end of the rectum.
2. The middle fold, largest & most constant, lies at the upper end of the rectal ampulla.
3. The lowest fold, lies 2.5 c.m. Below the middle fold.

The longitudinal folds are present in the lower part of an empty rectum, and are obliterated by distension.

Ayurvedic Concept–

Acharya Sushruta and Charak are considered that it is the part of pakvashaya and mula sthana of the purishavaha srotas, and also known as sthulaguda. Guda is one among the dasapranayatana, it is matruja avayava. It is muscular organ, about four and half anguli in length - [14 cm].

Acharya Sushruta explained it is one of sadya pranahara and mamsa marma. Measured four anguli. It is bahira mukha srotas and one of the karmendriya. Vagbhata explained it is Damani marma,

In the internal aspect it has three ring like mucosal folds lies at the distance of one and half anguli in between them, known as valis, the first is Pravahini, second one Visarajini, and third one Samvaharani. These are situated one above colored like the palate of an elephant.

Charaka said that, guda is divided in to uttara guda where purisha is collectable, and adhar guda where the purisha is expelled out, and the last part is gudousta.

तत्र वातवर्चोनिरसनं स्थूलान्त्रप्रतिबद्धं गुद नाम मर्म तत्र सद्योमरणं ॥

गुदः स्थूलान्त्र संश्रयः । (सु.शा.६/२५)
(अ.हृ.नि.७/३)

[illegible] ।
[illegible] ।
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[illegible] ॥ (च.सि. ९/३१)
[illegible] ॥ (अ. हृ. उ. २४)

Blood Supply–

It is supplied by Superior rectal artery it is the continuation of the inferior mesenteric artery, it divides into right and left branches. Middle rectal artery they arise from the anterior division of the internal iliac artery, inferior rectal and median sacral artery small branch supplies the posterior wall of the anorectal junction. Venous drainage similar to artery.

Nerve Supply–

Sympathetic $L_{1,2}$ are vasoconstrictor, inhibitory to the rectal musculature and motor to the internal sphincter. Parasympathetic S 2, 3, 4 are motor to the musculature of the rectum and inhibitory to the internal sphincter.

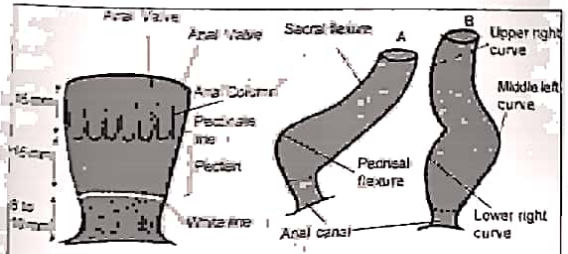

Fig. 1.21a. Interior of the anal canal Fig. 1.21b. Curvatures of the rectum

Functions of the Rectum–

It has two functional parts, The upper part acts as a faecal reservoir which can freely distend anteriorly. The lower part empty, but may contain faeces in cases of chronic constipation. Being sensitive its distension causes the desire to defecate.

Anal Canal–

The anal canal is the terminal part, lies in the perineum below the level of the pelvic diaphragm. It lies in the anal triangle of perineum in between the right & left ischiorectal fossae. Which allow its expansion during passage of the faeces.

It is about 3.8 cm long, it extends from the anorectal junction to the anus. It is surrounded by inner involuntary and outer voluntary sphincters which keep the lumen closed.

The anus is the surface opening of the anal canal, situated about 4 cm below and infront of the tip of the coccyx in the cleft between the two buttocks. The surrounding skin is pigmented and thrown into radiating folds and contains a ring of large apocrine glands.

The internal part shows many features, it divides into three parts.

The upper part 15 mm long, lined by mucous membrane, and shows 6 to 10 vertical folds, called the anal columns of Morgani, the lower ends of the anal columns are united to each other by short transverse folds called the anal valve. The anal valves together form a transverse line that runs all round the anal canal. This is the pectinate line.

The middle part is about 15 mm long, and no columns. The lower limit of the pecten is white line of Hilton. It lies in between subcutaneous part of external

anal sphincter and the lower border of internal anal sphincter. The lower part is about 8 mm long is lined by true skin containing sweat and sebaceous glands. It is supplied by superior rectal artery above the pectinate line, inferior rectal artery below the pectinate line.

Anal Sphincters–

The internal anal sphincters are involuntary, formed by the thickened circular muscle coat. It surrounds the upper three fourth [Upper and middle part]. The external anal sphincter is voluntary control, made up of a striated muscle and supplied by the inferior rectal nerve and perineal branch of the 4th sacral nerve. It surrounds the whole length at the anal canal and has three parts, subcutaneous, superficial and deep.

Anorectal Ring– It is a muscular ring lies at the anorectal junction. It is formed by the fusion of the puborectalis, deep external and internal sphincter.

Respiratory System–

The respiratory system includes a number of organs that are helps for the exchange of gases between the atmosphere and blood. These organs are nose, pharynx, larynx, trachea, bronchi and lungs.

The respiratory system is divides into two parts,

1. The upper respiratory tract.
2. The lower respiratory tract.

The upper respiratory tract includes the nose, throat and associated structures, while the lower respiratory tract includes the larynx, bronchi and lungs. Breathing is the inflow and outflow of air between the atmosphere and the lungs

Larynx–

It is the air passage and also helps for producing

the voice. It extends from the epiglottis above to the lower border of cricoid cartilage below, and further it is continued as trachea.

The larynx is cartilaginous structure, supported with muscles, membranous and ligaments. There are 9 cartilages, three are paired and three are unpaired cartilages.

Paired cartilages	Un paired cartilages
Arytenoid cartilage	Thyroid cartilage
Corniculate cartilage	Cricoid cartilage
Cuneiform cartilage	Epiglottis

Boundaries–

Above and front bounded by the epiglottis, on either side bounded by the aryepiglottic fold, back and below formed by the inter arytenoids fold.

The laryngeal cavity communicates with laryngopharynx above, and below continues as trachea.

The larynx is divides in to three parts–

1. Vestibular part - above the vestibular folds
2. Sinus of the larynx - the space between the vestibular and vocal folds
3. Infra - glottis part - below the vocal folds

Internal Features–

The internally there are two pairs of mucous folds, lies anteroposteriorly the above mucous fold are named vestibular folds and lower are vocal folds. There is space in between the vestibular folds is known as "rimavestibuli". The similar space lies in between the vocal folds is known as "rimaglottdis". The movements are abduction, adduction, elongation and relaxation takes in the mucous folds.

Nerve supply–

Internal laryngeal nerve branch of vagus nerve and recurrent laryngeal nerve

Trachea–

The trachea is wide tube for passage of air; it is also known as wind pipe it transmits the air between the nasopharynx and lungs. It lies in the midline of the lower part of the neck and superior mediastinum. It is continuous from the larynx above, at the lower border of cricoid cartilage and downwards ends by dividing into the right and left principal bronchi at the level of 4th thoracic vertebra.

It is about 10 to 15 cm length and external diameter about 2 cm in males and about 1.5 cm in females. The lumen is about 12 mm.

Structure–

It is fibro cartilaginous skeleton formed by the C shaped fibro cartilage rings, these are about 16 to 20 in numbers. The lumen is lined by ciliated columnar epithelium and contains many mucous and serous glands. The posterior part is some what membranous part it helps for free actions.

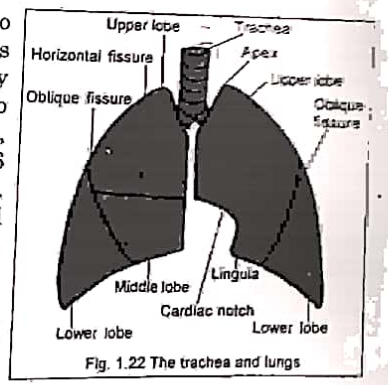

Fig. 1.22 The trachea and lungs

Blood supply– Inferior thyroid arteries, and left brachiocephalic vein.

Nerve supply–

Parasympathetic through the vagus and recurrent laryngeal nerves Sympathetic fibers are from the middle cervical ganglion.

Lungs–

The lungs are pair of respiratory organs placed in the thoracic cavity. On both side of the mediastinum, and covered by pleura membrane. The space between the two pleural cavities is known as mediastinum. The lungs are conical in shape, and weight about right lung is 700 gm and left lung is 600 gm.

External features–

1. Apex; 2. Base
3. Three borders– Anterior, Posterior and Inferior
4. Two surfaces– Costal and Medial; again the medial surface divides into Vertebral and Mediastinal surfaces.

Apex–

It is upper conical part and blunt lies above the clavicle about 2.5 cm at the medial on third of the clavicle. It is covered by pleura membrane is known as cervical pleura.

Base–

It is concave in nature and semi lunar shape, it rests on the diaphragm. It is also covered by the diaphragmatic pleura.

The anterior border is thin and shorter than the posterior border; the anterior border of the left lung shows a wide cardiac notch at the lower region next to that there is tongue like projection of the anterior border is named as lingual at the level of the 4th costal cartilage.

The posterior border is thick and ill defined. The inferior border is sharp and separates the base from the costal and medial surfaces.

The costal surface is convex and related with costal cartilage and ribs, covered by costal pleura.

The medial surface is slightly concave and divides in to two areas, the mediastinal surface related with mediastinum anteriorly and vertebral surface related with vertebrae posteriorly. It is covered by pleura.

Lobes of the lung–

The right lung has three lobes and two fissures, the lobes are upper, middle and lower, the fissures are oblique and horizontal.

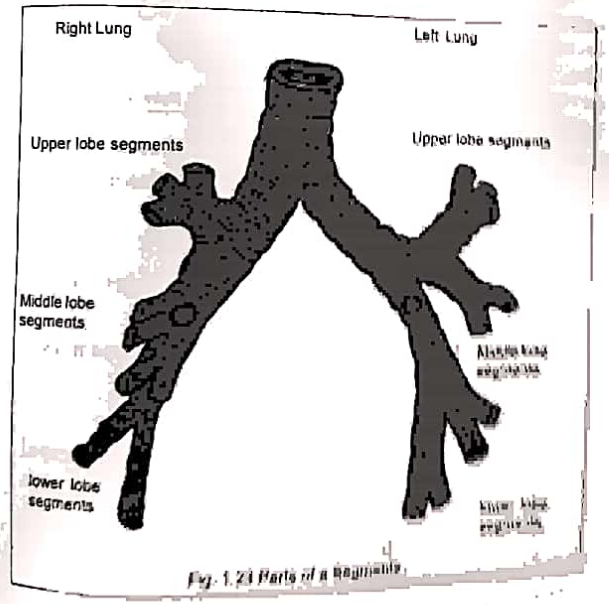

Fig. 1.24 Parts of a segment.

The left lung has two lobes and one fissure, the lobes are superior and inferior, the fissure is oblique.

Root of the lung-

The root of the lung is short and broad, which connects the medial surface of the lung to the mediastinum. The following structures are present in the root of the lungs, some are enter and some are come out through the hilum of the lung. All the structures are covered by the pulmonary ligament

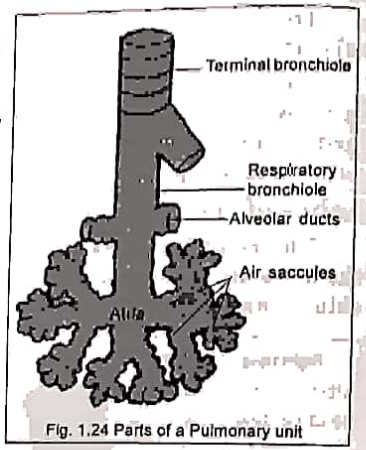

Fig. 1.24 Parts of a Pulmonary unit

1. Principal bronchus
2. Pulmonary artery
3. Two pulmonary veins
4. Bronchial arteries and veins
5. Lymph nodes and lymphatics
6. Areolar tissue

Blood supply– Bronchial arteries and drained by bronchial veins

Nerve supply– Parasympathetic- by vagus nerve. Sympathetic - by 2nd to 5th spinal segments

Bronchial Tree–

The trachea divides into two primary principal bronchi at the level of 4th thoracic vertebra one for each lung.

The right principal bronchus is shorter, wider and about 2.5 cm long, the left principal bronchus is longer

and narrower about 5 cm long. Each principal bronchus enters the lung through the hilum and divides into secondary lobar branches one for each lobe of the lung. Each lobar division further divides into tertiary or segmental bronchi, one for each bronchopulmonary segment.

The segmental bronchi further divides repeatedly to form small branches called terminal bronchioles, still smaller branches are called respiratory bronchioles. Each respiratory bronchiole ends is microscopic passaccules and Alveoli which are identified as Alveolar ducts, Atria, Air

Difference between the right and left lungs–

Right Lung	Left Lung
1. It has three lobes and two fissures	1. It has two lobes and one fissure
2. Anterior border is straight	2. Anterior border has cardiac notch near at its lower region
3. Longer and heavier	3. Smaller and lighter
4. Weights about 700 gm	4. Weights about 600 gm

Chapter-2

UROGENITAL SYSTEM
(मूत्रवह संस्थान/प्रजनन संस्थान)

Female external Genital organs–

- Mons pubis
- Vestibule of vagina having various opening
- Labia majora
- Labia minora
- Clitoris
- Bulbs of the vestibule
- Greater vestibular glands

Mons Pubis–

It is a rounded eminence present in front of the pubic symphysis, it is formed by subcutaneous fat and covered with pubic hair.

Labia Majora–

Two thick folds of skin, form the lateral boundaries of the pudendal cleft. The outer surfaces are covered with hair. The large sebaceous glands are lies in the inner surfaces.

Labia minora–

Thin folds of skin which lie within the pudendal cleft, contains numerous sebaceous glands.

Clitoris–

It is an erectile organ homologous with the penis, lies in the anterior part of pudendal cleft. The body of the clitoris is made up of two corpora cavernoses. A corpus spongiosum is absent.

Vestibule of the Vagina–

This is the space between two labia minora, having the following features.

1. Urethral orifice– lies about 2.5 cm behind the clitoris.
2. Vaginal orifice– lies in the posterior part of the vestibule.
3. Orifices of the ducts of the greater vestibular glands lie one on each side of the vaginal orifice.
4. Numerous lesser vestibular glands open on the surface of the vestibule.

Bulb of the Vestibule–

Two oval bodies of erectile tissue. The bulbs lie on either side of the vaginal and urethral orifices.

Greater Vestibular Glands–

These homologous with the bulbo urethral glands in the male.

Female reproductive organs–

1. Primary Sex Organs – Two ovaries (gonads)
2. Secondary Sex Organs – Two uterine tubes, Uterus, vagina, and mammary glands or breasts.

Ovary (स्त्री बीज ग्रन्थि)–

These are two female gonads lies in the ovarian fossa on lateral pelvic wall just below and behind the lateral part of uterine tube. In young girls, the ovaries are greyish pink, after puberty it is pink to grey.

External Features–

It has two borders and two surfaces. It is about 3 cm vertical, 2 cm transverse, and anteroposterior is 1.5 cm. It has upper and lower poles.

1. Upper or Tubal Pole– It is broader and related with the uterine tube.

2. Lower or Uterine Poles– Narrower, connected by the ligament of ovary, to the lateral angle of uterus.

Peritoneal Relation–

It is almost covered with peritoneum, connected to the posterior layer of broad ligament by short fold of peritoneum called the mesovarium.

Internal features–

1. Germinal epithelium of cubical cells.
2. Tunicae albuginea is a thin layer of connective tissue.
3. Cortex– contains ovarian follicles, each follicle contains one oocyte, the hormone estrogen is secreted by the cells.
4. Medulla– It is highly vascular connective tissue containing vessels, nerves, and lymphatics.

Blood Supply–

It supplies by the ovarian artery branch of the abdominal aorta, and some branches from the uterine artery.

Uterine Tubes (बीज वाहिनि)–

These are long tubes which convey oocyte from the ovary to the uterus. It is about 10 cm long. At the lateral end the uterine tube opens into the peritoneal cavity. Lateral end of the uterine tube is shaped like a funnel called the

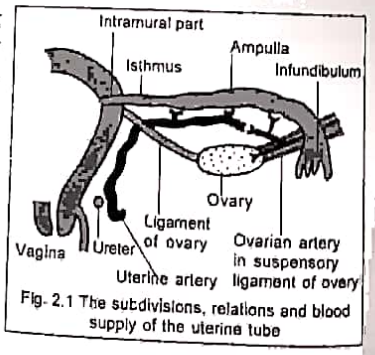

Fig. 2.1 The subdivisions, relations and blood supply of the uterine tube

infundibulum. It bears a number of finger like processes called fimbriae, one of the fimbriae is longer known as the ovarian fimbria.

The medial to the infundibulum slight dilated part is the ampulla. It is thin walled arches over the upper pole of the ovary. It is about 4 mm in diameter. The isthmus succeeds the ampulla, it is narrow, rounded and cord like. The uterine part about 1 cm long lies with in the wall of the uterus.

It has three layers–

1. Outer serous coat.
2. Middle muscular coat.
3. Inner mucous membrane which is lined by the ciliated columnar epithelium.

Blood Supply– Uterine and ovarian arteries.

Uterus (गर्भाशय)–

गर्भाशयोऽष्टम स्त्रीणां पित्तपक्वशयांतरे ॥ (वा.शा. ३)

It is one of the eighth Ashaya present in the females, The genital tract is like the inner portion of a conchshell and has three circular folds, the uterus lies in the third fold. The shape and appearance of the uterus is similar to that of the mouth of rohit fish. The cervix part appears like fish mouth.

शङ्खनाभ्याकृतिर्योनिर्मध्यावर्ता सा प्रकीर्तिता।
तस्यास्तृतीये त्वावर्ते गर्भशय्या प्रतिष्ठिता ॥
यथा रोहितमत्स्यस्य मुखं भवति रूपतः।
तत्संस्थानां तथारूपां गर्भाशय्यां विदुर्बुधाः ॥ (सु. शा. ५)

It is the organ which protects and provides nutrition to a fertilized ovum. It is a hollow, pear shaped organ with thick muscular walls. It is located in the lesser pelvis between the urinary bladder in front

infundibulum. It bears a number of finger like processes called fimbriae, one of the fimbriae is longer known as the ovarian fimbria.

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It is the organ which protects and provides nutrition to a fertilized ovum. It is a hollow, pear shaped organ with thick muscular walls. It is located in the lesser pelvis between the urinary bladder in front

and rectum behind. The forwarded bending of the uterus relative to the vagina is called anteversion, and is also slightly bent forwards on it self, referred as anteflexion, is about 120 degrees. The uterus communicates on each side with the uterine tube, and inferiorly with the vagina.

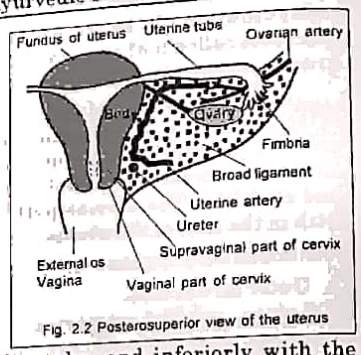

Fig. 2.2 Posterosuperior view of the uterus

Shape– Pear shaped or flattened from before backwards in the nulliparous.

Size– 7.5 cms length, 5 cms breadth, 2.5 cms thick, 30 to 40 grams weight.

It has three parts– 1. Fundus 2. Body 3. Cervix.

Fundus–

The fundus is upper doom shaped and convex, lies above the entrance of the uterine tubes. It is covered by peritoneum. The fertilized oocyte is usually implanted in the posterior wall of the fundus.

Body–

The body lies below the entrance of the uterine tubes. It narrows below, where it becomes continuous with the cervix. The cervix pierces the anterior wall of the vagina and is divided into the supra vaginal and vaginal parts of the cervix.

The cavity of uterine body is triangular in coronal section, the cavity of the cervix, the cervical canal, is

spindle shaped and communicates with the cavity of the body through the internal os, and with that of the vagina, through the external os.

In nullipara the external os is circular, in a parous women the external os is opened out transversely, so that it possesses an anterior lip and a posterior lip.

Histology–

It is made up of three layers–

1. Endometrium 2. Myometrium 3. Perimetrium.

1. Endometrium– It is inner most layer consisting three layers of cells 1. Columnar epithelium, 2. Loose connective tissue, 3. Dense connective tissue. The mucous membrane lining the body of the uterus is known as the endometrium, it is continuous above with the mucous membrane lining the uterine tubes, and below with the mucous membrane lining the cervix, from puberty to menopause, the endometrium undergoes extensive changes during the menstrual cycle, the changes in the endometrium is response to the ovarian hormone.

2. Myometrium– It is middle thick layer consists of three layers of smooth muscles fibers extend in all directions, and supported by connective tissue.

3. Perimetrium– It is outer most layer, consisting fibrous tissue.

The peritoneum is covered except anteriorly, below the level of the internal os where the peritoneum is reflected on to the bladder.

Cervix (गर्भाशय ग्रीवा)–

It is lower cylindrical part of the uterus. It is less mobile than the body. It is about 2.5 cm. Long slightly wider in the middle than at either end. The lower part

projects into the anterior wall of the vagina which divides it into supra vaginal and vaginal parts. The vaginal part projects into the anterior wall of the vagina. The spaces between it and vaginal wall are called the vaginal fornices. The cervical canal opens into the vagina by an opening called the external os.

Uterine Ligaments (गर्भाशय बन्धिनि)–

There are two types of uterine ligaments which are attached to the uterus.

(a) Peritoneal ligaments–

These are peritoneal folds which do not provide any support to the uterus.

1. Anterior ligament consists of the uterovesical fold of peritoneum.
2. Posterior ligament consists of the recto vaginal fold of peritoneum.
3. Right and left broad ligaments are folds of peritoneum which attach the uterus to the lateral pelvic wall. Some names given to sub divisions of the broad ligaments, like the ligament that stretches from the upper pole of the ovary to the lateral pelvic wall is called the suspensory ligament of the ovary.

The ovary is attached to the posterior layers of the ligament through the mesovarium. The ligament of the ovary passes from lower pole of the ovary to the lateral angle of the uterus.

The part of the broad ligament lying between the uterine tube and the ovarian ligament is called the mesosalpinx, while the part below the ligament of ovary is called the mesometrium.

Broad Ligament–

It is a fold of the peritoneum attaching uterus to

lateral wall of the pelvis, it extends to lateral wall of the pelvis, anterior and posterior layers covers the structures of the lateral wall of pelvis medially it covers fundus and body of uterus, it has different parts like mesosalpinx, mesometrium, suspensory ligament of ovary mesovarium.

(a) Contents of Broad Ligaments–

1. Uterine tubes
2. Round ligament of the uterus
3. Lymphatics and lymph nodes.
4. Uterine and ovarian vessels
5. Uterovaginal and ovarian nerve plexuses.
6. The ligament of the ovary.

(b) Fibro Muscular Ligaments–

1. Round Ligaments of the Uterus.
2. Transverse Cervical Ligaments.
3. Uterosacral Ligaments.

1. The Round Ligaments–

The round ligaments are the fibromuscular flat bands, 10 to 12 cm long, which lies in between the two layers of the broad ligaments. It is attached at the lateral angle of the uterus and runs forwards and laterally, passes in the deep inguinal ring, and merges with the areolar tissue of the labium majus.

2. Transverse Cervical Ligaments–

These are fan shaped condensations of the pelvic fascia on each side of the cervix. They connect the lateral aspects of the cervix and of the upper vaginal wall to the lateral pelvic wall.

3. Uterosacral ligaments–

These are connect the cervix to the periosteum of

[illegible] and enclosed within the recto uterine folds of peritoneum.

Blood Supply

1. Two uterine arteries - by of anterior division of internal iliac arteries.
2. Partly by the ovarian arteries.

Nerve Supply

Sympathetic and Parasympathetic through the inferior hypogastric and ovarian plexuses. Sympathetic nerves [T12 - L 1] produce uterine contraction and vasoconstriction. Parasympathetic nerves $S_{2,3,4}$ produce uterine inhibition and vasodilatation.

The Vagina-

It is a fibromuscular canal, forming the female copulatory organ. It extends from the vulva to the uterus and is situated behind the bladder and the urethra, and infront of the rectum and anal canal.

The anterior wall is about 3 inch long, and the posterior wall about 4 inch long. The diameter gradually increases from below upwards. The lumen is circular at the upper end, and is H shaped in the lower part.

The interior of the upper end of the vagina is in the form of a circular groove that surrounds the protruding cervix. The groove becomes progressively deeper. The anterior fornix lies in front of the cervix. The posterior fornix lies behind the cervix, the lateral fornices lie one on each side of the cervix.

Blood Supply-

Highly vascular - Vaginal artery branch of the internal iliac artery.

Cervico vaginal artery - branch of uterine artery, middle rectal and internal pudendal arteries.

Nerve supply–

Lower one third by pudendal nerve, upper one third sympathetic - $L_{1,2}$ Parasympathetic - $S_{2,3}$

Male Reproductive Organs–

It include the external and internal genitalia, external genitalia are the penis, and the scrotum. The internal genitalia are the epididymis, the ductus deference, the seminal vesicles, the ejaculatory duct, prostate and urethra.

Glands	Ducts	Supporting structures
1. A pair of testis	1. A pair of epididymis	1. Scrotum
2. Seminal vesicles	2. A pair of vasa deferens	2. The penis
3. Prostate	3. Ejaculatory ducts	3. Spermatic cord
4. Bulbo urethral glands	4. Urethra	

Testis (वीज ग्रन्थि)–

It is one of the male reproductive gland suspended by the spermatic cord in cutaneous bag called scrotum. Scrotum is formed by skin, fascia, and dartos muscle.

External Features–

1. Two poles – upper and lower.
2. Two borders – anterior and posterior.
3. Two surfaces – medial and lateral.

It is oval shaped 4 cm Length, 2.5 cm broad, 3 cm anteroposterior, obliquely placed, the upper and lower

poles are convex and smooth. It has medial and lateral surfaces which are separated by anterior and posterior borders, anterior border is rounded and convex. The posterior border is strait can be identified, because the epididymis is attached to it.

Coverings of the Testis–

Testis is covered by three layers and these are :

1. Tunica Vaginitis 2. Tunica Albuginea

3. Tunica Vesiculas.

1. Tunica Vaginalis– Testis and epididymis lies in a closed sac which is called the tunica vaginalis. The wall of the sac is formed by thin membrane. It has a visceral and a parietal layers. It covers the whole testis except for its posterior border.

2. Tunica Albuginea– It is a dense, white fibrous layer covering the testis. It is covered by the visceral layer of the tunica vaginalis except posteriorly where the vessel and nerves enter the gland. The posterior border of the tunica albuginea is thickened to form an incomplete vertical septum, called the mediastinum testis.

3. Tunica Vesiculas– It is innermost and vascular layer, lining its lobules, nearly about 200 to 300 lobules.

Structure of the Testis–

The glandular part consists 200 to 300 lobule. Each lobule contains 2 to 3 seminiferous tubules. Each tubule is highly coiled and measures about 2 feet in length, about 0.2 mm in diameter. The tubules are lined by cell which represent stages in the formation of spermatozoa.

The seminiferous tubules join together to form 20 to 30 straight tubules, tubules anastomose with each

other in the mediastinum to form a net work of tubules called rete testis. The rete testis gives rise to 12 to 20 efferent ductules which are enter the epididymis, near the upper pole.

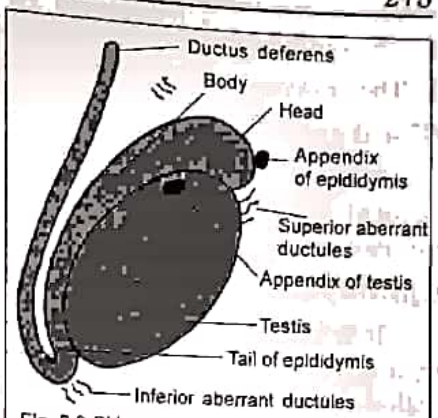

Fig. 2.3 Side view of the testis and epididymis

Blood Supply–

Supplied by testicular artery branch of the abdominal aorta, and drained through the testicular vein, nerves are sympathetic derived from 10th and 11th thoracic segment.

Scrotum (वृषण कोष)–

It is cutaneous bag, containing the right and left testis, the epididymis, and the lower part of the spermatic cord. Externally the scrotum is divided into right and left parts by a ridge or raphe, the dartos muscle is prolonged into a median vertical septum between the two halves of the scrotum.

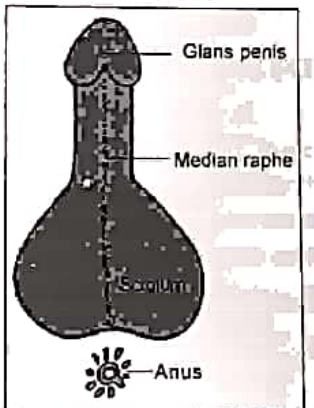

Fig. 2.4 Scrotum and penis show the median raphe

Layers– It is made up of the following layers.

1. Skin.
2. Dartos muscle which replaces the superficial fascia.
3. External spermatic fascia.

4. The cremasteric fascia.
5. The internal spermatic fascia.

Blood supply–

Superficial and Deep external pudendal artery. Scrotal brs of internal pudendal, cremasteric br of inferior epigastric.

Epididymis–

It is highly coiled part of the seminiferous tubules that act as reservoirs of spermatozoa. Its upper end is called the head, the head is enlarged and is connected to the upper pole of the testis by efferent ductules. The middle part is the body, The lower part is the tail. The head is made up of highly coiled efferent ductules, the body and tail are made up of a single duct, the tail becomes continuous with the ductus deferens.

Blood supply– Testicular artery.

Ductus Deferens–

It is also called the vas deferens or the deferent duct. The duct is thick walled muscular tube which transmits spermatozoa. It feels cord like and has a narrow lumen except at the terminal dilated part called the ampulla, about 18 inches long when straightened.

Location–

1. With in the scrotum along the posterior border of the testis
2. In inguinal canal as part of spermatic cord
3. In the greater and lesser pelvis

Seminal Vesicles and Ejaculatory Ducts–

Seminal Vesicles are two lobulated sacs. It is placed between the posterior surface of the bladder and the rectum. Each vesicle is about 5 cm long and some what

pyramidal in form. It consists of a single tube coiled upon it self. The tube has a diameter of 3-4 mm and its length when uncoiled varies from 10 to 15 cms.

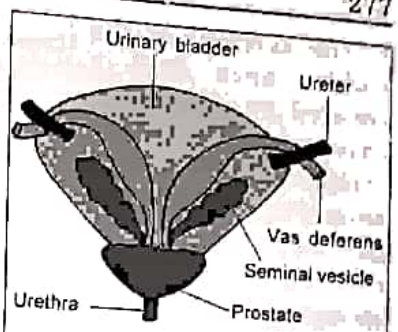

Fig. 2.5 Posterior view of the male urinary bladder, ureter vas deferens and the seminal vesicle

Ejaculatory ducts lies, one on each side of the median plane, are formed by the union of the duct of a seminal vesicle with the terminal part of a deferent duct, and are nearly 2 cm long. They commence at the base of the prostate, run anteroinferiorly between the median and right or left lobes, end on the colliculus seminalis in slit like orifice on or just within the margin of the openings of urethra.

Penis–

It is the male reproductive organ of copulation, it has two parts,

1. Root [attached part]
2. Body [free part)

1. Root–

It is situated in the superficial perineal pouch, and is composed of three masses of erectile tissues, two crura and one bulb. The crura is firmly attached

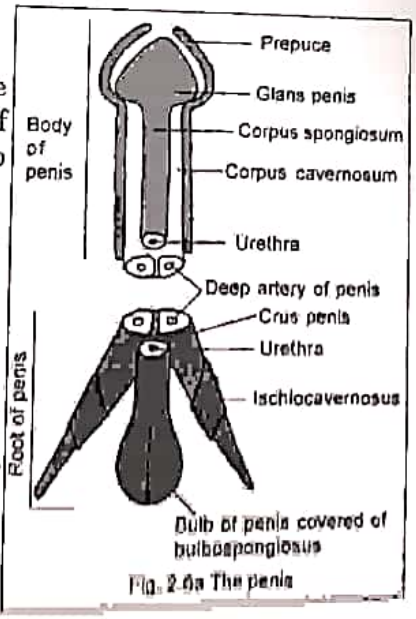

Fig. 2.6a The penis

to the margins of the public arch and is covered by the ischio-cavernosus. The bulb is attached to the perineal membrane in between the two crura. It is covered by the bulbo spongiosus. Its deep surface is pierced by the urethra.

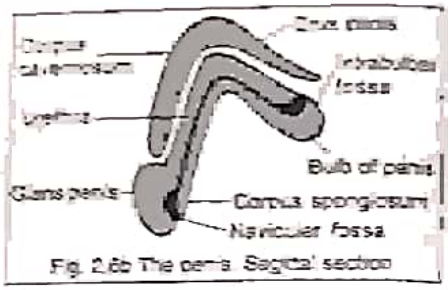

Fig. 2.6b The penis Sagittal section

2. Body–

It is free portion completely covered by the skin. It is continuous with the root in front of the lower part of pubic symphysis, it is composed of three elongated masses of erectile tissue. Three masses are the right and left corporacavernosa, and a median is corpus spongiosum.

The two corpora cavernosa are continuation of the crura, corpora cavernosa do not reach the end of the penis. They are covered by a strong fibrous envelope called the tunica albuginea. The corpus spongiosum is the continuation of the bulb of the penis, its terminal part is expanded to form a conical enlargement called the glans penis. Throughout its whole length it is traversed by a urethra.

The skin covering the penis is very thin and dark color, it is loosely connected with the fascial sheath of the organ, at the neck it is folded to form the prepuce which covers the glans to a varying extent.

Blood Supply– Internal pudendal artery gives off three branches.

1. Deep artery of the penis
2. The artery of the bulb of the penis
3. Dorsal artery of the penis

4. Superficial external pudendal artery - branch of femoral artery.

Bladder (बस्ति/मूत्राशय)–

It is one among the seven Ashaya, situated within the pelvis when it is empty, it extends into the abdominal cavity when it is full, it is also considered as Sadya pranahara and snayu marma, and one among the त्रिविध मर्म according to Acharya Charaka. It is hollow muscular organ which acts as a reservoir of urine, capacity about 120 to 320 cc,

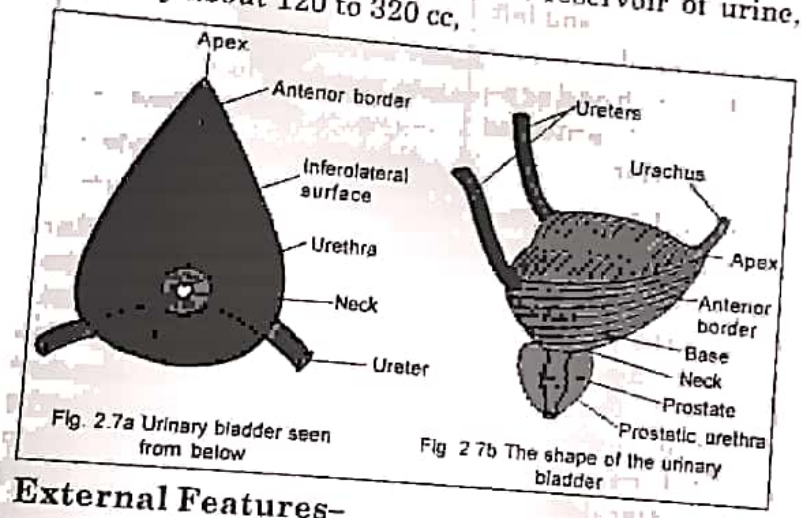

Fig. 2.7a Urinary bladder seen from below

Fig 2.7b The shape of the urinary bladder

External Features–

An empty bladder is tetrahedral in shape.

Apex–

Directed downwards, and is connected to the umbilicus by the median umbilical ligament, which represents the obliterated embryonic urachus.

Base–

Directed backwards, related to the uterine cervix and to the vagina in female, in male base is separated

from the rectum by the rectovesical pouch and coils of the intestine.

Neck–

lowest and most fixed part rests on the base of the prostate in male and related to the pelvic fascia in females.

Three surfaces– superior, right and left inferiolateral.

Four borders– two lateral, anterior and posterior.

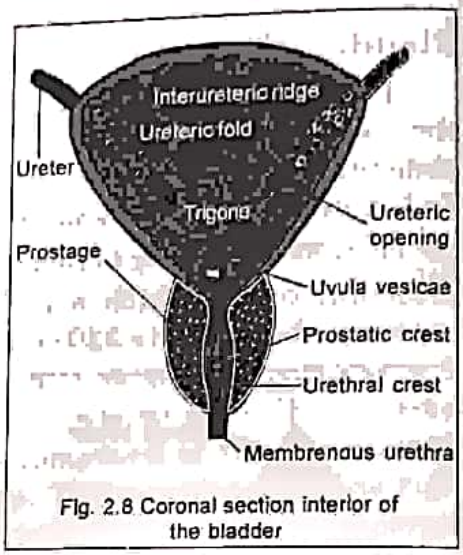

Fig. 2.8 Coronal section interior of the bladder

Internal features–

The interior part of the mucosa shows irregular folds, small triangular area over the lower part of the base of the bladder, the mucosa is smooth due to its firm attachment to the muscular coat. This area is the trigone of the bladder. The apex of the trigone is directed downwards and forwards. The internal urethral orifice is located here. The ureters open at the posterolateral angles of the trigone.

Ligaments– There are two types of ligaments.

1. True Ligaments–

The lateral true ligament - extends from the side of the bladder to the tendinous arch of the pelvic fascia.

(a) The lateral and medial puboprostatic ligaments.

(b) The median umbilical ligament.

(c) The posterior ligament of the bladder.

2. False or Peritoneal Ligaments–

These are peritoneal folds, which do not form any support to the bladder.

(a) The median umbilical fold.

(b) The medial umbilical fold.

(c) The lateral false ligament.

(d) The posterior false ligament.

Blood Supply–

Superior and inferior vesical arteries in additional from obturator, inferior gluteal, uterine and vaginal arteries in female.

Prostate Gland (पौरुष ग्रन्थि)–

It is an accessory gland of the male reproductive system. The secretions of this gland add bulk to the seminal fluid. The prostate is firm in consistency. In the female the prostate is represented by the paraurethral glands.

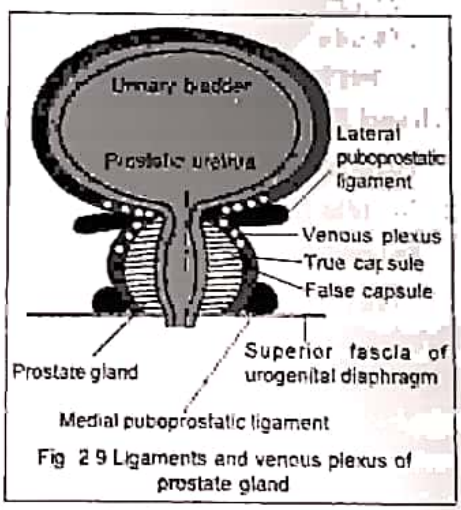

Fig 2.9 Ligaments and venous plexus of prostate gland

Location–

Lies in the lesser pelvis, below the neck of the urinary bladder, in front of the rectum, behind the lower part of public symphysis.

Size–

Transversely [width] 4 cm, at the base, vertical [length] 3 cm Anteroposterior - [thick] 2 cm.

Features– Apex directed downwards, Base directed upwards.

Surfaces– Anterior, posterior, and two inferiolateral

Lobes [five lobes]–

1. Anterior lobe
2. Posterior lobe
3. Median lobe
4. Right lateral lobe
5. Left lateral lobe

Structural Zone– There are two well defined concentric zones.

1. Outer larger zone is composed of large branched glands. This zone is frequently the site of carcinoma,
2. Inner smaller zone is composed of submucosal glands. This zone is typically prove to benign hypertrophy.

Blood Supply Branches from–

1. Inferior Vesical artery.
2. Middle Rectal arteries
3. Internal Pudendal artery.

Nerve supply– Both Sympathetic and Para Sympathetic.

Kidney (वृक्क)–

The kidneys are excretory organs situated, on either side of vertebral column lies on the posterior abdominal wall. These are retro peritoneal organs; the peritoneum is covers to the anterior surface of the kidney.

The kidneys are belongs to the Mutravaha Srotas and the moola of Medovaha Srotas, and one of the kostangas.

मेदोवहे द्वे तयोर्मूलम् कटि वृक्कौ च, तत्र विदग्धस्य मेदसोगमनं स्निग्धारुक्ता तालुशोषः स्थूलशोफता पिपासा च ॥ (सु शा ९)

Location–

Lies in the epigastric, hypochondriac, lumbar, and umbilical regions that extend from the 12th thoracic vertebra to 3rd lumbar vertebras.

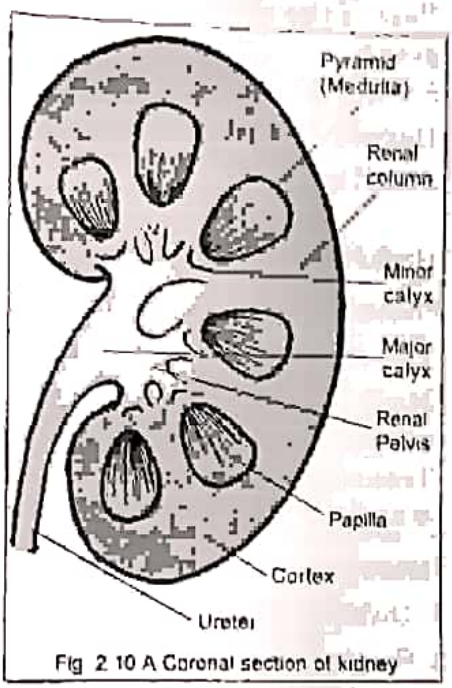

Fig 2.10 A Coronal section of kidney

Size– long - 11 cm; broad - 6 cm; thick - 3 cm; average 150 gms weight.

External features–

Shape– Been shape,

Poles– Upper and lower poles, the upper pole broad and covered by supra renal gland, lower pole is pointed.

Two borders– Medial and lateral, medial border is concave and the middle part is more concave known as hilum, the renal vein, renal artery, and renal pelvis are lies in the hilum anteroposteriorly. The lateral border is convex.

Two surfaces– Anterior and posterior, the anterior surface is irregular and related with viscera, The posterior surface is flat and related with the posterior abdominal wall muscles.

मेदोवहे द्वे, तयोर्मूलम् कटि: वृक्कौ च, [illegible]
[illegible] सु. शा. ९

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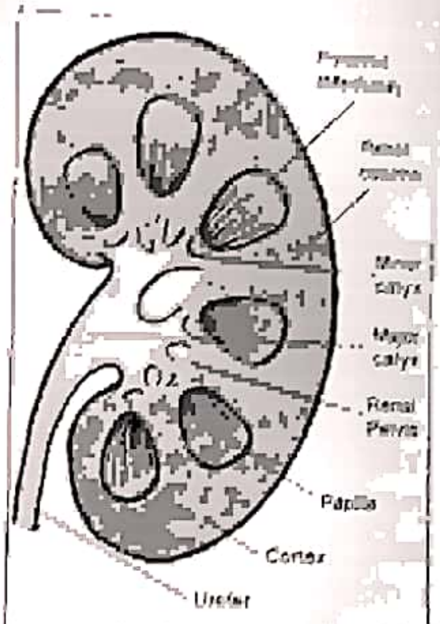
Size- long - 11 cm; broad - 6 cm; thick - 3 cm; average 150 gms weight.



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Two surfaces- Anterior and posterior, the anterior surface is irregular and related with viscera. The posterior surface is flat and related with the posterior abdominal wall muscles.

Relations–

Right kidney anteriorly	Left kidney anteriorly
Part of the suprarenal gland	Part of the supra renal gland
Second part of duodenum	Spleen & Stomach
Hepatic flexure	Pancreas
Small intestine	Splenic vessels & splenic flexure
Right lobe of the liver	Jejunum

Posterior relations - common to the both kidneys–

The diaphragm	Psoas major muscle
Medial and lateral arcuate ligaments	Quadratus lumborum muscle
Transverses abdominis muscle	Sub costal vessels and nerves

Internal features - Gross structures–

1. Outer cortex 2. Inner medulla
3. Space and renal sinus

The medulla consisting about 10 conical masses called the pyramids; their apices form renal papillae, which indent the minor calices.

Renal sinus is space consisting branches of renal arteries, renal veins and renal pelvis. The renal pelvis divides into 2 to 3 major calices, further divisions in to 7 to 13 minor calices. Each minor calyx ends in a expansion and indented by renal papillae.

Microscopic structure–

1. Secretary part–

1. Nephron, 2. Bowman's capsule,

Renal tubule consisting proximal convoluted

tubule, loop of Henle (descending and ascending limbs), Distal convoluted tubule

2. Collecting tubule–

Starts from the distal convoluted tubule, many tubules joins together to form the duct, that open into the minor calices through renal papillae.

Blood supply–

Right and left renal arteries branches of the abdominal aorta.

Scheme of arterial supply–

Renal artery - The artery divides into anterior and posterior divisions, further divides into 5 Segmental arteries, then further end arteries, that supply to the each segment of the kidney.

Vein– Renal veins drains into the inferior vena cava

Nerve supply– Renal plexus

Ureters (गविनी)–

These are a pair of narrow, thick walled muscular tubes; these connect the kidney to bladder. Each ureters has 25 cm long and 3 mm in diameter. The upper half lies in the abdomen, and lower half in the pelvis.

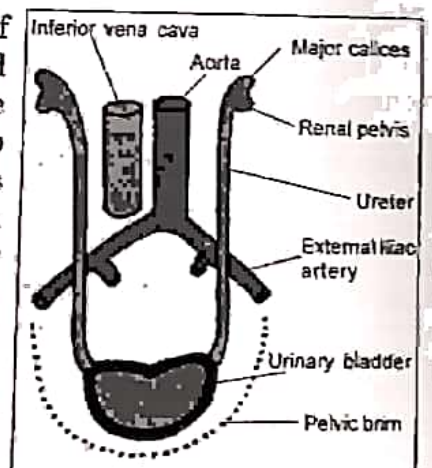


Fig. 2.11 The ureters and bladder

The ureters start with in the renal sinus as renal pelvis, descends

along medial margin, then downwards, it becomes gradually narrow till at the lower pole of the kidney, then it becomes proper ureter.

The ureter passes downwards medially, to the psoas major muscle and enters the pelvis by crossing in front of the common iliac artery, then downwards, reach the base of the urinary bladder and opens into it at the lateral angle of the trigone.

The ureters are slightly constricted at the three regions.

1. Pelvi ureteric junction
2. Brim of lower pelvis
3. At its passage through the bladder wall

Blood supply–

1. Upper part is by branch of the renal artery
2. Middle part is by branch of aorta
3. Pelvic part is by branch of vesicle and middle rectal arteries

Nerve supply–

Sympathetic from T 10 to L 1

Para sympathetic - from S 2 to S 4

Male Urethra (पुरुष मूत्र प्रसेक)–

It is membranous canal, conveys the urine from the bladder. Its length is about 18 to 20 cm. It extends from the internal urethral orifice at the neck of bladder to external urethral orifice at the tip of the penis. The prostatic part passes through the prostate and about 3 cm long, the membranous part is covered by the sphincter urethra and is about 2 cm long.

The penile part passes through the bulb and carpus spongiosum of the penis and about 15 cm long. The

internal sphincter urethra is involuntary and supplied by sympathetic nerves that controls the neck of bladder and prostatic urethra.

The external sphincter urethra is voluntary innervated by perineal branch of pudendal nerve, it controls the membranous urethra.

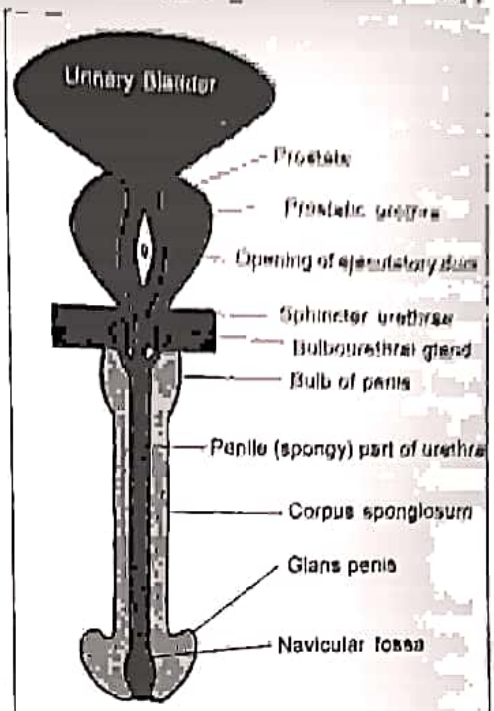


Fig. 2.12 Anterior view of the male urethra

Blood supply–

The branches of vesicle and internal pudendal arteries.

Female Urethra (स्त्री मूत्र प्रसेक)–

It is about 4 cm long and 6 mm in diameter. It starts from internal urethral orifice at the neck of the urinary bladder. It runs towards the urogenital diaphragm and ends at the external urethral orifice in the vestibule. The mucosa of the urethra is much folded and contains mucous glands. The groups of mucous glands are known as paraurethral glands, these are homologous with the male prostate.

Chapter-3
MEMBRANE
(कला शारीर)

Introduction–

Kala is a thin membrane, which lining the internal cavity of the ashayas, organs, blood vessels, and fibrous capsule of the joints etc. The kala separates the Dhatu and Ashaya. The ashaya is cavity which gives ashraya to the Dosha, Dhatu and Mala. The Dhatus rasa, rakta, etc. are lies within the ashaya. The inner lining mucous membrane of the organs is considered as kala.

कलाः खल्वपि सप्त भवन्ति धात्वाशयान्तरमर्यादाः । (सु.शा.४)

यथा हि सारः काष्ठेषु छिद्यमानेषु दृश्यते ।

तथाहि धातुर्मांसेषु छिद्यमानेषु दृश्यते । (सु. शा. ४/६)

The cross section of the wood will shows, the different layers and parts of its internal structures as layer by layer and thin layer which separates the different layers of structures,

Similarly the membrane appears by the cross section of the fleshy part of the body, or any muscular regions or any internal parts of the organs. The microscopic observation of the different layers of the tissues and the different structures are separated by thick or thin membranous layers or fascias, that fascia and thin membrane is the portion of kala which lining the between the ashaya and dhatu.

यस्तुधात्वाशयांतरेषु क्लेदावतिष्ठते स

यथा स्वमूष्मभिर्विपक्वः स्नायुश्लेष्मजरायुच्छन्नः

काष्ठ इवसारो धातुरसविशेषोऽल्पत्वात् कला संज्ञा ॥ (सु. शा. ४/६)

स्नायुभिश्च प्रतिच्छन्नान् संततांश्चजरायुणा ।

श्लेष्मणावेष्टितांश्चापि कलाभागांस्तुतान् विदुः ॥ (सु. शा. ४/७)

Acharya Vagbhata says the kleda which is lies in the internal part of the sakhya that becomes pakva by dhatvagni and forms as kala. This is thin membrane like jarayu, it covers by the kaphadosha. The snayu, peshi are covered by kala. It covers the internal and external layers of the organs, and it may be separates the muscles. It helps for the holding, movements, supporting, absorption, secretion and lubrication in the different parts of the body.

There are seven kalas explained in Samhita.

१. मांसधरकला ३. मेदोधरकला ५. पुरीषधरकला ७. शुक्रधरकला
२. रक्तधरकला ४. श्लेष्मधरकला ६. पित्तधरकला

1. Endo, Peri and Epimysium (मांसधरकला)–

The inter muscular fascia which lies between the muscles and consisting the veins, arteries, nerve fibres, and channels. The lining membrane of muscles, ligaments, tendons, the superficial and deep fascias are mamsadhara kala, just as lotus stalks located in the muddy water spread in the soil. Similarly the blood vessels, nerves lies in the muscle.

तासां प्रथमा मांसधरा, यस्यां मांसे सिरास्नायुधमनीस्रोतसां प्रताना भवन्ति ।
यथा बिस्समृणालानि विवर्धन्ते समन्ततः ।
भूमौ पङ्कोदकस्थानि तथा मांसे सिरादयः ॥

2. Endothelium (रक्तधरकला)–

It is lining internally of the blood vessels, internal aspect of liver and spleen, the thin membrane lies in between the lobules of spleen and liver. The tunic intima of the blood vessels is raktadhara kala.

द्वितीया रक्तधरा मांसस्याभ्यन्तरतः, तस्यां शोणितं
विशेषतश्च सिरासु, यकृत्प्लीहनोश्च भवति ॥

3. Adipose Tissue (मेदोधरकला)–

It is found in the abdomen. The adipose tissue lies in the layers of peritoneum like greater omentum, appendicies epiploic etc. The long and short bones contains internally the bone marrow, that bone marrow is majja dhatu. The cortex area of the kidney is medo dhatu.

तृतीया मेदोधरा; मेदो हि सर्वभूतानामुदरस्थमण्वस्थिषु च,
महत्सु च मज्जा भवति ॥ (सु. शा.४)

4. Synovial Membrane (श्लेष्मधरकला)–

This is found inside the joints. The fibrous capsule internally lining by the synovial membrane. That synovial membrane is sleesmadhara kala. The synovial fluid helps for lubricating the joints and avoid the friction between the articular parts of the bones. The fluid is sleshmak. kapha.

चतुर्थ कला – चतुर्थी श्लेष्मधरा सर्वसन्धिषु प्राणभृतां भवति ॥
(सु.शा.४/१४)

5. Purishadhara Kala (पुरीषधरकला)–

This lines the pakvashaya [colon] internally, from unduka to guda and helps to separates the mala [excretory products]. The Maladhara kala located in the unduka [caecum], that helps to separate the waste products. This kala helps for absorption of water, secrets the mucous that helps for lubricating the fecal matter.

पञ्चम कला – पञ्चमीपुरीषधरा नाम;
याऽन्तः कोष्ठे मलमभिविभजते पक्वाशयस्था ॥
यकृत्प्लमन्तात् कोष्ठं च तथाऽन्त्राणि समाश्रिता।
उण्डुकस्थं विभजते मलं मलधरा कला ॥

6. Pittadhara Kala (पित्तधरकला)-

This lies in the amashaya (stomach), pittashaya (gall bladder) and pakvashaya (colon) grahani and kahudantra (duodenum and small intestine) which mainly helps for the digestion and absorption protection etc.

षष्ठी कला – षष्ठी पित्तधरा;

या चतुर्विधमन्नपानमामाशयात् प्रच्युतं पक्वाशयोपस्थितं धारयति ॥

7. Sukradhara Kala (शुक्रधरकला)-

As per the saamhitas this layer lies in the whole body, just as gratha is present in the milk, but specially it lies in the testis, vasa deference seminal vesicles and ejaculatory ducts.

सप्तमी कला – सप्तमी शुक्रधरा; या सर्वप्राणिनां सर्वशरीर व्यापिनी।

यथा पयसि सर्पिस्तु गूढश्चेक्षौ रसो यथा। शरीरेषु तथा शुक्रं नृणां विद्याद्भिषग्वरः॥

There are some Vishista kalas which are covers and hold the organs, provides the attachment of vessels nerves.

१. उदरावरण कला

२. फुफ्फुसावरण कला

३. हृदयावरण कला

४. मस्तिष्कावरण कला

Pleura (फुफ्फुसावरण कला)-

It is one of the vishista kala, and a serous membrane, which is lined by mesothelium, and covers the lungs. There are two pleural sacs, one on each side of the thoracic cavity consisting the lungs. Each pleural sac has two layers. The outer parietal pleura and an inner visceral or pulmonary pleura. The two layers are continuous with each other, surrounding the hilum of the lung. There is space between the two pleural layers known as pleural cavity. It contains small amount of

tissue fluid. This fluid is sleshmka kapha, that helps to lubricate the membrane.

1. Visceral Pleura– It is inner layer which covers the all surfaces and fissures of the lung except at the hilum region, it is firmly adherent to the lung.

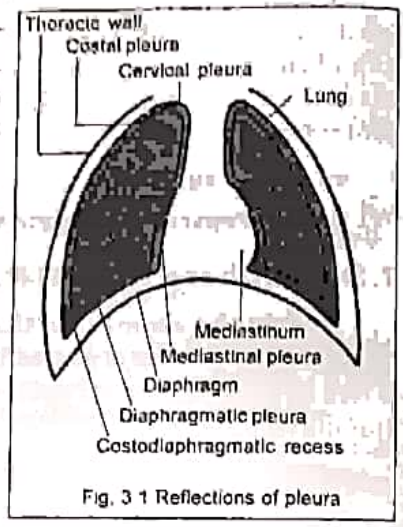


Fig. 3 1 Reflections of pleura

2. Parietal Pleura– It is outer layer, thick and covers the visceral pleura, and subdivided into four parts. (1) Costal pleura - which lines the thoracic wall and covers the costal surface of the lung. (2) Mediastinal pleura - It lines the corresponding surface of the mediastinum. It is reflected over the root the lung and becomes, continuous with the visceral pleura around the hilum of the lung. (3) Cervical Pleura - It extends into the neck above the clavicle and 1st rib and covers the apex of the lung. (4) Diaphragmatic Pleura - It Lines the superior surface of the diaphragm, and it covers the base of the lung.

Pulmonary Ligament–

The parietal layer surrounding the root of the lung that extends downwards beyond the root as a fold called the pulmonary ligament.

Recesses of pleura–

There are two recesses or folds of parietal pleura, which act as "reserve spaces" between the two layers.

(1) The costomediastinal recess – lies between the

costal and mediastinal pleura anteriorly behind the sternum and costal cartilage.

(2) The costodiaphragmatic recess lies inferiorly between the costal and diaphragmatic pleurae.

Surface Marking–

1. Curved line forming dome, 1" above the medial $^1/_3$ of clavicle.

2. The anterior border – The right lung: extends from the sterno clavicular joint downwards, medially to midpoint of the sternal angle, up to midpoint of the xiphisternal joint. The left lung - extends same as right up to the 4th costal cartilage then arches outwards and descends up to the 6th costal cartilage forms the cardiac notch.

3. The lower border– Crosses the 8th rib in the mid clavicular, 10th rib in the mid axillary, and 12th rib adjacent to the vertebral column.

Blood supply– Intercostal, internal thoracic and musculophrenic arteries.

Nerve Supply– Intercostal and phrenic nerves.

Pericardium (हृदयावरण कला)–

It is one of the vishista kala and fibroserous sac, which covers the heart and the roots of the great vessels. It has two layers, fibrous pericardium and serous pericardium.

Fibrous Pericardium–

It is outer layer encloses the heart and fuses with the vessels. It is conical sac made up of fibrous tissue and serves to limit the movement of the heart. It has apex fused with the roots of the great vessels. The base is broad blended with the central tendon of the diaphragm, above - It blends with the outer coats of

the great blood vessels, anteriorly - connected to the upper and lower ends of body of the sternum by the superior and inferior sternopericardial ligaments. Posteriorly related with principle bronchus and oesophagus on either side related with mediastinal pleura.

Serous pericardium–

It is inner layer thin and double layers, the outer layer is parietal pericardium is fused with fibrous pericardium. Inner layer is visceral pericardium is closely fused with the heart and it is also called the epicardium that is the first layer of the heart..

Pericardial Cavity–

It is potential space between the parietal and visceral layers, this cavity contains a small amount of serous fluid which lubricates the apposite surface and it is known as sleshmaka kapha.

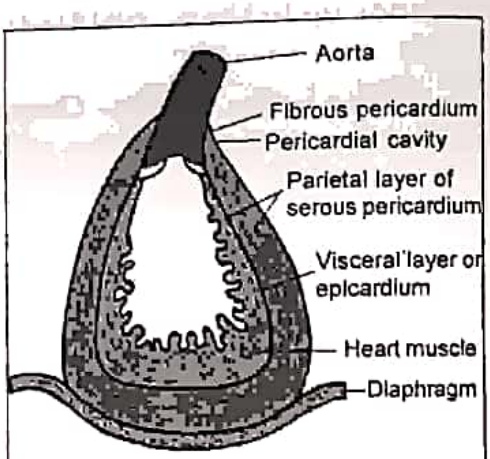


Fig 3.2 Layers of the Pericardium

Contents of the Pericardium–

It consist heart with cardiac vessels and nerves, ascending aorta, pulmonary trunk, lower half of the superior venacava, terminal part of the inferior venacava and the terminal parts of the pulmonary veins.

Blood Supply– Internal thoracic, musculo-phrenic arteries.

Nerve Supply– Phrenic nerve, autonomic nerves of heart.

Peritoneum (उदरावरण कला)–

It is one of the vishista kala and a serous membrane, which covers the abdominal organs. It is a large serous membrane lying the abdominal cavity. It compose of an outer layer of fibrous tissue and an inner layer of mesothelial cells. It is in the form of a closed sac which is invaginated by a number of viscera.

It has two layers–

1. Outer Parietal Layer 2. Inner Visceral Layer.

1. Outer Layer– It is parietal peritoneum which lines the inner surface of the abdominal and pelvic walls and the inferior surface of the diaphragm.

2. Inner layer– It is visceral peritoneum lines the outer surface of viscera, to which firmly adherent to the organs, and it can not be stripped.

Peritoneal Cavity–

The space between the parietal and visceral peritoneum, between these layers there is a thin film of serous fluid. The peritoneal cavity is divided broadly into two sacs (1) Greater sac (2) Lesser sac. Two sacs communicate with each other through the epiploic foramen at the region of right free margin of the lesser omentum. Peritoneal folds provide pathways for passage of vessels, nerves lymphatics and suspend the viscera.

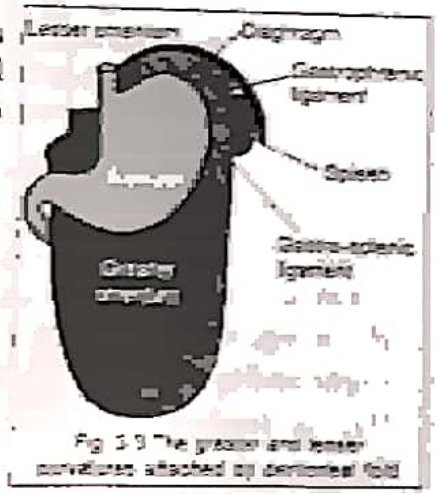


Fig. 3.9 The greater and lesser omentum attached by peritoneal fold

Different types of folds–

Greater Omentum–

The fold of the peritoneum extends from the greater curvature of the stomach up to various length, and over hangs the transverse colon, small intestine anteriorly. It is known as police man and apron of the abdomen.

Lesser Omentum–

It is the fold of peritoneum attached to the lesser curvature of the stomach, and to the porta hepatis of the liver. The right border is free.

Mesentery and mesocolon–

It is peritoneal layer covers the small intestine parts jejunum, ilium and part of the large intestines like transverse, sigmoid colon and appendix.

Ligaments–

The peritoneal ligaments are double layers of peritoneum connecting the viscera to each other, or to the diaphragm, or to the abdominal wall or to the pelvic wall.

Examples–

1. Falciform ligament
2. Lienorenal ligament
3. Coronary ligament
4. Hepato gastric ligament
5. Right and left triangular ligament,
6. Hepato duodenal ligament
7. Gastro splenic ligament
8. Ligaments of the uterus and urinary bladder

Functions–

Movement and holding of the viscera, Healing

power and adhesions, Protection of viscera, Storage of fat, absorption and dialysis.

Meninges (मस्तिष्क आवरण कला)–

The three membranous layers covering of the brain and spinal cord.

1. Dura mater - outer layer – वराक्शिक कला
2. Arachnoid mater middle layer – निशारिक कला
3. Pia mater Inner layer – चिनांकुश कला

The cerebrospinal fluid lies in the space between the arachnoid and the pia mater [sub arachnoid space] and acts as a water cushion.

Dura Mater (वराक्शिक कला)–

Thickest and outermost layer, it has composed of two layers The two layers are fused to each other at all the places, except where the cranial venous sinuses are enclosed between them, the same is called the dural venous sinuses. These venous sinuses drains the blood from the different part of the brain and finally drains into the internal jugular veins.

(a) Endosteal Layer (निशारिक कला)–

An outer endosteal layer which serves as an internal endocranium for the skull bones, and lining the internal surface of the cranium. It provides sheaths for the cranial nerves and is continuous with periosteum through the sutures and foramina.

(b) Meningeal Layer (चिनांकुश कला)–

Inner meningeal layer, which surrounds the brain. The meningeal layer is continuous with the spinal dura mater covers the spinal cord. the spinal dura has single layer. The meningeal layer of dura

mater folded on itself, to form the partitions which lodges the different parts of the brain, the folds are also helps for lodging the venous sinuses.

Meningeal folds-

1. Falx cerebri–

It is the large sickle shaped fold lies between the two cerebral hemispheres. It has anterior end narrow, and is attached to the crista galli, the posterior end broad and is attached along the median plane to the tentorium cerebelli. It has two margins as upper and lower.

The three sinuses attached to the borders

(1) The superior sagittal sinus – It lies at the upper border of falx cerebri.

(2) The inferior sagittal sinus– It lies at the lower border of falx cerebri.

(3) Straight sinus are attached– Lies in the middle of tentorium cerebelli the continuation of the inferior sagittal sinus.

2. Tentorium Cerebelli–

It is tent shaped fold lies between cerebellum and the occipital lobes of cerebrum. It forms roof of the posterior cranial fossa, and it divides the cranial cavity into supratentorial and infratentorial. The infratentorial containing the hind brain and the lower part of the mid brain. The posterior border has the transverse sinuses on either side.

3. Falx Cerebelli–

It is small sickle shaped fold lies in between the two cerebellar hemispheres in the median plane. The posterior border has occipital sinus.

4. Diaphragm Sellae–

It is small circular, horizontal fold forms the roof of the hypophyseal fossa. The diaphragm sellae has a

central aperture through which the stalk of the hypophysis cerebri passes.

Venous Sinuses of Duramater–

These are dural venous spaces, the walls of which are formed by the two layers of dura mater. The cranial venous sinuses communicate with veins outside the skull through emissary veins, venous sinuses receive the venous blood from the brain, meninges and bones of the skull. Cerebro spinal fluid is poured into some of them.

There are 23 venous sinuses of which 8 are paired and 7 are unpaired.

Paired Venous Sinuses–

1. Cavernous Sinus
2. Superior Petrosal Sinus
3. Inferior Petrosal Sinus
4. Transverse Sinus
5. Sigmoid Sinus
6. Sphenoparietal Sinus
7. Petrosquamous Sinus
8. Middle Meningeal Sinus/Veins

Unpaired Venous Sinuses–

1. Superior sagittal sinus
2. Inferior sagittal sinus
3. Straight Sinus
4. Occipital Sinus
5. Anterior inter cavernous sinus
6. Posterior inter cavernous sinus
7. Basilar plexus of veins

Arachnoid Mater–

It is middle layer thin and transparent membrane, The arachnoid is separated from the dura mater by the sub dural space and from pia by the sub arachnoid space which contains cerebro spinal fluid.

Arachnoid villi and granulations–

Arachnoid villi are minute protrusions of the arachnoid, through apertures in the duramater into the venous sinuses, especially in the superior sagittal sinus. They contain subarachnoid tissue and cerebrospinal fluid and capillary. With increasing age the size of the villi increase till they form arachnoid granulations.

Pia Mater– It i.s inner most layer and a thin vascular membrane closely invests the brain, dipping into various sulci and other irregularities of its surfaces. The blood vessels of the brain run in the subarachnoid space on the surface of the pia mater, They break up into branches on the pia mater.

Chapter-4

SENSE ORGANS

(इन्द्रिय शारीर)

Introduction–

एकैकाधिकयुक्तानि खादीनामिन्द्रियाणि तु ।
पञ्च कर्मानुमेयानि येभ्यो बुद्धिः प्रवर्तते ॥

(च.शा. १)

Prathvi pancha mahabootas predominent may cause to form the same mahabhoota pradhanya indriyas. There are five jnanendriyas (sense organs) these indriyas are formed by their mahaboota pradhanya. E.g. - The srotraendriya (ear) is predominant by akasha mahaboota, similarly to be considered as same.

इह खलु पञ्चेन्द्रियाणि पञ्चेन्द्रियद्रव्याणि पञ्चेन्द्रियाधिष्ठानानि पञ्चेन्द्रियार्थाः
पञ्चेन्द्रियबुद्धयो भवन्ति इत्युक्तमिन्द्रियाधिकारे ॥

(च. सू.)

The five sense organs like srotra, chakshu, grhana, jihba, twaka, the five dravyas, the five indriya adhisthanas, the pancha arthas, the panchabuddi, all are in related with the five sense organs. So jnanendriya means which they will give the knowledge through their adhisthanas.

कर्मेन्द्रियाणि – वाक् हस्त[illegible] ॥ (सु.शा. १)

पञ्च कर्मेन्द्रियाणि – तद्यथा हस्तौ, पादौ, पायुरुपस्थो, जिह्वा, चेति ॥

(च.शा. [illegible])

हस्त, पाद, पायु, उपस्थ, मुख– These are the five karmendriyas (motor organs).

कर्मेन्द्रियाणाम् [illegible] विसर्ग विहरणानि ॥

(सु. शा. [illegible])

The वाक् (oral cavity), indriya has the functions like speech, reading. The हस्त (Hand), indriya has the

functions like movements, giveing and taking, etc. The उपस्थ (urogenital organs) indriya helps for excreating the urine and reproduction function. The पायु (Anus) indriya helps to evacuate the waste product from the body. The पादम् (leg) indriyas are helps for locomotion. .

इन्द्रिय – पञ्चेन्द्रियाधिष्ठानानि तद्यथा –

तत्र चक्षुः श्रोत्रम् घ्राणम् रसनम् स्पर्शनमिति पञ्चेंद्रियाणि ॥ (च.सू. ८)

त्वक्, जिह्वा, नासिक, अक्षिणी, कर्णौ च । (च.शा.७/८)

पञ्चेंद्रियाधिष्ठानानि – अक्षिणी कर्णौ नाशिक जिह्वा त्वक् चेति ॥

त्वक, जिह्वा, नासा, अक्षि, कर्ण– These are the five jnanendriyas (sense organs).

पञ्च बुद्धीन्द्रियाणि – तद्यथा स्पर्शनं, रसनं, घ्राणं, दर्शनं श्रोत्रमिति ॥ (च.शा. ७/८)

पञ्च इन्द्रिय द्रव्याणि – खवायुर्ज्योतिरापोभूरिति ॥

आकाश, वायु, तेज, अप, पृथ्वि– These are the five indriya dravyas. the particular indriya has the predominance of their dravyas.

पञ्चेंद्रियार्थाः – शब्द स्पर्श रूप रस गंधाः ॥ (च. सू. ८)

स्पर्श, रस, गन्ध, रूप, शब्द– These are the five tanmatras or indriyarthas.

Skin (त्वक्)–

इन्द्रियं स्पर्शग्राहकं त्वक् सर्व शरीरवर्ति ॥

The skin organ helps to determination of the touch sensation, that covers the whole body. It is the one of the sense organ and divided into two distinct parts.

1. Epidermis – Superficial part
2. Dermis – Deep part.

1. Epidermis– It is superficial layer of the skin and formed by a stratified epithelium, on the palms of the hands and the soles of the feet, the epidermis is extremely thick, and in other areas it is thin.

2. Dermis– It is deep layer and composed of dense connective tissue, containing many blood, lymphatic vessels and nerves. It shows considerable variation in thickness in the different parts of the body.

The dermis of the skin is connected to the underlying deep fascia or bones by the superficial fascia. In the dermis the bundles of collagen and elastic fibers are arranged in parallel rows. It is flexible and highly elastic in nature.

The skin over the joints always folds in the same place, the appendages of the skin are the nails, hair, follicles, sebaceous glands, and sweat glands.

Pigmentation of the Skin–

There are five pigments of various levels, these are

1. Melanin [brown].
2. Melanoid.
3. Carotone [yellow to orange].
4. Haemoglobin [purple].
5. Oxyhemoglobin [red].

The average thickness of the skin is 1 to 4 mm, thickest skin lies in the sole of the foot, thinnest skin lies in the eye lids.

Histological layers of skin can be recognized in modern concept.

1. Stratum corneum.
2. Stratum lacidum.
3. Stratum granulisum.
4. Stratum spinosum.
5. Stratum basel.
6. Corium.

Ayurvedic Concept–

त्वचोनाम – सर्व देहावरणरूपा भूमिः स्पर्शनेंद्रियस्य स्रोतसाम् च स्वेदवहानां रोम्णामपिसरोमकूपानाम् ॥ (प्र. शा.)

The layer which covers the whole body and we feel the touch sensation such layer is known as tvaka, or sparshnendriya. It consist sweat glands, hair roots, and small blood capillaries. The sweat and waste material comes out through the small openings present in the layer of the skin.

तस्य खल्वेवम् प्रवृतस्य शुक्रशोणितस्याभिपच्यमानस्य
क्षीरस्येव सन्तानिकाः सप्त त्वचो भवन्ति ॥ (सु. शा. ४/४)

Acharya Sushruta explained, when life induced by the combination of sukra and shonita in the garbhashaya, at the same time it undergoes rapid transformation and formation. The seven layers of the skin is formed during the embryonic period, The skin is formed in the same manner as the layers of cream formed on the surface of the boiled milk.

There are seven types of layers as per Acharya Sushruta, but there is different opinion in the numbers by Acharyas.

१. अवभासिनी	२. लोहिता	३. श्वेता	४. ताम्रा
५. वेदिनी	६. रोहिणी	७. मांसधरा	

प्रथमा अवभासिनी–

तासां प्रथमा अवभासिनी नाम, या सर्वान्
वर्णानवभासयति पञ्चविधां च छायां प्रकाशयति।
सा व्रीहेरष्टादश भागप्रमाणा, सिध्मपद्मकन्टकाधिष्ठाना ॥

The first layer is avabhasini, it is $^{1}/_{18}$ of vrihi praman. It is adhistana for sidma, padma, and kantak diseases. It is whitish black color, and brajaka agni lies in this layer.

द्वितीया लोहिता–

द्वितीया लोहिता नाम व्रीहिषोडषभागप्रमाणा, तिलकालकन्यच्छव्यङ्गाधिष्ठाना।

The second layer is lohita it is 1/16 of vrihi praman. It is adhistana for tilakalak, nyacha, and vyanga diseases.

तृतीया श्वेता–

तृतीया श्वेता नाम व्रीहि द्वादशभागप्रमाणा, चर्मदलाजगल्लीमशकाधिष्ठाना।

The third layer is sweta it is $^1/_{12}$ of vrihi praman. It is adhistana for carmadala, ajagalli, mashaqka and mache diseases.

चतुर्थी ताम्रा–

चतुर्थी ताम्रा नाम व्रीहेरष्टभागप्रमाणा, विविधकिलासकुष्ठाधिष्ठाना।

The fourth layer is tamra it is $^1/_8$ of vrihi praman. It is adhistana for kilas and different verities of leprosy diseases.

पञ्चमी वेदिनी–

पञ्चमी वेदिनी नाम व्रीहिपञ्चभागप्रमाणा, कुष्ठ विसर्पाधिष्ठाना।

The fifth layer is vedini it is $^1/_5$ of vrihi praman. It is adhistana for visarpa and different verities of leprosy diseases.

षष्ठी रोहिणी–

षष्ठी रोहिणी नाम व्रीहि प्रमाणा, ग्रन्थ्यपच्यर्बुद श्लीपदगलगण्डाधिष्ठाना।

The sixth layer is rohini it is 1 vrihi praman. It is adhistana for granthi, apachi, arbhuda, slipada and galaganda diseases.

सप्तमी मांसधरा–

सप्तमी मांसधरा नाम व्रीहिद्वय प्रमाणा, भगन्दर विद्रध्यर्शोधिष्ठाना।

The seventh layer is rohini it is 2 vrihi praman. It is adhistana for bhagandara (fistula in ano) vidradhi (abscess) and arsha (piles) diseases.

Acharya Charak has explained there are six layers of skin. It is supported by Acharya Vagbhata.

शरीरे षट् त्वचः – तत्रधा– उदकधरा त्वग्बाह्या, द्वितीयात्वसृग्धरा,
तृतीया सिध्मकिलाससंभवाधिष्ठाना, चतुर्थी ददृकुष्ठसंभवाधिष्ठाना,
पञ्चमी त्वलजीविद्रधिसंभवाधिष्ठाना,
षष्ठी तु यस्यां छिन्नायां ताम्यत्यन्ध इव च तमः प्रविशति
यां चाम्बधिष्ठायारूंषि जायन्ते पर्वसु कृष्णरक्तानि स्थूलमूलानि
दुश्चिकित्स्यतमानि च; इति षट् त्वचः ॥ (च. शा.)

Acharya Gananatha sena stated that there are only five types of skin these are as follows :

१. अवभासिनी २. लोहिनि ३. श्वेतिनी ४. ताम्रणि ५. वेदिनी

Name of skin	Modern name	Pramana	Adhistnana for Diseases
1. अवभासिनी	Reflecting layer	$^1/_{18}$ vrihi	Sidma, Padma-kantak
2. लोहिता	Reddish layer	$^1/_{16}$ vrihi	Tilakalak, nyaccha, vyanga
3. श्वेता	White layer	$^1/_{12}$ vrihi	Charmadal, ajagalli, and Mashaka
4. ताम्रा	Pigment layer	$^1/_{8}$ vrihi	Kilas, Kustha
5. वेदिनी	Sensory layer	$^1/_{5}$ vrihi	Kustha, visapra.
6. रोहिणी	Proliferat-ing layer	1 vrihi	Granthi, Apachi, Arbuda, shlipad and Galaganda.
7. मांसधरा	Muscle	2 vrihi supporting	Bhagandhar, Arsha

Nose (नासा/घ्राणेन्द्रिय)–

इन्द्रियम् गन्धग्राहकं घ्राणं नासाग्रवर्ति ॥

It is one of the sense organ [Jnanendriya] and also it is a respiratory passage. Upper one third of the nasal cavity is lined by olfactory mucosa, consisting receptors of smell, and less vascular. The lower part of nasal cavity is lined by respiratory mucosa, it is highly vascular and warms the inspired air. The nose acts as an air conditioner where the inspired air is warmed, moistened and cleaned before it is passed on to the delicate lungs.

External–

Upper narrow end is root, lower end has the right and left nostrils. It has a skeletal framework, that is partly bone and,partly cartilaginous. The bones are nasal bones which form the bridge. The cartilage are superior and interior nasal cartilage, the septal cartilage and some small cartilage.

Nasal Cavity–

It extends from the external nostrils up to the posterior nasal apertures, and is sub divided into right and left halves by the nasal septum. Each half has a roof, a floor, medial and lateral walls. Each half measures about height - 5 cm, length - 5.7 cm, width 1.5 cm near the floor 1.2 mm near the roof. The roof is formed by cribriform plate of the ethmoid bone and nasal part of the frontal bone, nasal bone, cartilage and inferior surface of the body of sphenoid bone floor is formed by the palatine process of Maxilla and horizontal plate of the palatine bones.

Nasal Septum–

It is medium osteocartilaginous partition between

the two halves of the nasal cavity. Bony part is formed by the vomer bone and perpendicular plate of the ethmoid, cartilaginous part is formed by the septal cartilage and inferior nasal cartilage.

Lateral Wall–

Lateral wall has three parts, anterior part is small depressed area is vestibule, middle part is atrium of the middle meatus, posterior part contains the conchae. It is irregular owing to the presence of three, shelf like bony projections called conchae. The conchae increase the surface area of the nose, three conchae are usually found.

1. The inferior concha. 2. The middle concha
3. The superior concha.

Meatuses are passages beneath the over hanging conchae. Each meatus communicates freely with the nasal cavity proper. Inferior Meatus largest and lies below the inferior concha, here the naso lacrimal duct opens. Middle meatus - lies below the middle concha. and middle ethmoidal air sinus opens. Superior meatus shortest and shallowest lies below the superior concha, the posterior ethmoidal air sinuses opens.

Blood Supply–

Anterior and posterior ethmoidal arteries, spenopalatine artery, superior labial, and greater palatine arteries.

Ear (कर्ण/श्रोत्रेन्द्रिय)–

The ear is an organ of hearing and concerned in maintaining the equilibrium of the body. It consist three parts,

1. External Ear 2. Middle Ear
3. Internal Ear.

1. External Ear

It consist the auricle or ear pinna and external acoustic meatus.

Auricle– The part seen on the temporal surface, it is cartilage and covered by the skin. The lower part is soft and consist connective tissue, known as lobule. The large depression is concha it leads into the external meatus.

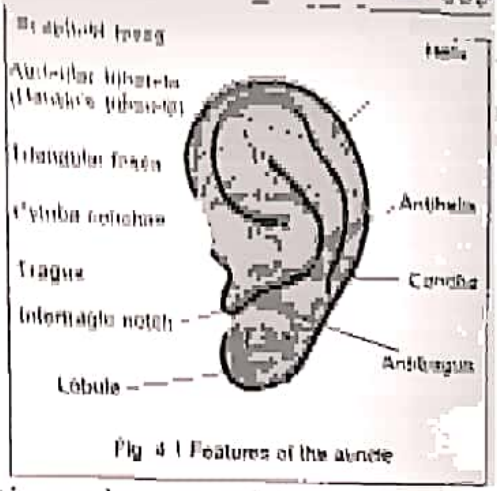


Fig. 4.1 Features of the auricle

External Meatus– It conducts sound waves. The canal is S-Shaped, it is about 24 mm long. The medial two third is bony [16 mm]; and one third is cartilaginous [8 mm]. Bony part is formed by the tympanic plate of the temporal bone, the cartilaginous part is C-Shaped.

Tympanic Membrane– It is a thin translucent partition between the external acoustic meatus and the middle ear. It is oval shape, measuring 9 × 10 mm. It is placed obliquely at an angle of 55 degree with the floor of the meatus. It has outer and inner surfaces. The outer surface is lined by thin skin, the inner surface provides attachment to the handle of malleus.

The tympanic membrane is composed of three layers–

(1) Outer cuticular layer, (3) Inner mucous layer.

(2) Middle fibrous layer,

2. Middle Ear–

It is marrow air filled space situated in the petrous part of the temporal bone. It is like a cube. It can be

subdivided into the tympanic cavity proper, and the epitympanic recess.

It communicates anteriorly with nasopharynx through the auditory tube. Posteriorly with the mastoid antrum.

Contents– Three small bones, namely the Malleus, the Incus, and the Stapes, ligaments of the ear ossicles, two muscles, vessels and nerves.

Ear Ossicles–

(1) Malleus– It is like hammer and largest ear ossicle. It has the rounded head, it articulates with body of incus. The neck related to the chorda tympanic membrane.

(2) Incus– It is like anvil, resembles like a molar tooth. It has body bears an articular surface, articular with the head of the malleus. Its tip bears a lentiform nodule articulates with the head of the stapes.

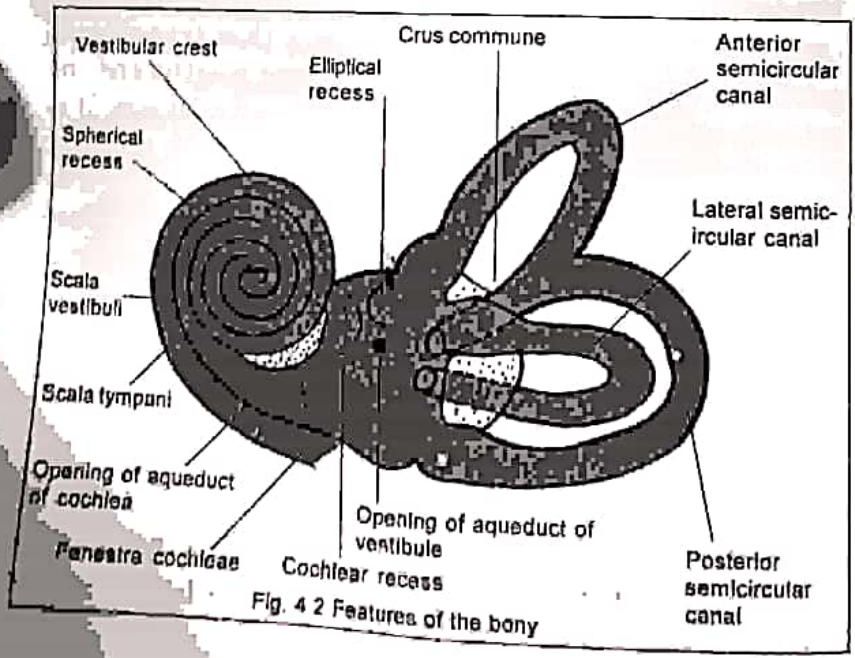


Fig. 4 2 Features of the bony

(3) Stapes– It is shaped like a stirrup, smallest and most medially placed ear ossicle. It has small head articulate with the incus. The narrow neck provides insertion of tendon of stapedius.

The incudemalleolar joint is a saddle type. The incudostapedial joint is a ball and socket. Both joints are synovial joints, surrounded by capsular ligaments.

3. Internal Ear - Labyrinth–

It lies in the petrous part of the temporal bone. It consist of the bony labyrinth within which there is a membranous labyrinth.

Bony Labyrinth– It consists of three parts :

1. The Cochlea, 2. The Vestibule,
3. The Semicircular Canals

Cochlea– The bony cochlea resembles the shell of a common snail. It forms the anterior part of the labyrinth. It has a conical central axis around which the cochlear canal makes two or three quarter turns.

Vestibule– It is the central part of the bony labyrinth. It lies medial to the middle ear cavity.

Semicircular Canal– There are three bony semicircular canals, they lie posterio superior to the vestibule, each canal describes two thirds of a circle and is dilated at one end to form the ampulla.

Membranous Labyrinth– It is in the form of a complicated, but continuous closed cavity filled with endolymph. Parts of the epithelium of the membranous labyrinth are specialized to form receptors for sound, for static balance and for kinetic balance.

Eye (चक्षु/चक्षुरिन्द्रिय)–

It is the organ of vision and jnanendriya,

Shape – Spherical, and Diameter – 2.5 cm.

Made up of three coats.

1. Outer or Fibrous Coat– Sclera and the cornea

2. Middle or Vascular Coat– Choroid the ciliary body and the iris.

3. Inner or Nervous Coat– The retina layer, the light entering the eyeball passes through before backwards the cornea, aqueous humor, the lens and the vitreous body.

Sclera–

It is opaque and outer layer forms the posterior five sixths of the eye ball. It is composed of dense fibrous tissue which is firm and maintains the shape of the eye ball. It is thickest behind, and thinnest about 6 mm behind the sclera corneal junctions.

The outer surface of the sclera is white and smooth. Its anterior part is covered by conjunctiva through which it can be seen as the white of the eye. The sclera is continuous anteriorly with the cornea at the sclero corneal junction, it is fused posteriorly with the dural sheath of the optic nerve. It provides the insertion to extrinsic muscles of the eye ball. The sclera is almost avascular. However, the loose connective tissue between the conjunctiva and sclera is vascular.

Cornea–

It is transparent, it replaces the sclera over the anterior one sixth of the eyeball, its junction with the sclera is called the sclero corneal junction, or limbus.

It is more convex than the sclera. It is separated from the iris by a space called the anterior chamber of the eye. The cornea is avascular and is nourished by lymph, it is supplied by branches of the opthalamic

nerve, structurally the cornea consists of the following layers.

1. Corneal Epithelium.
2. Bowman's Membrane.
3. The Substantia Propria.
4. Descemet's Membrane.

Choroid–

It is thin pigmented layer, which separates the posterior part of the sclera from the retina. Anteriorly it merges with the ciliary body. Outer surface is separated from the sclera by loose attachment. Inner surface firmly united to the retina.

Structurally it consists of–

1. Supra Choroidal Lamina
2. Vascular Lamina.
3. The Choriocapillary Lamina

Ciliary Body–

It is thickened part lying just posterior to the corneal limbus. It is continuous anteriorly with the iris and posteriorly with the choroid. It suspends the lens and helps it in accommodations for near vision.

The ciliary muscle is a ring of unstriped muscle which are longitudinal, radial or circular. All parts of the muscle are supplied by parasympathetic nerves.

Iris–

This is the anterior part of the uveal tract. It forms circular curtain with an opening in the centre called the pupil by adjusting the size of the pupil it controls the amount of light entering the eye. It is placed vertically between the cornea and the lens, thus divides the anterior segment of the eye into anterior and posterior chambers both containing aqueous humor.

Its peripheral margin is attached to the ciliary body. The central free margin forming the boundary of the pupil rests against the lens.

The iris contains well-developed ring of muscle called the sphincter pupillae which lies near the margin at the pupil. It is supplied by para-sympathetic, the dilator pupillae is an ill-defined sheet of redial muscle placed near the posterior surface of the iris, it is supplied by sympathetic nerves.

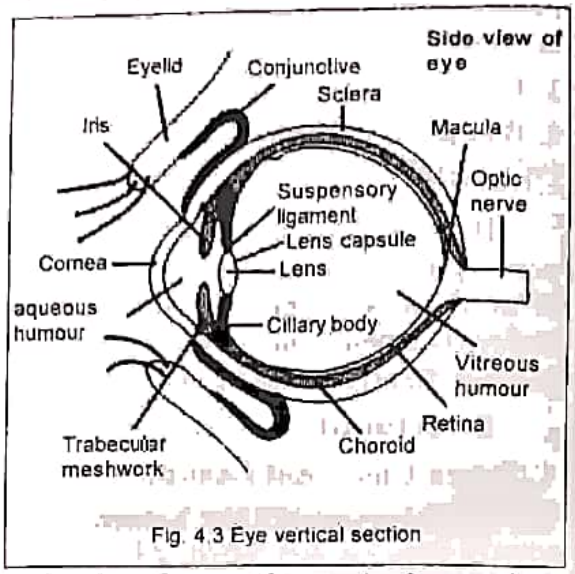


Fig. 4.3 Eye vertical section

Retina–

It is thin delicate inner layer. Continuous posteriorly with the optic nerve opposite the entrance of the optic nerve there is circular area known a the optic disc. It is about 1.5 mm in diameter.

Aqueous humor–

It is clear fluid with fills the space between the cornea infront and the lens behind. The aqueous humor is secreted into the posterior chamber from the capillaries in the ciliary processes. It passes into the anterior chamber, it is drained into the anterior ciliary veins.

The Lens–

It is a transparent biconvex structure which is placed between the anterior & posterior segments of the eye. It is circular in outline and diameter of 1 cm.

Vitreous–

It is a colorless, jelly like transparent mass which fills the posterior segment of the eye boll.

Lacrimal Apparatus–

Lacrimal Glands–

It is one of the gland among the lacrimal apparatus. It is a serous gland situated chiefly in the lacrimal fossa and partly on the upper eyelid. The gland is 'J' shaped, it has [1] an orbital part, larger and deeper and [2] a palpebral part, smaller and superficial.

About a dozen of its ducts pierce the conjunctive of the upper eye lid and open into the conjunctival sac near the superior fornix.

The gland is supplied by the lacrimal branch of the ophthalmic artery and by the lacrimal nerve. The nerve has both sensory and secretomotor fibres.

The lacrimal fluid secreted by the lacrimal gland flows into the conjunctival sac where it lubricates the front of the eye and deep surface of the lids.

Conjuctival Sac–

The potential space between the palpebral and bulbar parts is the conjunctival sac.

Lacrimal Sac–

It is membranous sac 12 mm long and 5 mm wide, situated in the lacrimal groove behind the medial palpebral ligament. Its upper end is blind, the lower end is continuous with the nasolacrimal duct.

Nasolacrimal Duct–

It is a membranous passage 18 mm long, it begins at the lower end of the lacrimal sac, runs downwards backwards and laterally, and opens into the inferior meatus of the nose.

Chapter-5

MARMA SHAREERA
(मर्म शारीर)

Marma Introduction (मर्म)-

Marma is a vital point of the body. The marma is one of the important regions of the body, If any injury to the marma region that leads deformity of the structures, produces the sever pain in the marma region, loss of movements, trauma to the local structures, and even some times there may be a death.

The physician should have to take care about the marma regions particularly in the medical and surgical treatments. The knowledge of marma is always most important in the field of medicine, even it is also helps in the marshal art and to avoiding the complications during the treatment. The awareness of structures which are lies at the region of marma helps in the treatment. The marma region is the site for jivatama. The life holds in the structures of marma sthana. The bleeding at the marma region may leads to complications.

Definition-

जीवा स्थानं तु मर्माख्यात। (गज निघण्टु)

मर्माणि जीवाधाराणि तेषामन्यतमं पीडायां मर्मधिक्रा
पीडा भवति चेतना निबन्ध वैशेष्यात ॥ (च.सि. 6)

The marma region is the site for the prana, the jivatma lies in the region of marma. It is the adhisthana for jivatma, the life holds in the region of marma. So if any injury or trauma to the marma there will be a deformity or may be a sudden death.

मारयन्तीति मर्माणि। (डल्हण)

मरण सदृश दुःख दायित्वात वा इति मर्म। (अ.हृ शा. ७)

मरणकारित्वात मर्म। (अ.हृ शा. ४/अरुण)

The injury to the marma makes symptoms like pain, deformity of the organ, loss of movements. Sever type intolerable pain in the body; the mind feels death is better than pain, such a irritant pain in the body and causes sever damage to the body.

मर्माणि मांस सिरा स्नायु अस्थि सन्धि सन्निपाता:।
तेषु स्वभावत एव विशेषेण प्राणास्तिष्ठन्ति;
तस्मान्मर्मस्वभिहतास्तांस्तान भावानापद्यन्ते॥ (सु.शा. ६/१५)
सोम मारुत तेजांसि, रज: सत्व तमांसि च॥
मर्मसु प्राया: पुंसां भूतात्मा चावतिष्ठते।
मर्मस्वभिहतास्तस्मात्र जीवन्ति शरीरिण:। (सु.शा. ६/३५)

The marma sthana is the grouping of मांस (muscle), सिरा (vessel), स्नायु (ligaments), अस्थि (bone), and सन्धि (joint) in a particular position. The life lies in that location. Where these five structures are usually lies in one region, such region is marma sthana, among these five structures any one may be the predominant in that area, which structure is predominant that structure name will be considered as of that marma. The tridosha vata, pitta, kapha and trigunas satva, raja, tama and bhootatma will situate in the marma region.

Importance of Marma–

मारयन्तीति मर्माण्युच्यन्ते, स्रोतांसि च क्षतेऽपि नावश्यतया मरणं।
यतो वक्षति स्रोतो विद्धं तु प्रत्याख्यायोपचरेत।
तत्र रुक्करवैकल्यकरेष्वपि अग्नि सोमादि प्राणानां मध्ये कस्यचित प्राणस्य हानेः॥
स्रोत: प्रभृतीनामपि मारणात्मकत्वान्मर्मत्वमस्त्येव,
तत कर्थमांसादीन्यतिरेकेणान्यानि मर्माणि।

यतो मांसादिष्वेव स्त्रोत: प्रभृतीनि सन्ति, तस्मान मांसादीनि पञ्चैव मर्माणीति ॥
(डल्हण)

Any injury to the marma they definitely lead to the death, even if there is no death, but the symptoms appears like seems to be death, the sadyapranahar marma definitely causes the death, but the other marmas like rujakara, kalantara pranahar are not lead to death, may induce the serious symptoms and causes the deformity or variation in functions of the body. The srotas injured by any cause, may not be death but they show variation in their normal functions.

While treating the diseases in different aspects, the knowledge of marma is very essential, the structure of that particular region knowledge is most useful. The local structures injury like vessels may leads to bleeding, bone may fracture and causes sever pain, the joints may dislocate causes the loss of movements and severe pain. The physician must have the knowledge of these marma regions to maintain the normal healthy life. The surgeon who knows the awareness of the marmas he will become successive in the field of surgery. Vaidyas are always to keep in their mind about the knowledge of marma.

चतुर्विधा यास्तु सिरा: शरीरे प्रायेण ता मर्मसु सन्निविष्टा: ॥
स्नाय्वस्थि मांसानि तथैव सन्धीन सन्तर्प्य देहं प्रतियापयन्ति ॥ (सु.शा. ६/१८)
तत: क्षते मर्मणि ता: प्रवृद्धः समन्ततो वायुरभिस्तृणोति ॥
विवर्धमानस्तु स मातरिश्वा रुज: सुतीव्रा: प्रतनोति काये ॥ (सु.शा. ६/१९)
रुजाभिभूतं तु तत: शरीरं प्रलीयते नश्यति चास्य सज्ञां ॥
अतो हि शल्यं विनिहर्तुमिच्छन्मर्मणि यत्नेन परीक्ष्य कर्षेत ॥ (सु.शा. ६/२०)

The four types of siras like vata vaha sira, pitta vaha sira, kapha vaha sira, and rakta vaha sira are supplying the blood to the marma sthana. The mamsa,

sira, snayu, asthi and sandhi marma are supplying by rich blood supply. In this marma sthanas are innervated by all four types' siras. Whenever there is injury to these marmas that leads to severe bleeding, and prakoopa of vayu dosha that spreads all over the body and causes the severity. Simultaneously due to vayu prakoopa the pain increases all over the body. Later the life becomes much irritant with pain, intolerance symptoms, and further may leads to death.

मर्म संख्या/भेद– TABLE - 1 Total - 107 marmas				
S. N.	According to Rachana	According to Shadangatva	According parinama-nusara	According to Vagbhata
1.	मांस मर्म- 11	ऊर्ध्व शाखा- 22	सद्यप्राणहर- 19	मांस मर्म- 10
2.	सिरा मर्म- 41	अधः शाखा- 22	कालान्तर प्राणहर- 33	सिरा मर्म- 37
3.	स्नायु मर्म- 27	मध्यमांग- 26	विशल्यघ्न- 03	स्नायु मर्म- 23
4.	अस्थि मर्म- 08	शिरोग्रीवा- 27	रुजाकर- 08	अस्थि मर्म- 08
5.	सन्धि मर्म- 20	----	वैकल्यकर- 44	सन्धि मर्म- 20
6.	----	----	----	धमनि मर्म- 09

Numbers and Classifications (मर्म संख्या/भेद)–

Structure wise marma classifications (रचनानुसार मर्म संख्या)–

सप्तोत्तरं मर्म शतं। तानि मर्मणि पञ्चात्मकानि भवन्ति; ॥

तद्यथा– मांसमर्माणि सिरामर्माणि स्नायुमर्माणि अस्थिमर्माणि सन्धिमर्माणि चेति।

न खलु मांससिरास्नाय्वस्थिसन्धिव्यतिरेकेणान्यानि मर्माणि भवन्ति ॥

(सु. शा. ६/३)

१. मांसमर्माणि – ११
२. सिरामर्माणि – ४१
३. स्नायुमर्माणि – २७
४. अस्थिमर्माणि – ८
५. सन्धिमर्माणि – २०

मांसमर्माणि– There are 11 Mamsa Marmas. & predominant of mamsa

तत्र तलहृदयेन्द्रबस्तिगुदस्तनरोहितानि मांसमर्माणि। (सु. शा. ६/७)

तलहृदय – 4, इन्द्रबस्ति – 4, गुद – 1, स्तनरोहित – 2

सिरामर्माणि– There are 41 Sira Marmas and the predominant of Sira.

नीलधमनीमातृकाशृङ्गाटकापाङ्गस्थपनीफणस्तनमूलापलापापस्तम्भहृदयनाभिपार्श्वसन्धिबृहतीलोहिताक्षोर्व्यः सिरामर्माणि। (सु.शा. ६/७)

धमनी (नील, मन्या)	– ४	मातृका	– ८	शृंगाटक	– ४
अपांग	– २	स्थपनी	– १	फण	– २
स्तनमूल	– २	अपलाप	– २	अपस्तंभ	– २
हृदय	– १	नाभि	– १	पार्श्वसन्धि	– २
बृहती	– २	लोहिताक्ष	– ४	उर्वी	– ४

स्नायुमर्माणि– There are 27 Snayu Marmas & the predominant of Snayu

आणी विटप कक्षधरकूर्चकूर्चशिरोबस्तिक्षिप्रांसविधुरोत्क्षेपाः स्नायुमर्माणि।

(सु.शा. ६/७)

आणी – ४ विटप – २ कक्षधर – २ कूर्च – ४ कूर्चशिर – ४

बस्ति – १ क्षिप्र – ४ अंस – २ विधुर – २ उत्क्षेप – २

अस्थिमर्माणि– There are 8 Asthi Marmas and predominant of Asthi

कटीकतरुणनितम्बांसफलकशंखास्त्वस्थि मर्माणि। (सु.शा. ६/७)

कटीकतरुण – २ नितम्ब – २ अंसफलक – २ शंख – २

सन्धिमर्माणि– There are 20 Sandhi Marmas and predominant of sandhi

जानुकूर्परसीमन्ताधिपतिगुल्फमणिबन्धकुकुन्दरावर्त कृकाटिकाश्चेति सन्धिमर्माणि।

जानु – २ कूर्पर – २ सीमन्त – ५ अधिपति – १ गुल्फ – २
मणिबन्ध – २ कुकुन्दर – २ आवर्त – २ कृकाटिका – २

According to the Acharya Vagbhata there are six types of marmas. He explained Dhamani marma is one of the another variety.

Marma sankya according to Vagbhata–

१. मांसममर्माणि – १० ३. स्नायुमर्माणि – २३ ५. सन्धिमर्माणि – २०
२. सिरामर्माणि – ३७ ४. अस्थिमर्माणि – ८ धमनिमर्माणि – ९

धमनि मर्म– The Dhamani marmas are as follows,

गुद – १ विधुर – २ अपस्तंभ – २ शृंगाटक – ४

Effect wise marma classification (परिणामानुसार मर्म संख्या)–

तान्येतानि पञ्चविधानि भवन्ति ; तथ्यथा– सध्यः प्राणहराणि, कालान्तरप्राणहराणि, विशल्यघ्नानि, वैकल्यकराणि, रुजाकराणि चेति।

१. सद्यःप्राणहराणि– १९ ३. विशल्यघ्नानि– ३ ५. रुजाकराणि– ८
२. कालान्तर प्राणहरणि– ३३ ४. वैकल्यकराणि– ४४

सद्यःप्राणहराणि– There are 19 Sadya pranahara Marmas.

शृंगाटकान्याधिपतिः शंखौ कण्ठसिरा गुदम।
हृदयं बस्तिनाभ्यौ च घ्नन्ति सद्यो हतानि तु॥ (सु.शा. ६/९)

शृंगाटक – ४ अधिपति – १ शंख – २ मातृका – ८
गुद – १ हृदय – १ बस्ति – १ नाभिः – १

तत्र सद्यःप्राणहराण्याग्नेयानि, अग्निगुणेष्वाशु क्षीणेषु क्षपयन्ति; ॥ (सु.शा. ६/१६)

The Sadya pranahara marmas are having the Agni guna pradhanya, the agni guna becomes immediate

prakoopa, by injury to the marma sthana, due to the agni prakopa that leads to sudden death. So if any injury to the marma sthana there will be immediate death. The death may occur with in the 7 days.

कालान्तर प्राणहराणि– There are 33 Kalantar pranahara Marmas.

वक्षोमर्मणि सीमन्ततलक्षिप्रेन्द्रवस्तयः।
कटीकतरुणे सन्धी पार्श्वजौ वृहती च या॥
नितम्बाविति चैतानि कालान्तरहराणि तु। (सु.शा. ६/११)

स्तनमूल – २	स्तनरोहित – २	अपलाप – २	अपस्तंभ – २
सीमन्त – ५	तलहृदय – ४	क्षिप्र – ४	इन्द्रबस्ति – ४
कटीकतरुण – २	पार्श्वसन्धि – २	वृहती – २	नितम्ब – २

कालान्तरप्राणहराणि सौम्याग्नेयानि अग्निगुणेष्वाशु क्षीणेषु क्रमेण च सोमगुणेषु कालान्तरेण क्षपयन्ति॥ (सु.शा. ६/११)

The kalantar pranahara marmas are having the agni and soumya gunas, so in any injury to these marma the death occurs gradually due to the gradual depletion of soumya guna. The death may occur within 15 days.

विशल्यघ्नानि– There are 3 Vishalyagna pranahara Marmas.

उत्क्षेपौ स्थपनि चैव विशल्यघ्नानि निर्दिशेत॥ (सु.शा. ६/११)

उत्क्षेप – २ स्थपनि – १

विशल्यप्राणहराणि वायव्यानि शल्यमुखावरुद्धो यावदन्तवार्युस्तिष्ठति तावीवति उद्धृतमात्रे तु शल्ये मर्मस्थानाश्रितो वायुर्निष्क्रमति। तस्मात् सशल्यो जीवत्युद्धृतशल्यो म्रियते॥ (सु.शा. ६/१६)

The vishalyaghna marma has the vayu mahaboota predominant, if shalya is removed from the marma

sthana, the vayu becomes immediate prakopa at its region and causes immediate death, so there is no harm still how long the shalya remains in the marma sthana. When shalya comes out from the marma sthana, the vayu mahabeena comes out of the marma sthana and causes death. "[illegible]"

वैकल्यकराणि– There are 44 Vaikalyakara Marmas.

लोहिताक्षाणि जानूर्वीकूर्चविटपकूर्पराः ।
कुकुन्दरे कक्षधरे विधुरे सकृकाटिके ॥
अंसांसफलकापाङ्गा नीले मन्ये फणौ तथा ।
वैकल्यकराण्याहुरावर्तौ द्वौ तथैव च ।

लोहिताक्ष – ४	आणि – ४	जानु – २
उर्वी – ४	कूर्च – ४	विटप – २
कूर्पर – २	कुकुन्दर – २	कक्षधर – २
विधुर – २	कृकाटिका – २	अंस – २
अंसफलक – २	अपांग – २	नील – २
मन्या – २	फण – २	आवर्त – २

वैकल्यकराणि सौम्यानि सोमो हि स्थिरत्वाच्छैत्या प्राणावलम्बनं करोति ॥
(सु.शा. ६/१६)

The vaikalyakara marma has soumya guna predominant, so due the soumya guna that causes the deformity of the structures. That deformity may leads to loss of the function, or the movements of that part, such marmas are known as vaikalyakara marmas.

रुजाकराणि– There are 8 Rujakara Marmas and these are as follows.

गुल्फौ द्वौ मणिबन्धौ द्वौ द्वे द्वे कूर्चशिरांसि च ॥
रुजाकराणि जानीयादष्टावेतानि बुद्धिमान ॥

गुल्फ – २ मणिबन्ध – २ कूर्चशिरा – ४

रुजाकराण्यग्निवायुगुणभूयिष्ठानि विशेषतः तौ रुजाकरौ पाञ्चभौतिकौ च रुजामाहुरेके ॥ (सु.शा. ६/२६)

The Rujakara marma has agni and vayu guna pradhanya, if injury to the rujakara marma sthana the agni and vayu gunas are becomes prakopa and causes the severe pain in the marma sthana, such marmas are rujakara marmas.

Regional wise marma classificatios (षडङ्गानुसार मर्म संख्या)–

The body is divided into six regions, the limbs, Trunk, head and neck, the marmas which are lies as according to this region is identified as shadanaganusara marmas.

तेषाम एकादशैकस्मिन सक्थि भवन्ति । एतेनेतरसक्थि बाहू च व्याख्यातौ, उदरोरसोर्द्वादश, चतुर्दश, पृष्ठे, ग्रीवां प्रत्यूर्ध्वे सप्तत्रिंशत ॥ (सु.शा. ६/५)

1. सक्थि (ऊर्ध्व & अधः शाखाः)– The upper and lower limbs consists 44 marmas

2. मध्यमांग (उदर, उरस & पृष्ठ)– The Trunk consist 26 (12 + 14) marmas,

3. ग्रीवा जत्रूर्ध्व– The Head and Neck region consisting 37 marmas

Upper and Lower limbs Marmas (तत्र सक्थिमर्माणि)–

क्षिप्रतलहृदयकूर्चकूर्चशिरोगुल्फेन्द्रबस्तिजान्वाण्युर्विलोहिताक्षाणि विटपं चेति ॥ बाहुमर्माणि तु क्षिप्रतलहृदयकूर्चकूर्चशिरोमणिबन्धेन्द्रबस्तिकूर्पराण्युर्वि लोहिताक्षाणि कक्षाधरं चेति ॥

ऊर्ध्व शाखा मर्म– The upper limb consist 11 x 2 = 22 marmas

१. क्षिप्र – २
२. तलहृदय – २
३. कूर्च – २
४. कूर्चशिर – २
५. मणिबन्ध – २
६. इन्द्रबस्ति – २
७. कूर्पर – २
८. आणि – २
९. बाहुवि – २
१०. लोहितक्ष – २
११. कक्षधर – २

अध: शाखा मर्म– The lower limb consist 11 x 2 = 22 marmas.

१. क्षिप्र – २
२. तलहृदय – २
३. कूर्च – २
४. कूर्चशिर – २
५. गुल्फ – २
६. इन्द्रबस्ति – २
७. जानु – २
८. आणि – २
९. उर्वी – २
१०. लोहितक्ष – २
११. विटप – २

शाखागत मर्म– Table -2 – Total marmas are 44

Upper Extremities Marmas				Lower Extremities Marmas			
Name	Nos	Rac	Par	Name	Nos	Rac	Par
1. Kshipra	2	c	B	1. Kshipra	2	c	B-½
2. Talahradaya	2	b	B	2. Talahradaya	2	b	B-½
3. Kurcha	2	c	D	3. Kurcha	2	c	D-4
4. Kurcha sira	2	c	E	4. Kurcha sira	2	c	E-1
5. Manibandha	2	e	E	5. Gulpha	2	e	E-2
6. Indrabasthi	2	b	B	6. Indrabasthi	2	b	B-½
7. Koorpar	2	e	D	7. Janu	2	e	D-3
8. Ani	2	c	D	8. Ani	2	c	D-½
9. Bahuvi	2	a	D	9. Oorvi	2	a	D-1
10. Lohitaksha	2	a	D	10. Lohitaksha	2	a	D-½
11. Kaksha-dhara	2	c	D	11. Vitapa	2	c	D-1

Rachananusar– सिरा - a, मांस - b, स्नायु - c, अस्थि - d, सन्धि - e.

ऊर्ध्व शाखा मर्म– The upper limb consist 11 x 2 = 22 marmas.

१. क्षिप्र – २
२. तलहृदय – २
३. कूर्च – २
४. कूर्चशिर – २
५. मणिबन्ध – २
६. इन्द्रबस्ति – २
७. कूर्पर – २
८. आणि – २
९. बाहुवि – २
१०. लोहितक्ष – २
११. कक्षधर – २

अध: शाखा मर्म– The lower limb consist 11 x 2 = 22 marmas.

१. क्षिप्र – २
२. तलहृदय – २
३. कूर्च – २
४. कूर्चशिर – २
५. गुल्फ – २
६. इन्द्रबस्ति – २
७. जानु – २
८. आणि – २
९. उर्वी – २
१०. लोहिताक्ष – २
११. विटप – २

शाखागत मर्म– Table -2 – Total marmas are 44

Upper Extremities Marmas				Lower Extremities Marmas			
Name	Nos	Rac	Par	Name	Nos	Rac	Par
1. Kshipra	2	c	B	1. Kshipra	2	c	B - ½
2. Talahradaya	2	b	B	2. Talahradaya	2	b	B - ½
3. Kurcha	2	c	D	3. Kurcha	2	c	D - 4
4. Kurcha sira	2	c	E	4. Kurcha sira	2	c	E - 1
5. Manibandha	2	e	E	5. Gulpha	2	e	E - 2
6. Indrabasthi	2	b	B	6. Indrabasthi	2	b	B - ½
7. Koorpar	2	e	D	7. Janu	2	e	D - 3
8. Ani	2	c	D	8. Ani	2	c	D - ¾
9. Bahuvi	2	a	D	9. Oorvi	2	a	D - 1
10. Lohitaksha	2	a	D	10. Lohitaksha	2	a	D - ½
11. Kaksha-dhara	2	c	D	11. Vitapa	2	c	D - 1

Rachananusar - सिरा - a, मांस - b, स्नायु - c, अस्थि - d, सन्धि - e.

Parinamanusar–

सद्यप्राणहर - A, कालान्तर - B, विशल्यघ्न - C, वैकल्यकर - D, रुजाकर - E.

Thorax and Abdomen region Marmas (उदर, उर: & पृष्ठ मर्म)–

There are 26 marmas in this region and these are as follows.

उदरोरसोस्तु – गुदवस्तिनाभिहृदयस्तनमूलस्तनरोहितापलपान्यपस्तम्भौ चेति ॥

पृष्ठमर्माणि तु कटिकतरुणकुकुन्दरनितम्बपार्श्वसन्धिबृहत्यं सफलकान्यंसौ चेति ॥

१. गुद – १ ३. नाभि – १ ५. स्तनमूल – २ ७. अपलाप – २

२. वस्ति – १ ४. हृदय – १ ६. स्तनरोहित – २ ८. अपस्तंभ – २

पृष्ठ मर्म–

१. कटीकतरुण – २ ४. पार्श्वसन्धि – २ ७. अंस – २

२. कुकुन्दर – २ ५. वृहती – २

३. नितम्ब – २ ६. अंसफलक – २

Table - 3

कोष्ठगत मर्म-Marmas of thorax and abdomen - 26 marmas

Name	Nos	Rac	Par	Pram	Name	Nos	Rac	Pari	Pram
गुद	1	b	A	4	वस्ति	1	c	A	4
नाभि	1	a	A	4	कुकुन्दर	2	e	D	½
हृदय	1	a	A	4	नितम्ब	2	d	B	½
स्तनमूल	2	a	B	2	पार्श्वसन्धि	2	a	B	½
स्तनरोहित	2	a	B	½	वृहती	2	a	B	½
अपलाप	2	a	B	½	अंसफलक	2	d	D	½
अपस्तंभ	2	a	B	½	अंस	2	c	D	½
कटीकतरुण	2	d	B	½					

Rachananusar- सिरा - a, मांस - b, स्नायु - c, अस्थि - d, सन्धि - e,

Parinamanusar-

सद्यप्राणहर - A, कालान्तर - B, विशल्यघ्न - C, वैकल्यकर - D, रुजाकर - E.

Head and Neck region Marmas (जत्रूर्ध्वगत मर्म)-

This region consisting 37 marmas.

जत्रुण ऊर्ध्वं चतस्रोथमन्योऽष्टौमातृका द्वे कृकाटिके द्वे विधुरे द्वे फणे द्वावपांगौ द्वावावर्तौ द्वावुत्क्षेपौ द्वौ शंखौ एका स्थपनी पञ्च सीमन्त चत्वारि शृंगाटकान्येकोऽधिपतिरिति ॥ (सु.शा. ६/६)

जत्रूर्ध्व मर्म-

१. धमनि (नील, मन्य) – ४
२. मातृका – ८
३. कृकाटिका – २
४. विधुर – २
५. फण – २
६. अपांग – २
७. आवर्त – २
८. उत्क्षेप – २
९. शंख – २
१०. स्थपनी – १
११. सीमन्त – ५
१२. शृंगाटक – ४
१३. अधिपति – १

Table-4: Marmas of Head and Neck - 37 Marmas

Name	Nos	Rac	Par	Pram
धमनि	4 (2x2)	a	D	4 ang
मातृका	8 (4x2)	a	A	4 ang
कृकाटिका	2 (1x2)	e	D	½ ang
विधुर	2 (1x2)	c	D	½ ang
फण	2 (1x2)	a	D	½ ang
अपांग	2 (1x2)	a	D	½ ang
आवर्त	2 (1x2)	e	D	½ ang
शंख	2 (1x2)	d	A	½ ang

Name	Nos	Rac	Par	Pram
उत्क्षेप	2 (1x2)	c	C	½ ang
विधुरा	1	a	C	½ ang
सीमन्त	5	e	B	4 ang
शृंगाटक	4 (2x2)	a	A	4 ang
अधिपति	1	e	A	½ ang

Rachananusar– सिरा - a, मांस - b, स्नायु - c, अस्थि - d, सन्धि - e,

Parinamanusar–

मद्यप्राणहर - A, कालान्तर - B, विशल्यघ्न - C, वैकल्यकर - D, रुजाकर - E.

विधुर मर्म– It is one of the jtrurdvagata marma, and praman is $^1/_2$ angula, situated below and back of the ear. these are two in number it belongs.to Snayu marma according rachana, and Vaikalyakara Marma according to parinamanusara. its effect was Karna badiyra, and disorders of ears.

शंख मर्म– It is one of the jatrurdvagata marma, and pramana is $^1/_2$ angula situated in between ear and forehead that is shanka pradesha, in relations with shankasthi region. These are two in number. It is asthi Marma according to rachana, Sadya pranahara Marma: according to parinamanusara. Its effect was Sadya pranahara causes immediately death.

मर्म शारीर

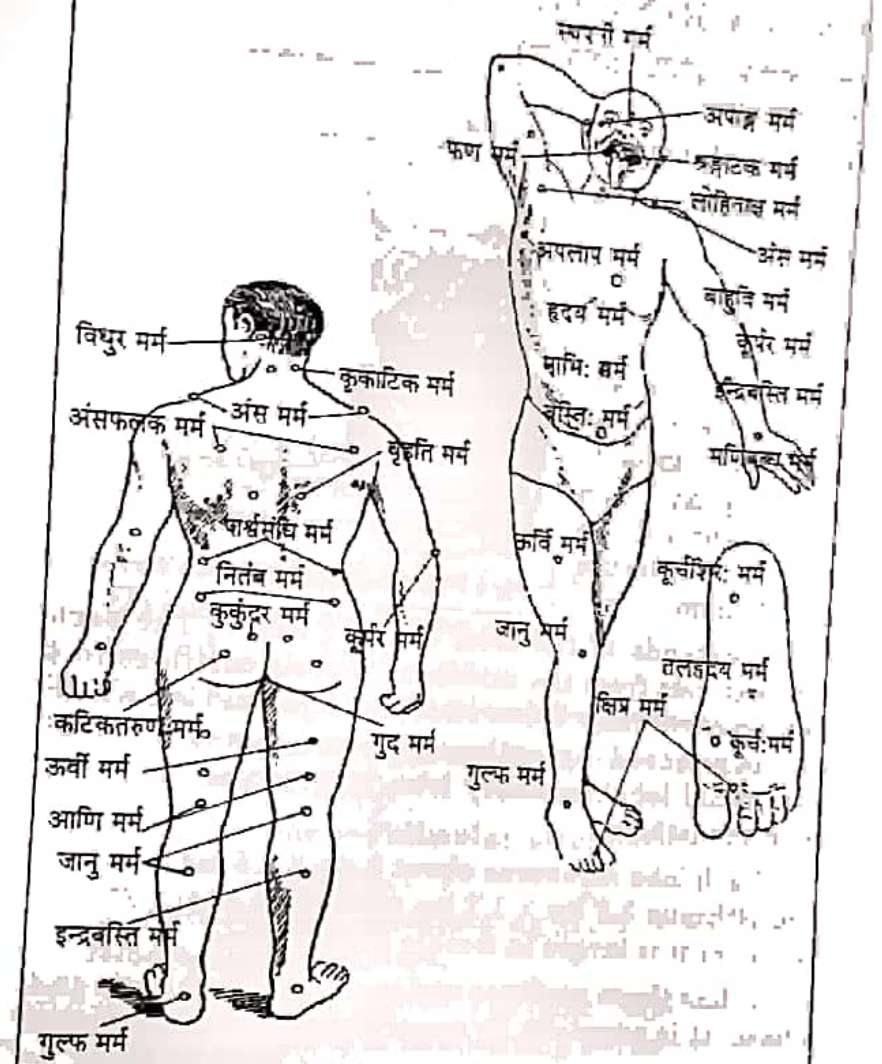


Fig Marmas on the Anterior surface of the Body

Fig. 5.1 Marmas on the Posterior surface of the Body

Chapter-6

ENDOCRINE GLANDS
(नि:स्रोत ग्रन्थि शारीर)

Thyroid Gland (ग्रैवेयक ग्रन्थि)–

It is endocrine gland lies in front and side of lower part of the neck, it regulates the basal metabolic rate, stimulates somatic and psychic growth, and play an important role in the calcium metabolism.

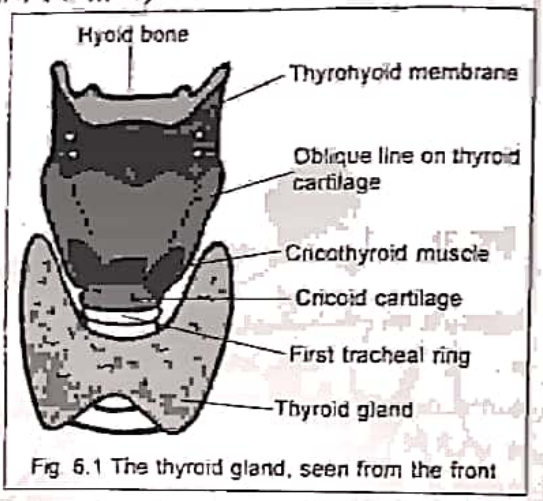


Fig. 6.1 The thyroid gland, seen from the front

It extends at the level of $C_{5, 6, 7}$ and T_1 The each lobe extends from the middle of thyroid cartilage to 4 or 5 tracheal ring. It has two lobes right and left which are connected by isthmus. Some times a third pyramidal lobe/Accessory lobe, may project upwards from the isthmus.

Each lobe measures about 5 cm × 2.5 cm × 2.5 cm and isthmus 1.2 cm × 1.2 cm and weigh about 25 gm. However it is larger in female than males.

It has three surfaces and two borders an apex and a base. It is supplied by superior and inferior thyroid arteries.

Blood Supply–

1. Superior thyroid artery branch of external carotid artery.

2. Inferior thyroid artery- branch of thyrocervical trunk.

3. Accessory arteries branches of tracheal and oesophageal arteries.

Vein– Superior, middle and inferior thyroid veins.

Pituitary Gland (पीयूषक ग्रन्थि)–

It is master gland controls other endocrine glands. It lies in the hypophyseal fossa of the sphenoid bone.

Size– Breadth - 12 mm; Length - 8 mm. It has Adenohypophysis and Neurohypophysis two parts.

External features– It has two lobes anterior and posterior.

Anterior Lobe– It consists of clusters of cells supported by reticular fibres, it secrete the following hormones.

1. Somatotrophic (S.T.H or Growth) hormones.
2. Mammotrophs – Prolactin or Lactogenic hormone (L.T.H)
3. Thyrotrophs – Thyroid stimulating hormone (T.S.H)
4. Corticotrophs – Corticotrophin/Adreno corticotropin hormone (A.C.T.H)
5. Gonadotrophs – Follicular stimulating (F.S.H) hormone.
6. Leuteotrophs – Luteinizing (L.H) hormone in female, I.C.S.H in male.

Intermediate Lobe– The lobe cells are melanotrophs - Melanocyte stimulating hormone (M.S.H) secretes. It causes increase pigmentation of the skin.

Posterior Lobe– Consist the nonmyelinated nerve fibre and special types of neuroglial cells known as pituicyte. It is connected with hypothalamus. It

stores and releasing the Vasopressin (A.D.H) and Oxytocin hormones.

Blood supply–

1. Superior and inferior hypophyseal arteries, branches of internal carotid artery.
2. Venous blood drains into cavernous sinus.

Triangles of the Neck–

There are two triangles mainly in the neck region, which lies on either side of the neck.

1. Anterior triangle 2. Posterior triangle

The two triangles are separated by sternomastoid muscle which is attached to the manubrium sterni and mastoid process of temporal bone along with lateral 1/3 of superior nuchal line.

Anterior Triangle–

It is the triangle which lies in the anterolateral part of the neck, it encloses four supra hyoid and four infra hyoid muscles.

Boundaries–

Anterior– Anterior median plane.

Posterior– Anterior border of sternomastoid muscle.

Base– Base of mandible, and a line joining angle of mandible to mastoid process.

Apex– Manubrium sterni

Divisions of the Anterior Triangle–

It is subdivided by the digastric muscle and the superior belly of omohyoid muscle into four triangles.

1. Submental
2. Carotid
3. Digastric
4. Muscular

Sub Mental Triangle–

It is a median triangle, and bounded as follows :

On each side, the anterior belly of the corresponding digastric muscle. Base is formed by body of the hyoid bone. Apex lies at the chin, floor formed by right and left mylohyoid muscles.

Contents–

1. Submental lymph nodes and veins.
2. Adjoining gums.
3. Anterior part of floor of mouth.
4. Tip of tongue.

Digastric Triangle–

The area between the body of the mandible and the hyoid bone. It is bounded Anterioinferiorly- anterior belly of digastric, posteroinferiorly posterior belly of digastric and stylohyoid muscles. Superiorly [base]- base of mandible and line joining the angle of mandible to the mastoid process. Roof is formed by skin and fascia, floor - is formed by mylohyoid muscle anteriorly, hyoglossus posteriorly.

Contents–

1. Sub mandibular gland.
2. Facial artery and vein.
3. Styloglossus and stylopharyngeus.
4. Mylohyoid nerve and vessels.
5. Intermediate tendon of the digastric.
6. Submental artery.
7. Lower part of parotid gland.
8. Hypoglossal nerve
9. Glossopharyngeal nerve.

Carotid Triangle–

A good view of all large vessels and nerves, it is bounded by - superiorly posterior belly of the digastric muscle, and fascia. Anterioinferiorly - anterior border of sternomastoid muscle. Roof - by skin and fascia. Floor - by thyrohyoid muscle, hyoglossus, middle and inferior constrictors muscles.

Contents–

1. Common carotid, Internal, and external arteries and brs.
2. Internal jugular vein common facial, vein, pharyngeal vein, lingual vein.
3. Vagus nerve, laryngeal nerve, spinal accessory nerve, hypoglossal nerve, sympathetic chain.

Muscular Triangle–

It is infrahyoid region are included in this triangle. It is bounded by - Anteriorly - anterior median line from hyoid bone to sternum, Posteriosuperiorly - Superior belly of omohyoid muscle. Posterioinferiorly - anterior border of the sterno mastoid muscle.

Contents– Infrahyoid muscles namely :

1. Sternohyoid
2. Sternothyroid
3. Thyrohyoid
4. Omohyoid.

Posterior Triangle–

It is a space on the side of the neck situated behind the sternomastoid muscle.

Boundaries–

Anterior– Posterior border of sternomastoid muscle.

Posterior– Anterior border of trapezius.

Base– Middle $^1/_3$ of clavicle.

Apex– Lies on the superior nuchal line where the trapezius sternomastoid meet.

Roof– Investing layer of deep cervical fascia.

Floor– The free vertebral layer of deep cervical fascia cover in the muscles.

Divisions of Posterior Triangle–

It is subdivided by the inferior belly of the omohyoid into

1. Occipital Triangle
2. Supraclavicular [Subclavian] Triangle

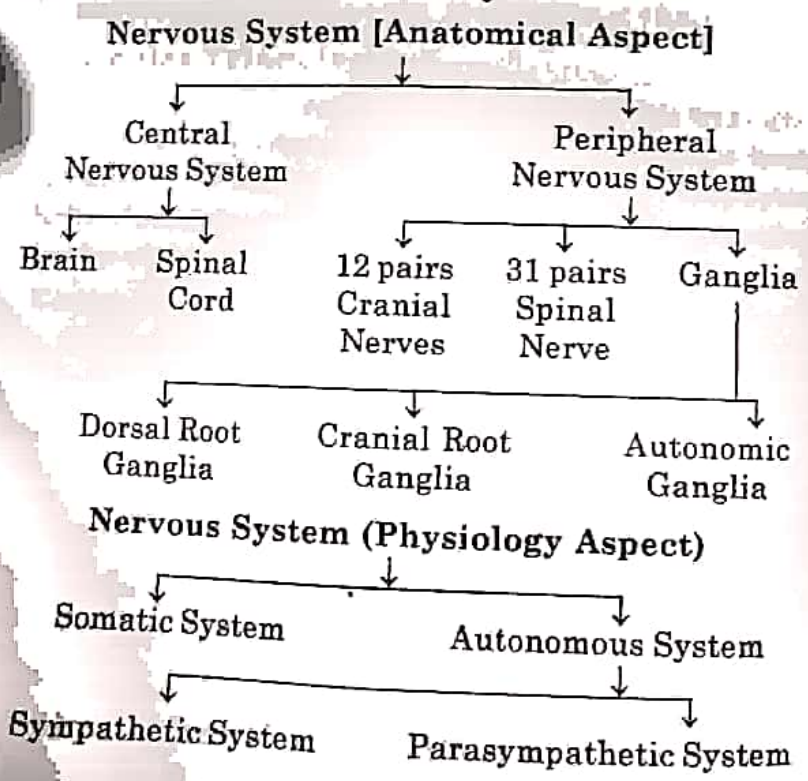
Chapter-7

NERVOUS SYSTEM
(नाडि तन्त्र शारीर)

Introduction–

The nervous system is one of the controlling system, it control all activates of the body, it controls voluntary and involuntary functions of the body, individual can react for internal and external environment. There is response mechanism of the body. Stimulus and response are controlled by the system.

Classification of Nervous System–



Classifications of Brain–

Brain (मस्तिष्क)

Fore brain (पुर मस्तिष्क)	Mid brain (मध्य मस्तिष्क)	Hind brain (पश्चिम मस्तिष्क)
↓	↓	↓
Cerebrum	Cerebral Aqueduct	Pons (उष्णीषक)
		↓
		(सुषुम्ना शिर्षक) Medulla
		↓
		(धम्मिलक) Cerebellum

Cerebrum–

It is largest part of the brain, situated in the cranial cavity with the relation to anterior, middle and posterior cranial fossa. It has two hemispheres, as right and left. These are partly separated by longitudinal tissue and connected with corpus callosum.

Hemisphere Features–

Sulci–

1. Central Sulcus– It separates the frontal lobe from the parietal lobe

2. Parieto occipital Sulcus– It separates the parietal lobe from the occipital lobe, it is more visible on the medial surface of hemisphere.

3. Lateral Sulcus– It separates the temporal lobe from the parietal and frontal lobes

Lobes–

1. Frontal Lobe
2. Parietal Lobe
3. Occipital Lobe
4. Temporal Lobe

Surfaces–

1. Superio Lateral. 2. Medial. Surface
3. Inferior has Tentorial and Orbital.

Poles–

1. Frontal pole 2. Temporal 3. Occipital

Borders–

1. Superiomedial.
2. Inferolateral.
3. Superciliary.
4. Medial Orbital.
5. Medial Occipital.

Internal features–

1. Grey Matter– outer peripheral layer
2. White Matter – Inner layer
3. Basal Nucleus.

Grey Matter–

It forms the outer peripheral layer, 1.5 to 4.5 mm in thickness known as cerebral cortex. It consists of innumerable nerve cells about 15 billions cells. The cerebral cortex consists three layers :

1. **Allocortex**– Outer layer of cells, consisting three layers of cells

2. **Meso Cortex**– It is middle layer of cells, consisting four or five layers.

3. **Isocortex**– Inner most layer of cells consisting six layers of cells.

White Matter–

It forms the central core, it consists of multitudes of nerve fibres connecting various parts of the cortex with other parts of CNS. There are three types of nerve fibers in the white matter namely :

Fig. 7.1 Sagittal Section of the Brain

1. Association Fibres– The fibres connecting within the same hemisphere from one lobe to other lobes.

2. Commissural Fibres– The fibres connecting from one hemisphere to opposite hemisphere, the fibres are crossing to the opposite side.

3. Projecting Fibres– The fibres are connecting from cerebrum to other parts of the central system like pons, medulla, cerebellum and spinal cord.

Basal Nucleus–

Basal nucleus are the large masses of grey matter situated deeply within the white matter of the cerebral hemispheres.

1. Corpus Striatum
2. Caudate Nucleus
3. Amygdaloid Body
4. Lenticular Nucleus
5. Claustrum.

Frontal Lobe–

This lobe is separated from the parietal lobe by a central sulcus. It is lies in the anterior cranial fossa.

further it is classified in to gyrus and sulci. The main gyrus are pre central, superior, middle and inferior gyrus. It is mainly belongs to the motor centers like voluntary control system. The skeletal movements, speech centre and the eye field areas are lies.

Parietal Lobe–

It is related with the parietal bone and separated from the frontal lobe by a central sulcus anteriorly, occipital lobe by a parieto-occipital sulcus posteriorly. It has mainly post central, superior, middle and inferior gyrus. It is mainly belongs to the sensory centers.

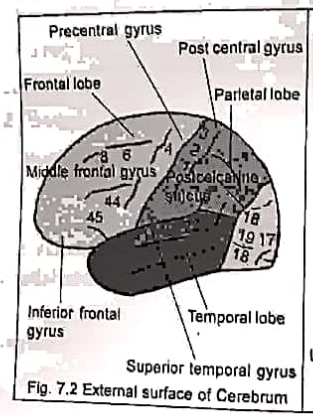


Fig. 7.2 External surface of Cerebrum

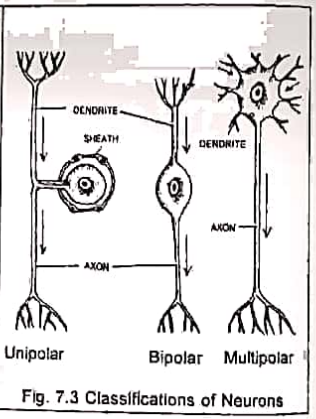


Fig. 7.3 Classifications of Neurons

Occipital Lobe–

It is posterior lobe related with the occipital bone, it is separated from the parietal lobe by parieto occipital lobe. It belongs to mainly vision area.

Temporal lobe–

It is lies below the parietal lobe and separated by a lateral sulcus, and belongs to the auditory centers.

Blood Supply– Anterior cerebral arteries, branch of internal carotid.

Cerebral Cortex–

Frontal Lobe– Frontal Lobe Consist 2 parts – [Functional]

1. Pre Central Cortex 2. Pre Frontal Cortex

Pre Central Cortex–

It is also called excitomotor cortex it is divided into 3 parts :

1. Primary Motor Area. (4 and 4a)
3. Supplementary Motor Area.
2. Pre Motor Area. (6, 8, 44, and 45)

Primary Motor Area–

The area Nos. 4 and 4a is the primary motor area. Connections are–

Efferent nerve fibres–

(a) Corticospinal Tracts [Pyramidal Tract].

(b) Fronto Pontine Fibers.

(c) To Corpus Striatum, Red Nucleus, Thalamus, Subthalamus and Reticular Formation.

(d) To other areas of Cortex [Association Fibers].

Afferent fibres–

(a) From Dentate nucleus via Red nucleus and Thalamus.

Functions–

Concerned with initiation of voluntary movements and speech. Area 4 is center for movement, Body represents upside down [medial surface to lateral surface] like – toes, ankle, knee, hip, trunk, shoulder, arm, elbow, wrist, hand, fingers, and face. However, the

face is not represented in inverted manner, face from above downwards is eye lids, nose, cheek, upper lip, lower lip. Sends motor signals to the facial muscles of both sides [bilateral] and other muscles of the apposite side. During recovery of paralysis, upper part of body recover fast, if area 4 is affected along with are 6 the effect is very severe. Area 4a is called suppressor area; it inhibits movements initiated by area 4.

Premotor Area - Areas numbers 6, 8, 44 and 45.

It is concerned with the postural movements and sends motor signals to the axial muscles.

Area 6–

It is sub divided into 6 a and 6 b. 6 a is concerned with coordination of movements initiated by area 4. Thus the skilled movements are accurate and smooth. 6 b is the cortical center for extra pyramidal system.

Area 8–

It is frontal eye field, it is concerned with movements of eyeball, it receives afferent fibers from dorsomedial nucleus of thalamus and with occipital lobe. It sends efferent fibers to oculomotor nuclei in tegmentum of mid brain. Frontal eye field is concerned with conjugate movement of eyeballs, opening and closure of eye lids, pupillary dilatation and lacrimation.

Area 44 and 45 [Broca's]–

These are motor area of speech in inferior frontal gyrus, 44 is lies in pars triangularis and 45 in pars opercularis.

Function– It is responsible for movement of tongue, lips and larynx. This area is situated in left hemisphere [dominant hemisphere] in right-handed persons.

Supplementary Motor Area–

It lies in medial surface of frontal lobe. Various motor movements are elicited like raising the contra lateral arm, Turning the head and eye, movements of synergetic muscles of trunk and legs coordinated skilled movements.

Pre Frontal Cortex or orbitofrontal Cortex–

Areas are 9, 10, 11, 12, 13, 14, 23, 24, 29 and 32. Areas 23, 24, 29 and 32 are in medial surface.

Connections–

Afferent fibres– Receives afferent fibers from :

(a) Dorsomedial Nucleus of Thalamus.
(b) Hypothalamus.
(c) Corpus Striatum.
(d) Amygdaloid.
(e) Mid Brain.

Efferent fibres– Cortex sends fibers to

(a) Thalamus
(b) Hypothalamus
(c) Tegmentum
(d) Caudate nucleus
(e) Pons
(f) Temporal lobe

Functions–

Earlier it is in excitable so, it was called the silent area. Now, it is known stimulation of this area with low voltage electrical stimulus causes changes in the activity of G. I. Tract, Cardiovascular, Respiratory and Excretory Systems and other autonomic functions. It also causes fear.

(a) Center for the higher functions like emotion, learning, memory and social behavior. Short-term memories are registered here.
(b) Center for planned actions.
(c) Seat of Intelligence [organ of mind].

(d) Responsible for the various autonomic changes during emotional conditions.

Applied Physiology–

1. Emotional instability
2. Lack of concentration.
3. Lack of initiation and difficulty in planning.
4. Impairment of recent memory occurs.
5. Loss of moral and social sense is common and there loss of love for family and friends.
6. Failure to realize the seriousness of the condition.
7. Functional abnormalities like Hyperphagia-increased appetite. Loss of control over sphincter of the urinary tract and rectum. Disturbance in orientation and slight tremor.

Parietal Lobe– Functionally it is divided into 3 areas.

1. Somesthetic area I or Primary sensory area 3, 1 and 2.
2. Somesthetic area II.
3. Somesthetic association area 5 and 7.

Somesthetic Area No. I–

It receives sensory fibers from thalamus, Receive sensory impulses from cutaneous receptors [touch, pressure, pain, temperature] and proprioceptors of opposite side.

Area No.1 is concerned with sensory perception and area nos. 2 and 3 are involved in the integration of these sensations. This area sends sensory feedback to the premotor area. It is also concerned with the movement of head and eye balls. This area is also responsible for recognizing the discriminative features of sensations.

Somesthetic Area No.II–

This area receives sensory impulses from somesthetic area I and from thalamus directly. Though the exact role of this area is not clear. It is concerned with perception of sensation.

Somesthetic Association Area–

The area 5 and 7 are concerned with synthesis of various sensations, perceived by somesthetic area 1.

Temporal Lobe–

Primary auditory area– 41,42, and wernicke area

Audiopsychic area– area no - 22

Primary Auditory Area–

41 and 42 areas are bes in the anterior transverse gyrus and lateral surface of superior temporal gyrus wernick's area is in upper part of superior temporal gyrus posterior to area no 41 and 42.

Connections– Afferent fibres: Receive from

1. Medial Geniculate Body.
2. Pulvinar of Thalamus.

Efferent fibres : Sends to

1. Medial Geniculate Body. 2. Superior Colliculus.
3. Pulvinar

Functions–

The areas 41 42 are concerned only with perceptions of auditory impulse. Interpretation of sound occure with the help of audiopsychic [area 22) and Wernicke s area.

Audiopsychic area–

Area 22. Concerned with interpretation of auditory sensations along with Wernicke's area.

Area of Equilibrium–

It lies in the posterior part of Superior temporal gyrus. It is concerned with maintenance of equilibrium of the body stimulation of this causes dizziness, swaying, falling and feeling of rotation.

Applied–

1. Aphasia [Disturbance in Speech].
2. Auditory disturbances.
3. Disturbances is smell and taste sensations occur.
4. Dreamy states– The patients are not aware of their own activities and have the feeling of unreality.

Occipital Lobe–

Areas of visual cortex consists of three areas. Visual cortex - Primary visual 17, Visual association 18, Occipital eye field 19.

Connections–

Afferent fibres– Receives from lateral geniculate body

Efferent fibres– Sends to superior colliculus and lateral geniculate body

Functions–

Area 17 – is concerned with perception of visual impulses.

Area 18 – is concerned with interpretation of visual impulses.

Area 19 – is concerned with movement of eyes.

Thalamus–

Thalamus is a large ovoid mass of gray matter, situated bilaterally in diencephalon. The thalamus on both sides lies in the lateral wall of the 3rd ventricle

and in the floor of the central part of the lateral ventricle. It has anterior and posterior ends; superior, inferior, medial and lateral surfaces.

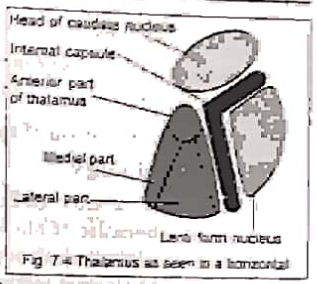


Fig 7.4 Thalamus as seen in a horizontal

The anterior end is narrow and forms the posterior boundary of the interventricular foramen. The posterior end is expanded; it overhangs the lateral and medial geniculate bodies.

Thalamic Nuclei–

Each thalamus is divided into 5 main nuclear groups by the internal medullary septum. The nuclear groups of thalamus are :

1. Midline Nuclei.
2. Intralaminar Nuclei.
3. Medial Mass of Nuclei.
4. Lateral Mass of Nuclei.
5. Posterior Group of Nuclei.

Functions of Thalamus–

It is primarily concerned with somatic functions and it plays little role in the visceral functions. Thalamus usually considered as a "Functional Gateway" for cerebral cortex. The various functions of thalamus are :

1. Relay center for the sensations.
2. Center for modification and integration of sensory impulses. It is also a center determining the quality of crude sensations. Sensations have two qualities.

(a) The discriminative nature

(b) The affective nature.

3. Sexual sensations
4. Arousal and alertness reactions
5. Reflex activity
6. Center for integration of motor functions

Applied Physiology–

Causes of Thalamic Lesion– The thalamic lesion occurs mostly because of blockage [due to thrombosis] of thalmogeniculate branch of posterior cerebral artery. The lesion of thalamus leads to thalamic syndrome. Following are the symptoms of thalamic syndrome.

1. Loss of sensation.
2. Astereognosis [Ability to recognize a known object by touch with closed eyes is called stereognosis. The loss of this is known as astereognosis].
3. Ataxia– Incoordination of voluntary movements.
4. The patient is unable to locate the position of a limb with closed eyes.
5. Spontaneous pain.

Limbic System–

It is a group of cortical and sub cortical structures, which form a limbus or ring around the hilus of cerebral hemispheres. It is also called limbic lobe, formerly this was called as rhinencephalon. The parts of the human brain controlling behavioral patterns involved in higher functions of human beings. A series of structures constitute the limbic system.

Components of Limbic System–

A. Paleocortical Structures–

1. Hippo Campus. 2. Pyriform Cortex.
3. Olfactory pathway and Olfactory area

B. Cingulate Gyrus or Limbic Cortex–

C. Sub cortical structure–

1. Amygdaloid Complex.
2. Septal Nuclei.
3. Thalamic Nuclei.
4. Hypo Thalamic Nuclei.
5. Caudate Nuclei.
6. Reticular formation of Midbrain

Functions of the Limbic System–

1. Regulation of Endocrine Glands.
2. Olfaction [Olfactory Center].
3. Regulation of Food Intake.
4. Regulation of A.N.S like Heart rate, Blood pleasure, Water balance, Body temperature.
5. Regulation of Sexual Function.
6. Emotional State.
7. Motivation.

Cerebellum (धम्मिलक)–

It is the largest part of the hindbrain, lies in the posterior cranial fossa behind the pons and medulla.

Two cerebellar hemispheres are united to each other through a median vermis. It has two surfaces as superior and inferior. Superior is convex and Inferior is a deep median notch.

Three Lobes– 1. Anterior lobe; 2. Middle Lobe– Largest lobe; 3. Floculonodular lobe is Smallest lobe.

Three fissures–

1. Horizontal fissure Separates superior and inferior surfaces.
2. Primary fissure separated anterior and middle lobes.
3. Posterolateral fissure separates floculonodular lobe and middle lobe.

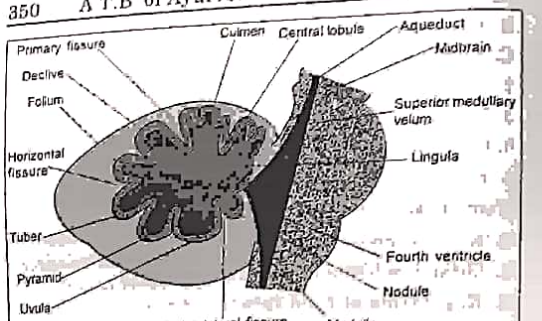


Fig. 7.5 Sagittal section through the brain stem and cerebel

Cerebellar hemispheres consists the following lobules.

1. Ala.
2. Quadrangular Lobule.
3. Simple Lobule.
4. Superior Semilunar Lobule.
5. Inferior Semilunar.
6. Biventral Lobule.
7. Tonsil.
8. Flocculus.

Vermis consists the following Lobules–

1. Lingula
2. Central Lobule
3. Culmen
4. Declive
5. Folium
6. Tuber
7. Pyramid
8. Uvula
9. Nodule

{Lala, Chand, Could; Die, For, Terlyne, Pant, Un, Necessarily }

Internal Structure–

Grey matter– Consists the cerebellar cortex and the carebellar nuclei

1. Nucleus Dentatus
2. Nucleus Globosus
3. Nucleus Emboliformis.
4. Nuclei, Fastigii.

White Matter–

Consists nerve fibres which are extrinsic and intrinsic fibres. Cerebellum connect through group of nerve fibres to form three peduncles which connect to the mid brain, pons and medulla.

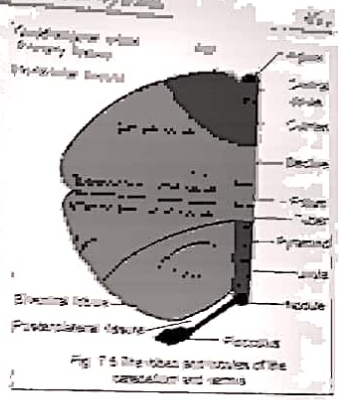


Fig. 7.6 The lobes and nuclei of the cerebellum and vermis

Cerebellar Peduncles–

Three pairs of cerebellar peduncles connect the cerebellum to the mid brain, pons and medulla.

Superior cerebellar peduncles–

It connects the cerebellum and mid brain, consist the afferents and efferents nerve fibres (Tracts).

1. Anterior spino cerebellar
2. Trigemino cerebellar
3. Tecto cerebellar
4. Cerebello rubral
5. Dentate thalamic

Middle cerebellar peduncles–

It connects the pons with cerebellum, it consists the ponto cerebellar fibres.

Inferior cerebellar peduncles–

It connects the medulla with cerebellum, it is also consisting afferents and efferents nerve tracts.

Blood supply–

1. Posterior inferior cerebellar artery branch of vertebral artery.

2. Anterior inferior cerebellar artery branch of basilar artery.
3. Superior cerebellar artery branch of basilar artery.
4. Veins drains into straight, transverse, sigmoid and occipital sinuses.

Functions of Cerebellum–

Archicerebellum [Vestibulcerebellum]–

1. It is connected with vestibular apparatus.
2. It is concerned with maintenance of posture and equilibrium.
3. It plays an important role in the maintenance of tone posture and equilibrium.

Paleocerebellum [Spinocerbellum]–

It is connected with spinal cord; it is concerned with the maintenance of muscle tone and anticipatory adjustment of muscle contraction during movement.

Neocerebellum [Corticocerebellum or Cerebrocerebellum]–

1. Its connection with cerebral cortex.
2. It is concerned with planning, programming and coordination of skilled movements.
3. Concerned with the integration and regulation of well-coordinated muscular activities.
4. The lesion in corticocerebellum leads to disturbances in movements.

Mechanism of Action of Corticocerebellum–

Domping Action–

Any extra or exaggeration of muscular activity is prevented and the movements become smooth and accurate.

Ballistic Movements–

The rapid alternate movements which take place in different parts of the body, while doing any skilled or trained work like typing, cycling, dancing etc. Neocerebellum plays an important role in pre planning of these movements during learning process.

Timing and Programming the Movement–

A chain of movements occur rapidly in a sequential manner, while using a typewriter or any other fast skilled work. It plans the time duration of each movement; time interval between movements- and the various sequential movements.

Servomechanism–

If there is any interference, in skilled and sequential movements. The cortico cerebellum immediately influences the cortex and corrects the movements, this action is known as servomechanism.

Comparator Function–

The movements become accurate and precise. This function is known as Comparator Function.

Applied Physiology–

1. Disturbances in tone and posture.
   (a) Atonia – Loss of tone in muscle.
   (b) Attitude – Changes in the attitude.
   (c) Hypotonia – Reduction of tone in muscle.
   (d) Deviation Movement.
   (e) Effect on deep reflexes
2. Disturbances in equilibrium
3. Disturbances in movements
   (a) Ataxia – Lack of coordination of movement.

(b) Asynergia – Lack of coordination between different groups of muscles.

(c) Asthenia – Weakness of muscles.

(d) Dysmetria – The inability to properly direct or limit motions.

(e) Intention tremor– Rapid alternate rhythmic and involuntary movement of flexion and extension in the joints of fingers and wrist or elbow.

(f) Astasia – Unsteady voluntary movements.

(g) Nystagmus – To and fro movement of eyeball.

(h) Dysarthria – The disturbance in speech is called dysarthria [non-coordination of speech muscles].

(i) Adiadochokinesis– Inability to do rapid alternate successive movements like supination and pronation.

Pons (उष्णीषक)–

It is the ventral part of the hindbrain and middle part of brain stem. It is continuous above with the mid brain and below with the Medulla oblongata. It lies in the posterior cranial fossa. It is about 2.5 cm long.

External features–

Two - surfaces– 1. Ventral 2. Dorsal

Ventral Surface–

It is convex from side to side and concave from above downwards. There is a shallow sulcus in the median plane, known as basilar sulcus which lodges the basilar artery. Laterally the surface is continuous with the middle cerebellar peduncle. The trigeminal nerve, the abducent nerve, the facial nerve and the vestibulocochlear nerves are attached.

Dorsal or Posterior Surface–

It forms the upper part of the floor of the 4th ventricle and is hidden by cerebellum.

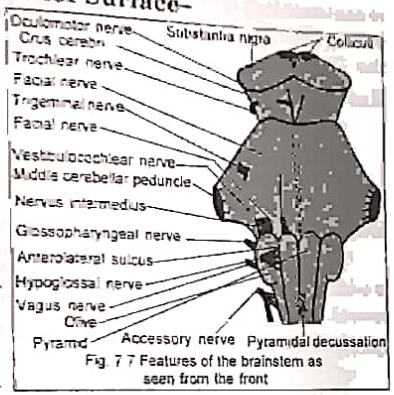


Fig. 7.7 Features of the brainstem as seen from the front

Internal Features–

Basilar Part– It consists of nerve cells and nerve fibres,

Nerve Cell– Pontine nuclei.

Nerve Fibres– 1. Longitudinal Fibres
2. Transverse Fibres

Tegmentum– It consists ascending and descending tracts and nuclei of cranial nerves (5th, 6th, 7th, 8th).

Blood supply– Pontine branches of basilar artery, hemorrhage may cause contra lateral hemiplegia.

Medulla Oblongata (सुषुम्ना शीर्षक)–

It is ventral part of the hind brain. It is continuous above with the pons and below with the spinal cord. It is piriform shape, having width 2 cm; length 3 cm and thickness 1.25 cm.

Cavity of the Medulla– The medulla is divided into two parts.

1. Lower Closed Part 2. Upper Open Part.

The lower part of the medulla contain central canal

is continuation with the central canal of the spinal cord below. The upper part of the medulla forms the floor of the 4th ventricle.

External Features–

Two surfaces– 1. Ventral and 2. Dorsal

Two fissures– 1. Anteromedian fissure;
2. Posteromedian Sulcus.

Regions - Anterior Region–

Elongated elevation on either side of anterior median fissure called the pyramids contain cortico spinal fibres.

Lateral Region–

Prominent oval swelling lateral to pyramids known as the olive. It is olivary nucleus. Posterolateral presents inferior cerebellar peduncles.

Posterior Region–

Lower Part– Consists two fasciculus.

1. Fasciculus Gracilis on the medial side.
2. Fasciculus Cuneatus Laterally

Upper Part– The Medulla opens posteriorly into the 4th ventricle.

Internal Features–

It resembles a transverse section of the spinal cord in having the same three funiculi and the same tracts. It has 9th, 10th, 11th, 12th nuclei of cranial nerves.

1. Nucleus gracilis and cuneatus,
2. Hypoglossal nucleus
3. Dorsal nucleus of vagus
4. Solitary nucleus
5. Spinal nucleus of trigeminal nerve.

4. Nucleus ambiguus
5. Inferior olivary nucleus
6. Vestibular nucleus

Visceral Centres–

1. Respiratory centre.
2. Cardiac centre for regulation of heart rate
3. Vasomotor centre for regulation of blood pressure

Blood supply– Anterior spinal artery, branch of vertebral artery and posterior inferior cerebellar artery

Cerebro Spinal Fluid–

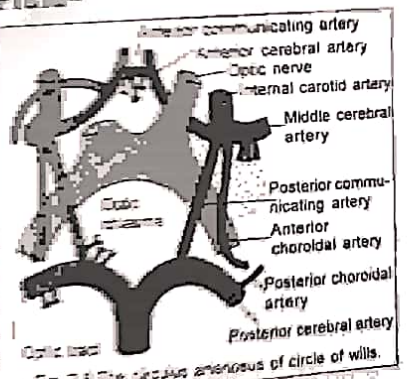


Fig. 7.8 The circulus arteriosus of circle of Willis.

It is modified tissue fluid, lies in the ventricular system of the brain and in the subarachnoid space around the brain and spinal cord. CSF replaces lymph in the CNS. It protects the brain and spinal cord. It is formed by the choroid plexuses of the lateral ventricles and small amounts of the third and fourth ventricles. Choroid plexus are clusters of blood capillaries.

Total quantity– 120 ml. Normal pressure - 6 to 100 mm of C S F (or of water)

Circulation–

C S F passes from each lateral ventricle to the 3rd ventricle through the interventricular foramen. From

the third ventricle it passes to the fourth ventricle through the cerebral aqueduct. From the 4th ventricle the CSF passes to the subarachnoid space through the median and lateral apertures of the 4th ventricle and to central canal of the Spinal cord.

Absorption– It is absorb chiefly through the arachnoid villi and granulations in the superior sagittal sinus, thus drains into the cranial venous sinuses.

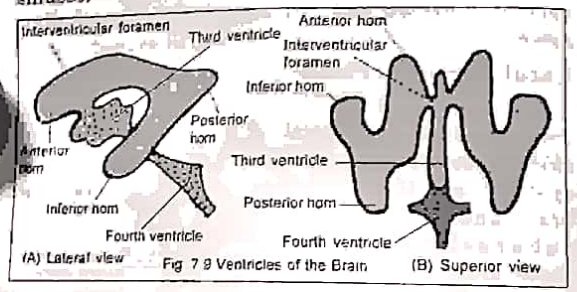


Fig 7.9 Ventricles of the Brain

Functions–

It is protective, nutritive and path way for metabolites from the CNS syste m.It regulates the volume of cra nial cavity..

Spinal Cord (सुषुम्ना काण्ड)–

It is the organ of central nervous system situated in the upper two third of the vertebral column. It is cylindrical and elongated.

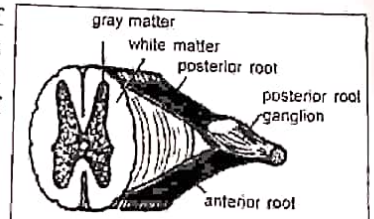


Fig. 7.10 Cross Section of Spinal cord

Extends–

It extends from the level of the upper border of the atlas up to the lower border of L1 vertebra. It is about 45 cm in length. The lower end is conical in shape known as the conus medullaris. The apex of the conus medullaris continued down as the filum terminale, along its length, the cord presents two enlargements. one is cervical and anther one is lumbar enlargements.

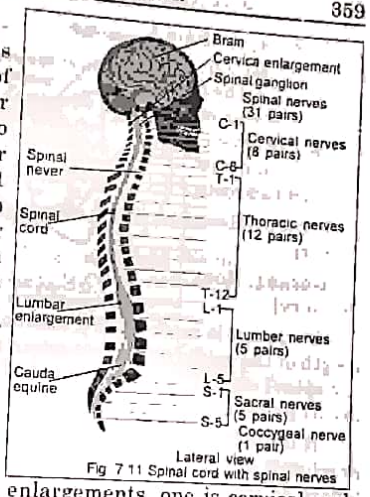


Fig 7.11 Spinal cord with spinal nerves

Internal Structures–

Grey matter internally forms an H Shaped mass in the center. In each half of the spinal cord the grey matter is divisible into anterior, posterior and a small lateral grey columns. It consists of cell bodies, in center there is canal which is known as central canal of the spinal cord. The central canal has slit dilatation at the conus medullaris is known as terminal ventricle. The C.S.F circulate in this central canal and nourishes the spinal cells.

White matter is peripheral forms in half of the spinal cord is divisible into anterior, lateral and posterior columns. It consist of group of nerve fibres known as ascending and descending tracts.

The spinal cord gives attachment on either side to a series of spinal nerves. Each spinal nerve arises by two roots

1. Ventral Root [Motor]
2. Dorsal Root [Sensory]

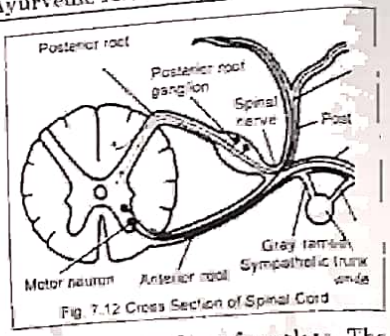


Fig. 7.12 Cross Section of Spinal Cord

Each root is made up of a number of rootlets. The length of the spinal cord gives origin to the rootlets for one spinal nerve constitutes one spinal segment. There are 31 pairs of spinal segments.

It is covered by three meningeal layers like dura, arachnoid and pia maters. Spinal dura mater is single, where as cranial dura matter is double as endosteal and meningeal layers. The filum terminale is 20 cm length and divided into filum internum - 15 cm, and filum externum - 5cm. It is supplied by anterior and posterior spinal arteries

Spinal Nerves (सुषुम्ना नाडि)–

The Spinal Nerve is formed by the union of ventral and dorsal nerve roots on either side of the spinal cord. The spinal nerve, divides into ventral and dorsal rami. The dorsal nerve root is sensory root, Ventral nerve root is motor root. Spinal nerve is covered

by meningeal layer within the vertebral column, it emerges through their respective inter vertebral foramen.

There are 31 pairs of spinal nerve and classified as follows–

1. Cervical spinal nerves	8 pairs	ग्रीवानुग नाडि.
2. Thoracic spinal nerves	12 pairs	पृष्ठानुग नाडि
3. Lumbar spinal nerves	5 pairs	कटिपूर्वि नाडि
4. Sacral spinal nerves	5 pairs	त्रिकपूर्वि नाडि
5. Corygeal spinal nerves	1 pair	अनुत्रिकपूर्वि नाडि

Cervical plexus (ग्रीवानुग नाडि प्रवेणि)–

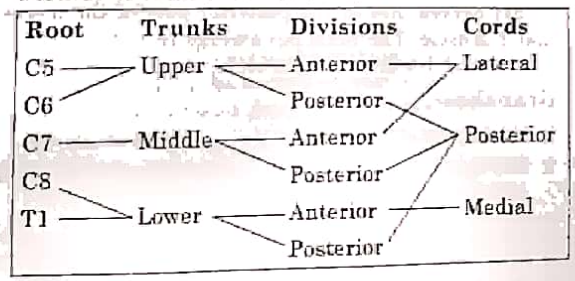
Cervical plexus is formed by the union of ventral rami of the first four cervical nerves, it is covered in front by the cervical fascia.

Branches–

1. Cutaneous brs – skin of the head, neck and thorax
2. Muscular brs – some muscles of the neck
3. Phrenic nerve – It is the only motor nerve supply to the diaphragm. It is formed by ventral rami of C_3, C_4 and C_5.

Brachial plexus (कक्षानुग नाडि प्रवेणि)–

It is formed by the ventral rami of the C5, 6, 7, 8 and T1 spinal nerves. It lies in the posterior triangle. The plexus may be divided into the roots, the trunks, the divisions and the cords level.



Branches–

1. From the Lateral Cord–
   (a) Lateral Root of Median Nerve [C_{5-7}].
   (b) Lateral pectoral Nerve [C_{5-7}].
   (c) Musculocutaneous Nerve [C_{5-7}].
2. From the Medial Cord–
   (a) Medial Root of Median Nerve [C_8, T_1].
   (b) Medial Pectoral Nerve [C_8, T_1].
   (c) Medial Cutaneous Nerve of Arm [C_8, T_1].
   (d) Medial Cutaneous Nerve of Fore Arm [C_8, T_1].
   (e) Ulnar Nerve [$C_{7,8}$, T_1].
3. From the Post Cord–
   (a) Upper and Lower Subscapular Nerve [$C_{5,8}$]
   (b) Thoracodorsal Nerve [$C_{6,7,8}$ T_1].
   (c) Axillary Nerve [$C_{5,6}$].
   (d) Radial Nerve [C_{5-8} T_1].

The median nerve is formed by the union of lateral and medial roots.

Lumbar plexus (कटि पूर्वि नाडि प्रवेणि)–

It is formed by the ventral rami of the L_1 to L_4 spinal nerves, lies in the posterior part of the psoas major muscle. The branches emerge from the lateral and medial borders of the muscle.

Branches–

1. Ilio hypogastric.
2. Ilio Inguinal– Enter the lateral and anterior abdominal wall.
3. Lateral Cutaneous Nerve of the Thigh– Enters the thigh.

4. Femoral Nerve– [L_2 L_3, L_4] enters the thigh behind the inguinal ligament.
5. Obturator Nerve– [L_2 L_3 and L_4] crosses the pelvic brim in front of the sacro iliac joint and behind the common Iliac vessels.

Sacral plexus (त्रिकपूर्वि नाडि प्रवेणि)–

It is formed by the union of ventral rami of the L_4, L_5 and $S_{1,2,3,4}$ Spinal nerves. The L_4 nerve join with L_5 nerve to form the Lumbosacral trunk. The trunk

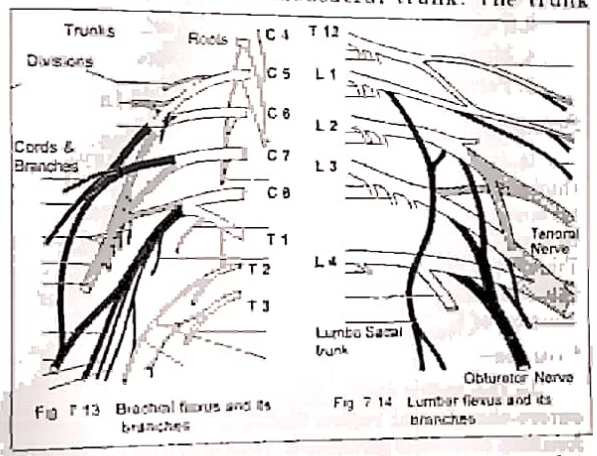


Fig 7.13 Brachial plexus and its branches

Fig 7.14 Lumbar plexus and its branches

descends over the ala of the sacrum, crosses the pelvic brim in front of the sacroiliac joint and joins nerve S_1. Branches derived from both dorsal and ventral divisions are :

1. Sciatic Nerve– The common peroneal nerve from dorsal division [$L_{4,5}$ $S_{1,2}$]. The tibial nerve from ventral division [$L_{4,5}$ $S_{1,2,3}$].
2. Posterior Cutaneous Nerve of Thigh– Dorsal division of $S_{1,2}$ and ventral division of $S_{1,2}$.

1. Branches from Dorsal Division–

(a) Superior Gluteal Nerve.
(b) Interior Gluteal Nerve.
(c) Nerve to Piriformis.
(d) Perforating Cutaneous Nerve.

2. Branches from Ventral Division–

1. Nerve to Quadratus Femoris
2. Nerve to Obturator Internus.
3. Pudendal Nerve.
4. Muscular brs to perineal muscles.
5. Pelvic splanchnic nerves.

Sciatic Nerve (गृध्रसि नाडि)–

It is the largest branch of Sacral plexus, and thickest nerve in the body. It begins in the pelvis and terminates at the superior angle of the popliteal fossa by dividing into the tibial and common peroneal nerve. Tibial part is formed by the ventral division of $L_{4,5}\ S_{1,2,3}$ the common peroneal part is formed by the dorsal division of $L_{4,5}\ S_{1,2}$

Course–

In the pelvis it lies in front of piriformis then it enters the gluteal region through the greater sciatic foramen below the piriformis, runs downwards passing between ischial tuberosity and the greater trochanter. Then it enters the back of the thigh, runs vertically downwards up to the superior angle of the popliteal fossa. It terminates by dividing into the tibial and common peroneal branches

Branches–

1. Articular branches.
2. Muscular branches.

1. Terminal branches - Tibial and Common Peroneal Nerves.

Applied-

1. Shooting pain along with branches is known as Sciatica, pain begins in the gluteal region, and radiates along the back of the thigh and the lateral side of the leg to the dorsum of the foot.
2. Nerve may be injured by penetrating wounds, dislocation of the hip joint, the fracture of the pelvis, this results in loss of all movements below the knee, sensory loss in the back of the thigh and the whole leg.

Cranial Nerves (शंखस्थ स्नायु)-

There are 12 pairs of cranial nerves originates from the Brain and distributed to the different parts of the body.

	Name	Type	Location	Distribution
1.	Olfactory (Ghranid Nadi)	Sensory	Fore brain	Nose of Smell
2.	Optic (Drashi Nadi)	Sensory	Fore brain	Nerve of Vision
3.	Oculomotor (netra peshi prachesta)	Motor	Mid brain	Eye muscles except superior oblique and Lateral rectus
4.	Trochlear (Netra Peshi prachesta)	Motor	Mid brain	To superior oblique
5.	Trigeminal (Tridhara)	Both	Pons	Three branches Ophthalmic, Maxillary and Mandibular

	Name	Type	Location	Distribution
6.	Abducent [Netra Peshi Prachesta]	Motor	Pons	To lateral rectus
7.	Facial [Vaktra Nadi]	Both	Pons	Motor - facial muscles lingual gland sensory - Anterior 2/3 of tongue and soft palate
8.	Auditory [Shruti Nadi]	Sensory	Pons	Nerve of hearing
9.	Glosso pharyngeal [Kantarasani Nadi]	Both	Medulla Oblongata	Motor pharyngeal muscles Parotid gland. Sensory, post 1/3 of tongue, tonsil, pharynx carotid sinus and body.
10.	Vagus [Pranada Nadi)	Both	Medulla Oblongata	Thorax and Abdominal viscera
11.	Accessory [Greeva Prstagas]	Motor	Medulla Oblongata	To sterno mastoid, Trape, zius and constrictor muscles
12.	Hypoglossal [Jeevha talika]	Motor	Medulla Oblongata	Muscles of Neck and Tongue.

1	2	3.	4	5	6
One	Of	Our	Trained	Teacher	Asked
Some	Says	Marry	Money	But	My
7	8	9	10	11	12
For	A	Good	Vehicle	And	Horse
Brother	Says	Bad	Business	Marry	Money

Chapter-8

SHATA CHAKRA SHAREERA
(षट् चक्र)

Introduction-

In Hinduism and in some related Asian cultures, chakra is thought to be a nexus of metaphysical and or biophysical energy residing in the human body.

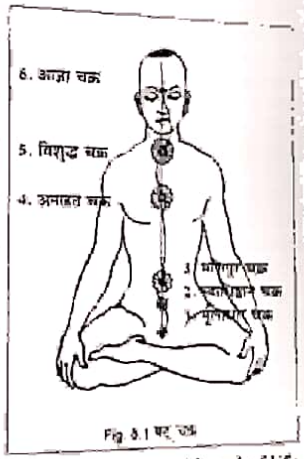


Fig. 8.1 षट् चक्र

The shata chakras are mainly explained in the yoga samhita. The chakras are thought to vitalize the physical body and to be associated with interactions of a physical, emotional, and mental nature. The chakras are considered of life energy or prana, (also called Shakti), which is thought to flow among them along pathways called nadis. The function of chakras is to spin and draw in this universal life force energy to keep the spiritual, mental, physical health of the body in balance.

Definition-

The word "chakra" signifies a wheel. The chakra is an energy centre in the human body and its energy

system through which power and life force flow. The chakras are conceived as focal points where psychic forces and bodily functions merge with and interact with each other.

- The New Encyclopedia Britannica, Volume 3, 1993, page 58

Shat Chakras (षट् चक्र निरूपणे)–

चतुर्दलं स्याद् आधारं स्व अधिष्ठानं च षट् दलम् ।
नाभेर्दशदलं पद्मं सूर्य संख्या दलं हृदि ॥
कण्ठे स्याद् षोडशदलं भ्रूमध्ये द्विदलं तथा ।
सहस्रदलमाख्यातं ब्रह्मरन्ध्रे महाप्रभे ॥ (शिव संहिता)

The shata chakras are as follows. These lies with in the merudhand in the median plain starts from the lower to the above.

१. मूलाधार चक्र	३. मणिपूर चक्र	५. विशुद्ध चक्र
२. स्वाधिष्ठान चक्र	४. अनाहत चक्र	६. आज्ञा चक्र

Mooladhara Chakra (मूलाधार चक्र)–

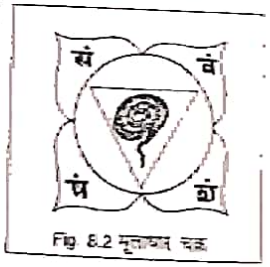


Fig 8.2 मूलाधार चक्र

It is situated in between the payu and upastha, shape is triangular, and origin of ida and pingala nadi, having 4 dalas, Ganesha devata, Bijakshara like व, श, ष, सं, yellow color kundalani shakthi gives power and energy.

चतुर्दलं स्याद् आधारं ॥
गुदात् द्व्यंगुलश्च ऊर्ध्वं मेढ्रेकांगुलस्त्वधः ।
एवञ्चास्ति समं कन्दं समताश्चतुरंगुलम् ॥ (शिव संहिता – ५/५६)

Scanned with CamScanner

2. Vesicle Plexus- it supplies to Bladder – शं
3. Prostatic Plexus- in males it supplies to – षं
prostate in females it supplies to Yoni.
4. Uterine Plexus- in females it supplies to – सं
Garbhashaya in males it supplies to spermatic cord.

A great energy rests in the Perineum and is called the Swayambhu linga

Rest all the chakras depends on this i.e. why it is called as Mooladhara chakra. अपान वायु is related to this chakra

Swadhisthana Chakra (स्वाधिष्ठान चक्र)–

It is situated above the upastha at base of medra, within the pelvic cavity. It has 6 dalas, red in color, it has jala tatva, having bijakshar like वं, भं, मं, यं, रं, लं. etc. shakini is the shakti, Vishnu is god, controlled by the apana vayu.

स्वाधिष्ठानं च षट् दलम्। द्वितीयन्तु सरोजन्च लिंगमूले व्यवस्थितम्॥

(शिव संहिता – ५/५६)

It is situated above the upastha within the pelvic cavity.

1. Location	Base of genital organs
2. No.of Petals	Six
3. Color of Petals	Vermilion
4. Letters	वं, भं, मं, यं, रं, लं.
5. Elements	Apa mahaboota
6. Bija (Seed)	Vam
7. Bija-bearer	Makara
8. God	Vishnu
9. Goddess	Raakini

10. Loka	Bhuvah
11. Quality	Liquid essence
12. Sense Organ	Tongue
13. Motor Organ	Penis
14. Yantra	Half moon

15. Result of concentration – Attainment of poetic powers and Yoga

स्वाधिष्ठानाह्वयं चक्रं लिंगमूले षडश्रके ॥ (योगशिखा–२)
स्वाधिष्ठानं ततश्चक्रं मेढ्रमेवनिगद्यते ॥ (ध्यानविन्दु–४८)
स्वाधिष्ठानं षड दलं ॥ (योगचूडामणि–४)

Lumbar plexus is in this region. It has six perals are related to six plexuses. They are–

1. Spermatic plexus – supplies to scrotum and testis. – बं
2. Left coiic plexus– supplies to descending colon. – भं
3. Sigmoid plexus– supplies to sigmoid colon. – मं
4. Superior Hemorrhoidal Plexus– supplies to superior rectal part. – यं
5. Inferior mesenteric plexus. – रं
6. Hypogastric plexus– supplies to the pelvic organs. – लं

Manipura Chakra (मणिपुर चक्र)–

It lies at the level of umbilical region, having 10 dalas, neela varna and urdva mukha, teja tatva pradhanya. Having bijakshar like डं, ढं, णं, तं, दं, धं, नं, पं,फं, vishnu devata. Lakhimi is the shakti.

तृतीयं पंकजं नाभ्यो मणिपूरकसंज्ञकम् ॥ (शिव संहिता – ५/५६)
नाभिमूले स्वाधिष्ठानोर्ध्वे । नाभिदेशस्थितं चक्रं दशरत्रं मणिपूरकम् ॥

It lies at the level of umbilical region.

1. Location Naval

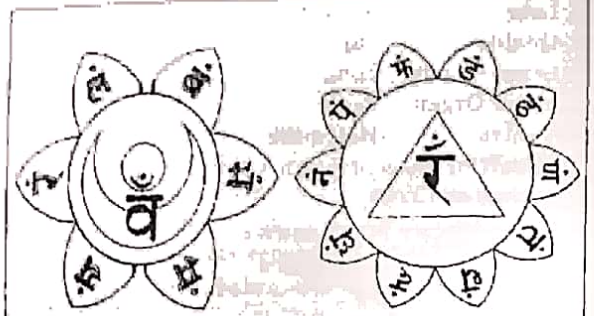


Fig. 8.3a स्वाधिष्ठान चक्र

Fig. 8.3b मणिपुर चक्र

2.	No.of Petals	Ten
3.	Color of Petals	Blue
4.	Letters	डं, ढं, णं, तं, थं, दं, धं, नं, पं, फं,
5.	Elements	Teja mahaboota
6.	Bija (Seed)	Ram
7.	Bija-bearer	Ram
8.	God	Rudra
9.	Goddess	Laakini
10.	Loka	Svah
11.	Quality	Form
12.	Sense Organ	Eye
13.	Motor Organ	Feet
14.	Yantra	Triangular

15. Result of concentration – Vidya and capacity.

Coeliac plexus is present at this site. It has ten petals with the following plexus related to them.

1. Phrenic Plexus – supplies to diaphragm and Kidneys.
2. Hepatic Plexus – it is large one & supplies to liver & Amashaya.
3. Splenic Plexus – supplies to spleen.
4. Superior Gastric Plexus – supplies to Amashaya.
5. Superior renal Plexus – supplies to supra renal glands.
6. Renal Plexus – supplies to Kidneys and Ureters.
7. Spermatic Plexus – supplies to spermatic cord.
8. Superior Mesenteric Plexus – supplies to small intestines.
9. Pancreatic Plexus – supplies to Agnyashaya.
10. Colic Plexus – supplies to part of small intestine, ceacum and ileocaecal junction.

Anahata Chakra (अनाहत चक्र)–

It lies at the region of hraday, having 12 dal... Iswara is the devata, having the bijakshara like कं, खं, गं, घं, ङ, चं, चं, जं, झं, ञ, टं, टं, etc. god is Eswara.

Anahata is lies at the region of hraday.

हृदये अनाहतं नाम चतुर्थे पंकजं भवेत् ॥ (शिव संहिता – ...)

1.	Location	Heart
2.	No. of Petals	Twelve
3.	Color of Petals	Red (or) White
5.	Elements	Vayu mahaboota
4.	Letters	कं, खं, गं, घं, ङ, चं, च ...

6. Bija (Seed)	Yam
7. Bija-bearer	Deer,
8. God	Rudra, Iswara
9. Goddess	Kaakini
10. Loka	Mahan
11. Quality	Touch
12. Sense Organ	Skin
13. Motor Organ	Hand
14. Yantra	Six cornered

15. Result of concentration – Achievement of Rationality, Goodness.

द्वादशारं महाचक्रं हृदये चाप्यनाहतम्।
तावदेव निरोद्धव्यं यावत् हृदि गतश्चयम्।
एतत् ज्ञानम् च ध्यानं च शेषोऽन्यायो विस्तरः॥

Cardiac plexus is present at the heart region. The twelve petals are related to the following plexuses.

1. Right deep cardiac plexus.	– कं
2. Left deep cardiac plexus.	– खं
3. Anterior Pulmonary plexus.	– गं
4. Posterior Pulmonary plexus.	– घं
5. Superficial cardiac plexus.	– ङं
6. Cardiac ganglion of Weisberg plexus.	– चं
7. Right coronary plexus.	– छं
8. Ventricular plexus.	– जं
9. Left coronary plexus.	– झं
10. Endo cardiac plexus.	– ञं
11. Remark.	– टं
12. Bibders ganglion plexus.	– ठं

Vishudda Chakra (विशुद्ध चक्र)–

It lies at region of griva pradesha having 16 dalas. Red color, vehicle white elephant bears pasha and ankusha, shankini is the shakti, the beejaksharas are अं, आं, इं, ईं, उं, ऊं, ऋं ॠं ऌं, एं, ऐं, ओं, औं, etc and lies at the region of griva pradesha.

कण्ठस्थानास्थितं पद्मं विशुद्धं नाम पंचमम् ॥ (शिव संहिता – ५/९०)
कंटप्रदेशे । कंटकूपे विशुद्धाख्यंचक्रं षोडशाक्षरम् ।
पीतं जालंधरं तिष्ठत्यत्र गुरेश्वरः ॥
ताड्डित्वा कंटमायाति तन्नडी पूरयेदिति ॥

1.	Location	Throat.
2.	No.of Petals	Sixteen.
3.	Color of Petals	Dark- Smoke.
4.	Letters	अं, आं, इं, ईं, उं, ऊं, ऋं ॠं ऌं, एं, ऐं, ओं, औं,
5.	Elements	Akasha. mahaboota
6.	Bija (Seed)	Ham
7.	Bija-bearer	Elephant.
8.	God	Five faced sadaasiva.
10.	Loka	Janah:
9.	Goddess	Shaakini
11.	Quality	Sound.
12.	Sense Organ	Ear.
13.	Motor Organ	Tongue.
14.	Yantra	Round.

15. Result of concentration – Speech & Knowledge.

Pharyngeal plexus is mainly present at this site .The 16 bheja aksharas have been explained with the following plexus.

1. Superior cervical plexus. – अं
2. Carotid plexus. – आं
3. Cavernous plexus. – इं
4. Internal & External cerebral plexus. – ईं
5. Pharyngeal plexus. – उं
6. Laryngeal plexus. – ऊं
7. Superficial cardiac plexus. – ऋं
8. External carotid plexus. – ॠं
9. Superior, Inferior & Middle cervical plexus – ऌं
10. External middle cervical plexus. – ॡं
11. Thyroid plexus. – एं
12. Middle cardiac plexus. – ऐं
13. Superior & Inferior cervical plexus. – ओं
14. Subclavian plexus. – औं

Fig 5.4a आज्ञा चक्र

Fig 5.4b विशुद्ध चक्र

15. Inferior cardiac plexus. – अं
16. Vertebral plexus. – आः

Aina Chakra (आज्ञा चक्र)–

आज्ञापद्मं भ्रुवोर्मस्ध्ये हक्षेपेतं द्विपत्रकम् ॥ (शिव संहिता – ५/२६)

It lies in the head region, between the two eye brow, that is center of the brain, having 2 dalas. White color, ascending nature beejakshara are हं, क्षं etc., tatva mahat, shiv is god, this chakra corresponds to tapo loka.

It lies in the head region, between the two eye brow, that is center of the brain,

1.	Location	Middle of the eye brows.
2.	No.of Petals	Two.
3.	Color of Petals	White.
4.	Letters	हं, क्ष
5.	Elements	Mahata tatva
6.	Bija (Seed)	Om
7.	Bija-bearer	Naada.
8.	God	Lingam.
9.	Goddess	Haakini
10.	Loka	Tapah:
11.	Quality	----
12.	Sense Organ	----
13.	Motor Organ	----
14.	Yantra	Oval, like linga.
15.	Result of concentration	Perfection of Speech.

Important nervous structures lying at this site are Cavernous plexus and Olfactory bulb.

त्रिविध नाडि–

Totally 3,50,000 nadis are described in the Goraksha and Bela Samhita. These 350000 nadis are mainly grouped into the four types,

The main classification is as follows–

1. Trividha Nadi
2. Dashavida Nadi
3. Chaturadhasa Nadi
4. Kula sankya Nadi

Trividaha Nadis–

There are three nadis.

1. Ida Nadi 2. Pingal Nadi 3. Sushumna Nadi

Ida Nadi (इडा नाडि)–

वाम मुष्कात् तु संभूता नाडि दक्षिण गामिनी ।
वामम् तुनासिका द्वारं प्राप्नोति गिरिजेःमले ।

It lies left to the sushumna nadi, situated left side of the vertebral column, it has Chandra Devata, and soumya guna, the god is moon, color like white lotus flower, its color white kamal and mandakini water like. The nerve fibres which lies and runs from the spinal cord towards the left side distributed towards the left part of the body is known as Ida nadi.

Pingal Nadi (पिण्गळ नाडि)–

सुषुम्ना सा समाश्लिष्टा वाम नासा पुरे गता ॥
मेरोर्मूले स्थितः सूर्यः कलाः द्वादश संयुतः ।
दक्षिणे पथि रश्मिभिर्वहत्यूर्ध्व प्रजापतीह ॥

It lies right to the sushumna nadi, situated right side of the vertebral column, it has Surya Devata, and agneya guna, sun is god, the color is whitish red, the nerve fibres which runs from the spinal cord towards right side and distributed towards right side of the body is called as pingal nadi. It is tikshna guna.

Sushumna Nadi (सुषुम्ना नाड़ि)–

It is the main nadi which lies on the median plane within the vertebral column. It is also known as Merudhanda. Some of centres live in the spinal cord, and considered as one of the organ of central nervous system. It gives nerves on either side, runs towards right and left side of the body. Totally there are 31 pairs of spinal nerves. It extends from foramen magnum to 1st lumbar vertebra about 45 cms in length. This is also known as Sushumna Kahand, lies between ida and pingal nadis.