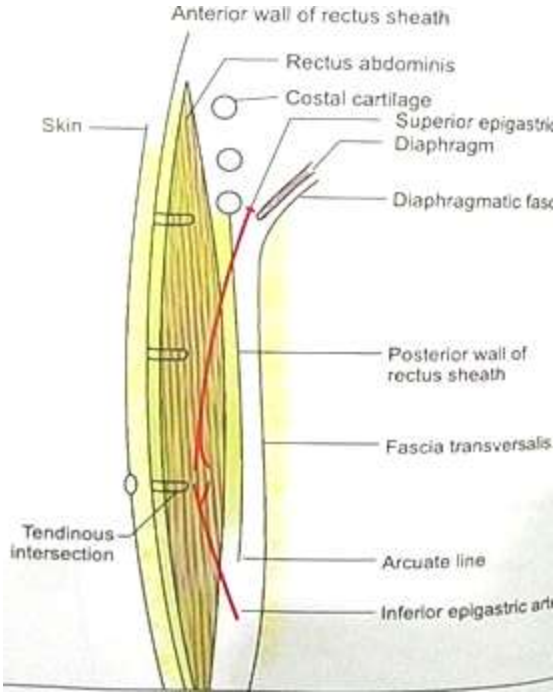
ANTERIOR ABDOMINAL WALL

RECTUS SHEATH UNDER THE FOLLOWING HEADINGS:FORMATIONS AT DIFFERENT LEVELS,CONTENTS, APPLIED ANATOMY(LE)

Rectus sheath is an aponeurotic sheath covering the rectus abdominis muscle
It has 2 walls- anterior and posterior.
Anterior wall- completely covers the muscle from end to end.
It is firmly adherent to tendinous intersections of the rectus muscle

Posterior wall – is incomplete, being deficient above the costal margin and below the arcuate line
It is free from the rectus muscle

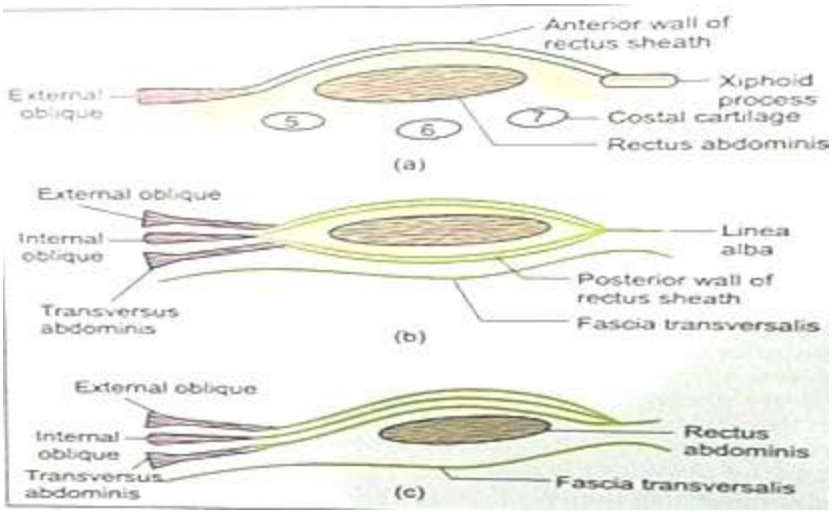


Formation

Above the costal margin:
Anterior wall- external oblique aponeurosis
Posterior wall- deficient, rectus muscle rests on 5^{th},6^{th}, 7^{th} costal cartilages.
Between the costal margin and arcuate line
Anterior wall- external oblique aponeurosis
Anterior lamina of internal oblique aponeurosis

Posterior wall- posterior lamina of internal oblique aponeurosis
Aponeurosis of transverses muscle

Below the arcuate line
Anterior wall – aponeurosis of all the 3 flat muscles of abdomen
Posterior wall – deficient. The rectus muscle rests on fascia transversalis.



Content:

Muscle,
Rectusabdominis,
Pyramidalis

Arteries
Superior epigastric artery – terminal branch of internal thoracic artery
Inferior epigastric artery- a branch of external iliac artery

Veins
Superior epigastric vena comitantes join the internal thoracic vein
Inferior epigastric vena comitantes join the external iliac vein

Nerves
Terminal branches of lower six thoracic nerves

Functions

Checks bowing of rectus muscles during its contraction and thus increases the efficiency of the muscle
Maintains the strength of anterior abdominal wall.

New concept of rectus sheath formation

The aponeurosis of all the flat muscles of abdomen are bilaminar thus giving 6 laminae in all. Three layers form the anterior wall and three layers form the posterior wall of the rectus sheath.

Clinical anatomy

Divarication of recti

Separation of two rectus muscles occurs in elderly multiparous women with weak abdominal muscles. Hernia sac containing loops of intestine protrude forward between the widely separated recti.

Hematoma of rectus sheath-

Superior and inferior epigastric arteries are unduly stretched during a severe bout of coughing or in later months of pregnancy, which ruptures when subjected to trauma. Thus an hematoma is formed within the rectus sheath.

Epigastric hernia-

The lineaalba is formed by the interlacing of aponeurotic fibres of the three abdominal muscles. It is wider above the umbilicus and narrow below it . The part becomes weak in elderly multiparous women. Raised intra abdominal causes a small amount of extraperitoneal fat along with a small containing greater omentum to protrude through the upper part of linea alba epigastric hernia.

UMBILICUS(SE)

Umbilicus is the normal scar in the anterior abdominal wall formed by the remnants of root of umbilical cord.

Position

In healthy adults it lies in the anterior median plane at the level of disc between L3 and L4 vertebra.

It is lower in infants and in persons with pendulous abdomen.

Anatomical significance

The level of umbilicus serves as watershed line for venous and lymphatic drainage.

The venous blood and lymph flow upwards above the umbilicus and downwards below the umbilicus.

It indicates the level of T10 dermatome.

It is one of the important sites of portocaval anastomosis.

Embryological significance

It is the meeting point of four folds of embryonic plate.

In embryonic life , a defect exists in linea alba at this site called umbilical ring which provides passage to

Midgut loop which herniates into the umbilical cord during 10^{th} – 12^{th} weeks of intrauterine life.

Two endodermal loops- allantois and vitellointestinal duct

Umbilical vessels

Clinical aspects

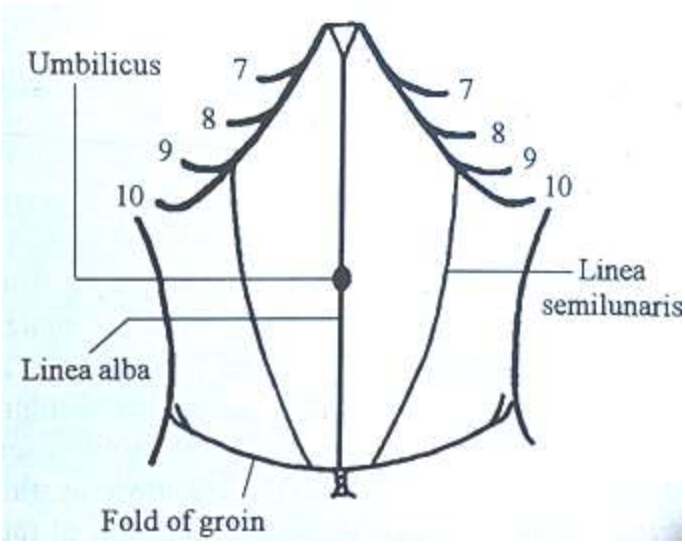
Congenital anomalies

Fecal fistula

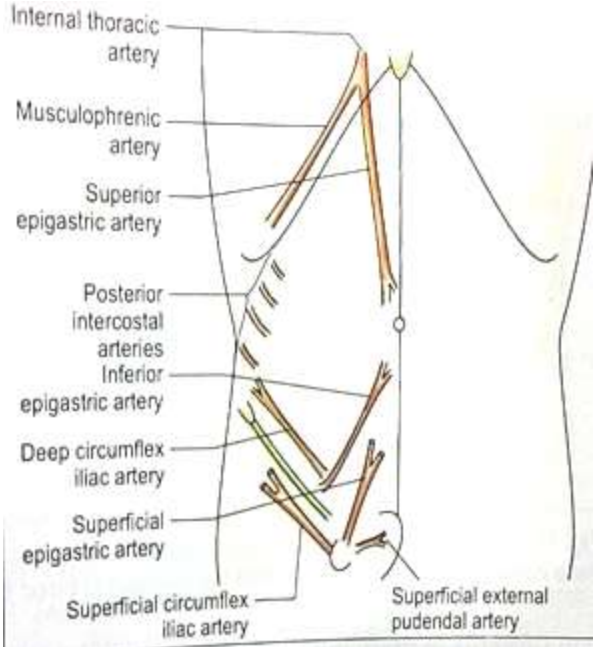
Urinary fistula

Exomphalos

Congenital umbilical hernia



ANTERIOR ABDOMINAL WALL – BLOOD SUPPLY(SE)



Anterior abdominal wall is supplied by

Cutaneous arteries

Deep arteries

Cutaneous arteries

Cutaneous branches of superior and inferior epigastric arteries

Cutaneous branches of posterior intercostals arteries

Superficial branches of femoral artery- superficial external pudendal, superficial epigastric and superficial circumflex iliac arteries

Cutaneous veins-

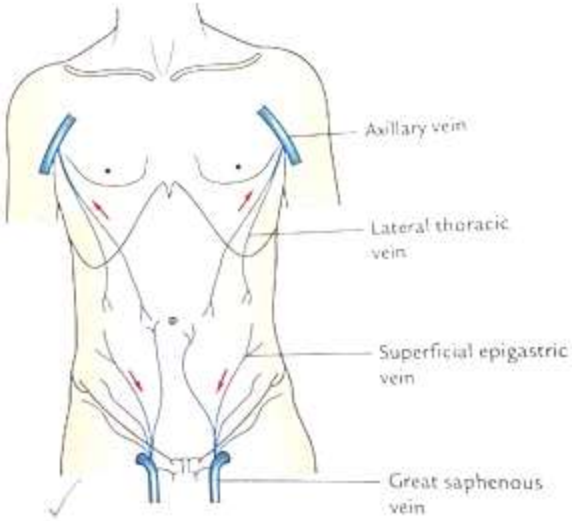


Fig. 3.11 Superficial veins of the anterior abdominal wall.

They accompany the arteries and drain as follows

Below the umbilicus- into the great saphenous vein – into inferior venacava

Above the umbilicus- into axillary vein – superior venacava.

Deep arteries

Superior epigastric and musculophrenic arteries

inferior epigastricand deep circumflex iliac arteries

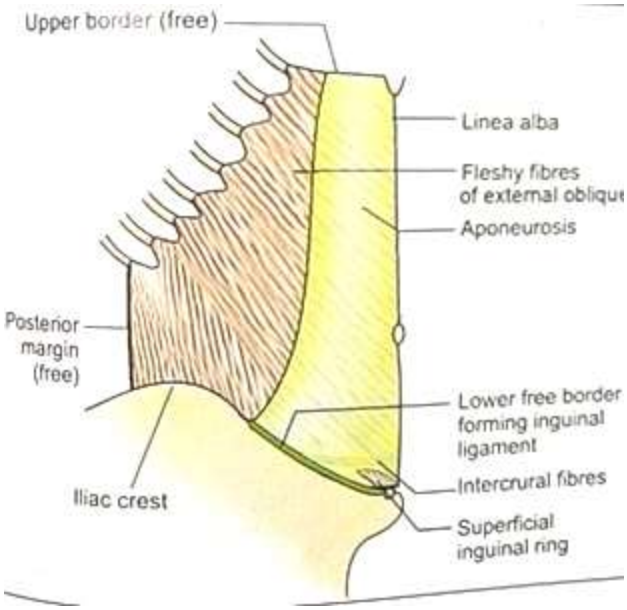
small branches of intercostals, subcostal and lumbar arteries.

EXTERNAL OBLIQUE MUSCLE(SE)

External oblique muscle is one of the three flat muscles of the abdomen,

Origin

Arises from eight fleshy slips from the outer surface (middle of shaft) of lower eight ribs.



Insertion

The fibres run downward , forward and medially

Most of the posterior fibres pass vertically downwards to be inserted on the anterior 2/3 of outer lip of iliac crest. Posterior border of muscle is free

The remaining fibres end in a aponeurosis which is inserted into linea alba extending from xiphoid process to pubic symphysis.

The upper border of aponeurosis is free and is overlapped by pectoralis major muscle.

The lower border of aponeursis is free, thickened and rolled inwards to form the inguinal ligament

Just above the pubic crest the aponeurosis presents a triangular aperture called superficial inguinal ring.

Nerve supply

Lower six thoracic nerves

Actions

Supports and protects the abdominal viscera

Compresses the abdominal viscera as in expulsive acts like micturition, defecation, vomiting

Forceful expiratory acts like coughing , sneezing .

Movements of the trunk- lateral flexion and rotation.

RECTUS ABDOMINIS(SE)

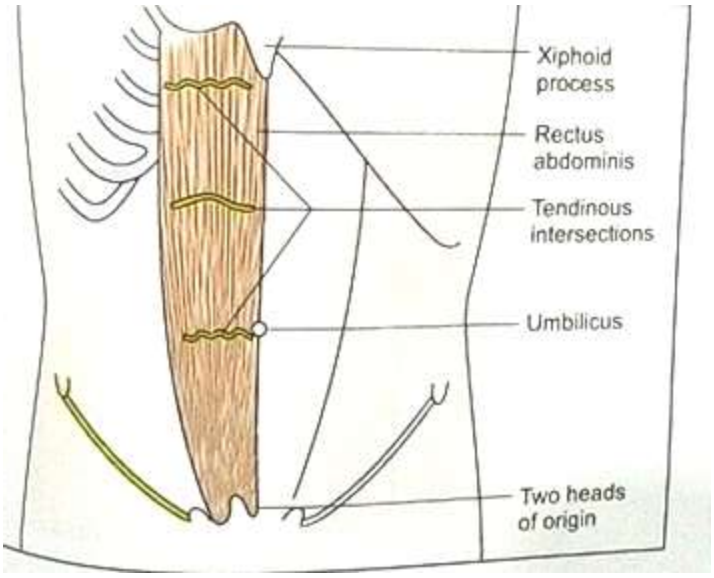
Rectus abdominis is a long , flat strap muscle extending vertically upwards along the linea alba from pubic symphysis below to the costal margin above.

Origin

The muscle arises by two twotendinous heads

Lateral head from lateral part of pubic crest.

Medial head from anterior pubic ligament



Insertion

By four fleshy slips along a horizontal line passing laterally from xiphoid process to 5^{th},6^{th} and 7^{th} costal cartilages

The muscle presents three tendinous intersections

Opposite to umbilicus
Opposite to free end of xiphoid process
Midway between the above two

The muscle is enclosed in aaponeurotic sheath derived from the three flat muscles of the abdomen.

Each tendinous intersection is attached to the anterior wall of rectus sheath and they divide the long muscle column into shorter segments to provide more strength.

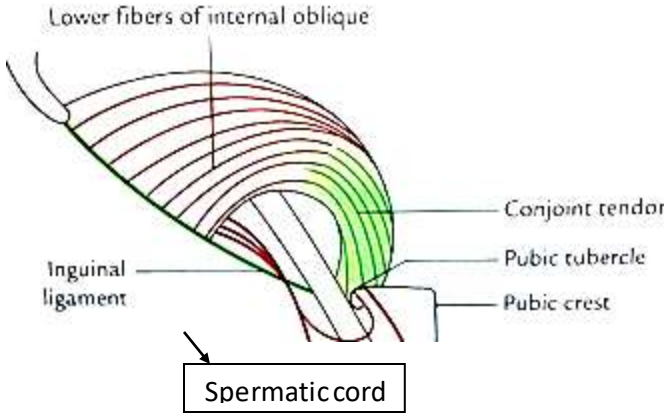
Nerve supply

Lower six thoracic nerves

Action

1) Flexion of the trunk at the lumbar region
2) It tenses the linea alba

CONJOINT TENDON(SE)



Conjoint tendon (falxinguinalis) is formed by the fusion of lower aponeurotic fibres of internal oblique and transverses abdominis muscles which arches over the spermatic cord and is attached to the pubic crest and medial part of pectin pubis.

It forms the medial half of the posterior wall of inguinal canal and strengthens the anterior abdominal wall opposite the superficial inguinal ring.
Medially it blends with the anterior wall of rectus sheath.
Laterally it may extend upto the interfoveolarligament(thickening in fascia transversalis along the medial border of deep inguinal ring) .

The weakening of Conjoint tendon due to old age or injury to iliohypogastric or ilioinguinal nerves predisposes the occurrence of direct inguinal hernia.

RECTUS SHEATH- FORMATIONS , CONTENTS AND APPLIED ANATOMY(SE)

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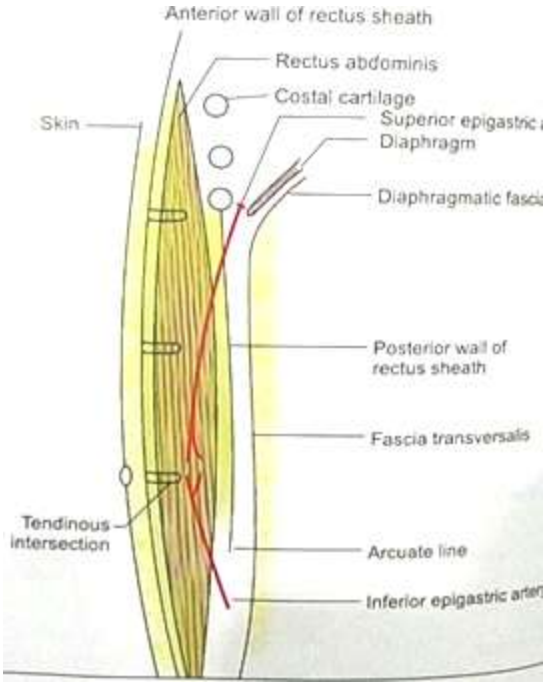

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Pyramidalis

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PHYSIOLOGICAL UMBILICAL HERNIA(SA)

During the 5th – 10th week of intrauterine life the midgut loop herniates into the extra-embryonic part of coelomic cavity. Thus the midgut loop appears as a content of physiological umbilical hernia. This loop returns back to the abdominal cavity during the 10th- 12th week of intrauterine life.
Persistence of this in new born is called exomphalos.

RASPBERRY TUMOUR(SA)

The vitellointestinal duct communicates the primitive midgut with the extra- embryonic part of yolk sac.
In 98% cases the duct disappears.
When the distal part of the duct persists, it may discharge mucus at the surface ,evaginating the surface at the umbilicus producing raspberry red tumour(cherry red tumour).

TRANSPYLORIC PLANE AND STRUCTURES LIE ON IT(SA)

It is an imaginary horizontal plane.
Anteriorly – it passes through the tips of 9th costal cartilages and posteriorly through the lower part of the body of L1 vertebra. This plane lies midway between the suprasternal notch and pubic symphysis.
Structures lying at the level of this plane
- Pylorus of stomach
- Fundus of gall bladder
- Hila of both kidneys

ILIOINGUINAL NERVE(SA)

It is the anterior primary ramus of L1 spinal nerve
It pierces the internal oblique muscle below and lateral to iliohypogastric nerve and enters the inguinal canal.
The nerve runs along the inferolateral side of spermatic cord and comes out through the superficial inguinal ring.
It has no lateral cutaneous branch.

INGUINAL LIGAMENT(SA)

The inguinal ligament is formed by the lower border of external oblique aponeurosis which is thickened and folded backwards on itself.
It extends from the anterior superior iliac spine to the pubic tubercle.
The lateral half of the ligament is rounded and oblique and the medial half is grooved upwards and horizontal.

Lower border – attachment of fascia lata
Upper surface- lateral2/3rd - internal oblique
- Lateral 1/3rd- transversus abdominis

Middle part – cremaster muscle

CREMASTRIC REFLEX(SA)

Upon stroking the skin of the upper medial aspect of thigh, there is reflex contraction of cremaster muscle leading to elevation of testis.
This reflex is more brisk in children.

Afferent limb- femoral branch of genitofemoral nerve
Efferent limb- Genital branch of genitofemoral nerve
Reflex center- LI and L2 spinal segments

PYRAMIDALIS MUSCLE(SA)

It is a small triangular muscle lying anterior to the lower part of rectus abdominis muscle.
This muscle lies within the rectus sheath.
Apex is directed above and medially and base lies in front of the pubis.
It is rudimentary in human beings.
Nerve supply – subcostal nerve
Action –It tenses the lineaalba

NERVE SUPPLY TO PYRAMIDALIS AND DARTOS MUSCLE(SA)

Pyramidalis

It is supplied by subcostal (T12) nerve.

Dartos muscle

It is supplied by sympathetic fibres through genital branch of genitofemoral nerve.

RECTUS SHEATH- MUSCLES FORMING, CONTENTS(SA)

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MENTION THE LAYERS PRESENT IN THE ANTERIOR WALL OF RECTUS SHEATH AT DIFFERENT LEVELS(SA)

Above the costal margin:

Anterior wall- external oblique aponeurosis

Between the costal margin and arcuate line

Anterior wall- external oblique aponeurosis
-Anterior lamina of internal oblique aponeurosis

Below the arcuate line

Anterior wall – aponeurosis of all the 3 flat muscles of abdomen

ARCUATE LINE(SA)

The posterior wall of the rectus sheath, at the level midway between the pubic symphysis and umbilicus, ends in an arcuate line or lineasemicircularis(fold of douglas).
The line is concave downwards.

Below the level of arcuate line the anterior wall of rectus sheath is formed by the aponeurosis of all three muscles of abdomen.

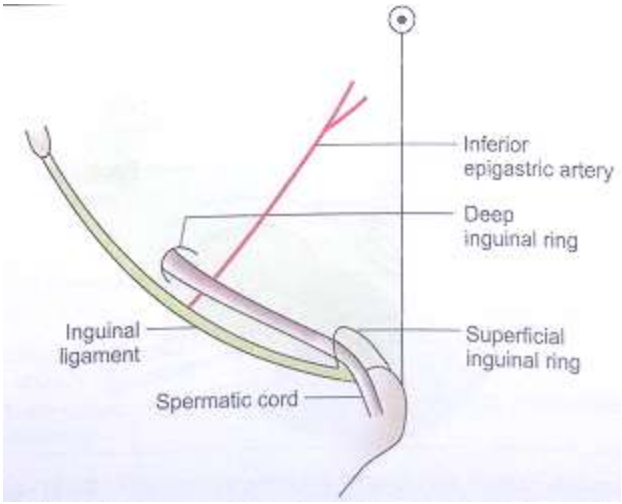
DESCRIBE INGUINAL CANAL UNDER FOLLOWING HEADINGS (a)LOCATION & EXTENT (b)BOUNDARIES (c) CONTENTS (d) APPLIED ANATOMY. ADD A NOTE ON INGUINAL HERNIAS. MENTION FACTORS PREVENTING INGUINAL HERNIAS(LE)

Inguinal canal is a **musculoaponeurotic canal**

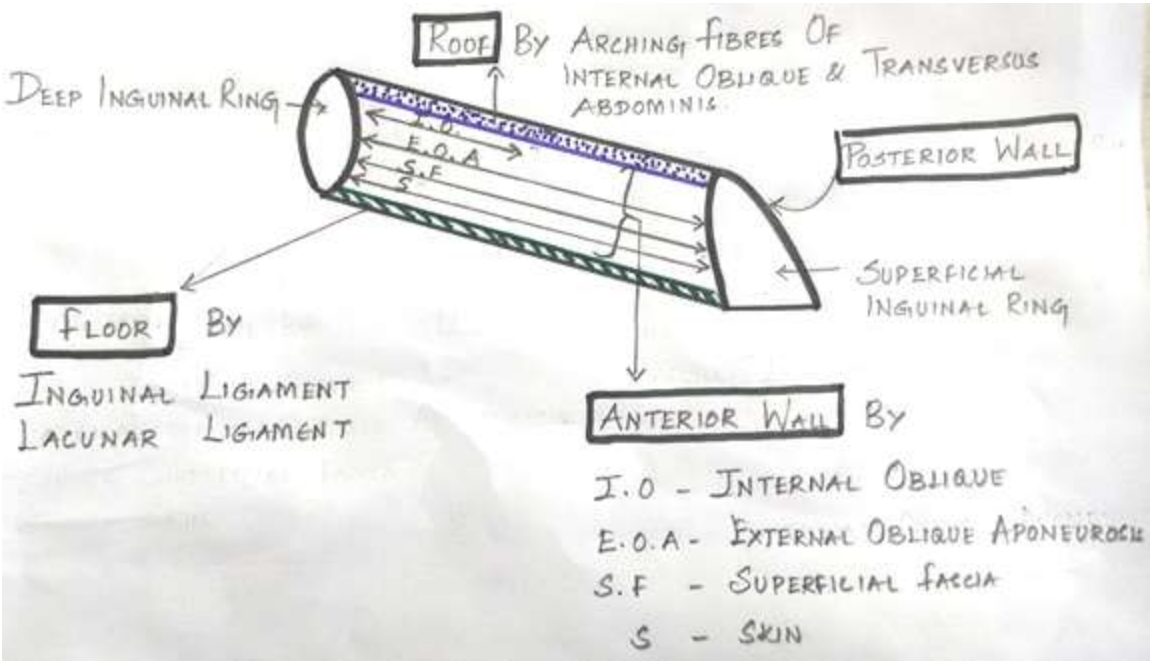
Location & Extent

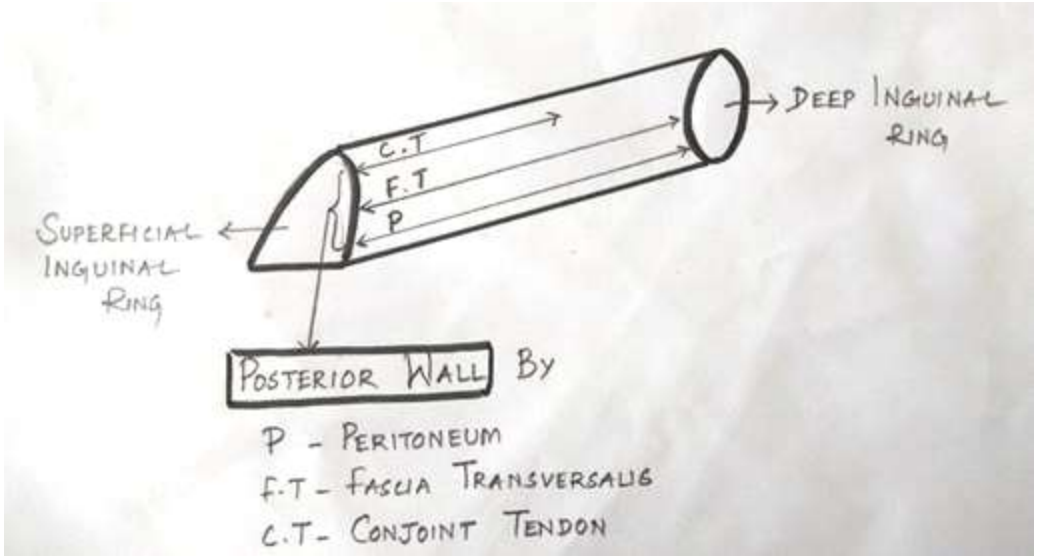
It is located in the lower part of anterior abdominal wall, just above the medial half of inguinal ligament.

It extends from deep inguinal ring to superficial ingunal ring.



Boundaries





Deep inguinal ring:

It is an oval gap in fascia transversalis situated about 1.25 cm above the midinguinal point & lateral to stem of inferior epigastric artery.

Superficial inguinal ring:

It is a triangular gap in external oblique aponeurosis

Anterior wall: from outwards to inwards

Skin

Superficial fascia

External oblique aponeurosis

Internal oblique muscle (only in lateral 1/3)

Posterior wall: from inwards to outwards

Parietal peritoneum

Extraperitoneal fat

Fascia transversalis

Internal oblique muscle (only in medial 2/3)

Conjoint tendon (only in medial $\frac{1}{4}$)

Roof:

Arching fibres of

Internal oblique muscle

Transversus abdominis

Floor:

Inguinal ligament's grooved upper surface

Lacunar ligament (at medial end)

Contents

Spermatic cord in males or Round ligament of uterus in females

Ilioinguinal nerve

Applied anatomy

Inguinal hernia:

Protrusion of any of the abdominal contents through the inguinal wall or inguinal canal is called inguinal

Hernia

Types of inguinal hernia:

Direct inguinal hernia

Indirect inguinal hernia

		Direct inguinal hernia	**Indirect inguinal hernia**
1.	Congenital / Acquired	Acquired	Congenital Acquired
2.	Etiology	Weakness of Abdominal wall muscles	Persistence of patent processus vaginalis
3.	Age	Old	Children ,Young age
4.	Unilateral / bilateral	Bilateral	Unilateral / bilateral
5.	Relation to inferior epigastric artery	Medial	Lateral
6.	Enters inguinal canal through	Inguinal triangle	Deep inguinal ring

Factors preventing inguinal hernias:

Obliquity of inguinal canal- since the inguinal canal is oblique, the anterior & posterior walls are approximated like flap valve when the intra abdominal pressure is raised.

Superficial inguinal ring is guarded from behind by conjoint tendon

Deep inguinal ring is guarded from front by internal oblique muscle

Shutter mechanism of internal oblique muscle

Contraction of cremaster pulls the testis upwards & superficial inguinal ring is plugged by spermatic cord (ball valve mechanism)

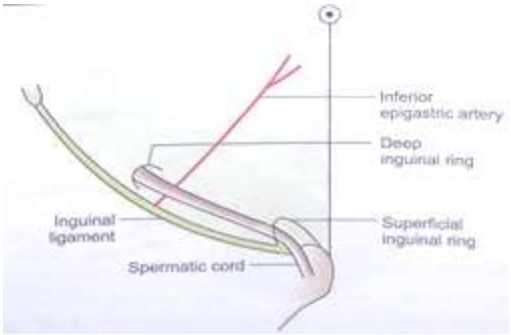
Contraction of external oblique results in approximation of 2 crura of superficial inguinal ring (slit mechanism)

INGUINAL CANAL – BOUNDARIES AND CONTENTS(SE)

Inguinal canal is a **musculoaponeurotic canal,** which is located in the lower part of anterior abdominal wall, just above the medial half of inguinal ligament.

It extends from deep inguinal ring to superficial ingunal ring.

It is about 4 cm long



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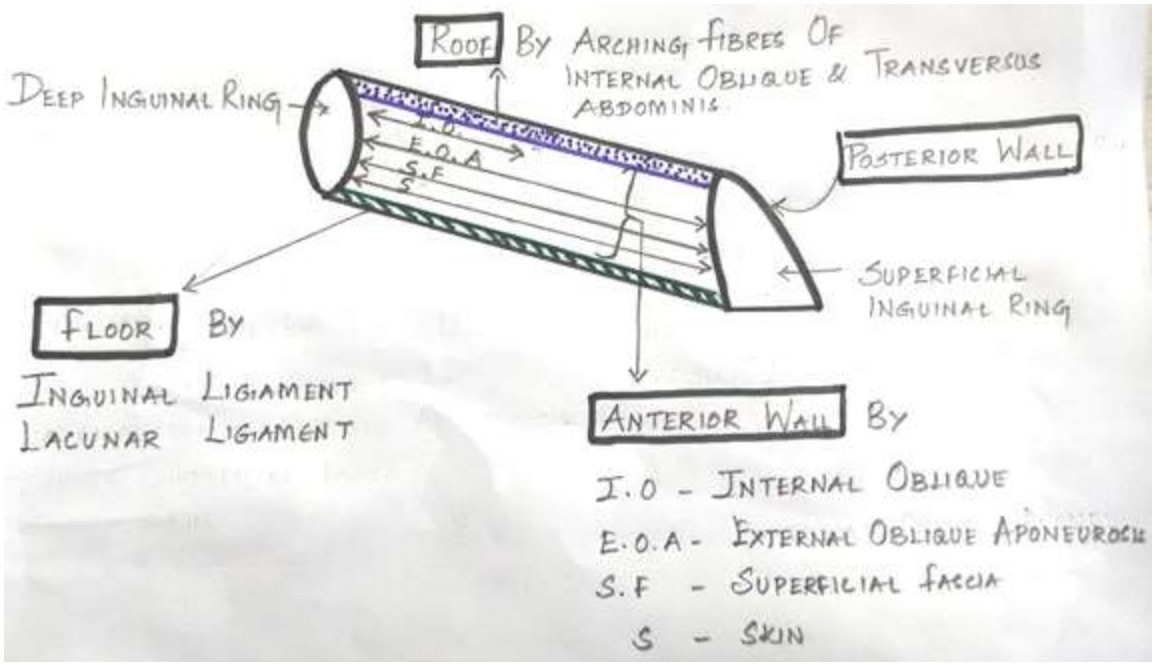
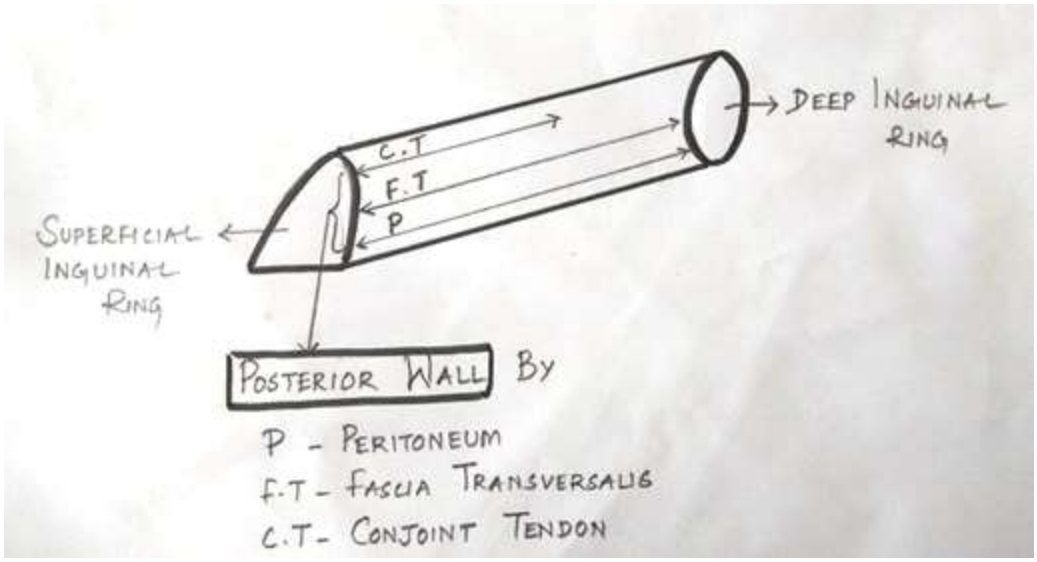




Deep inguinal ring:

It is an oval gap in fascia transversalis situated about 1.25 cm above the midinguinal point & lateral to

stem of inferior epigastric artery

Superficial inguinal ring:

It is a triangular gap in external oblique aponeurosis

Base is formed by pubic crest

2 sides of triangle are called as medial & lateral crura

Anterior wall: from outwards to inwards

Skin

Superficial fascia

External oblique aponeurosis

Internal oblique muscle(only in lateral 1/3)

Posterior wall: from inwards to outwards

Parietal peritoneum

Extraperitoneal fat

Fascia transversalis

Internal oblique muscle (only in medial 2/3)

Conjoint tendon (only in medial $\frac{1}{4}$)

Roof:

Arching fibres of

Internal oblique muscle

Transversus abdominis

Floor:

ligament's grooved upper surface

ligament (at medial end)

Contents

Spermatic cord in males or Round ligament of uterus in females

2Ilioinguinal nerve

SPERMATIC CORD – COVERINGS AND CONTENTS (SE)

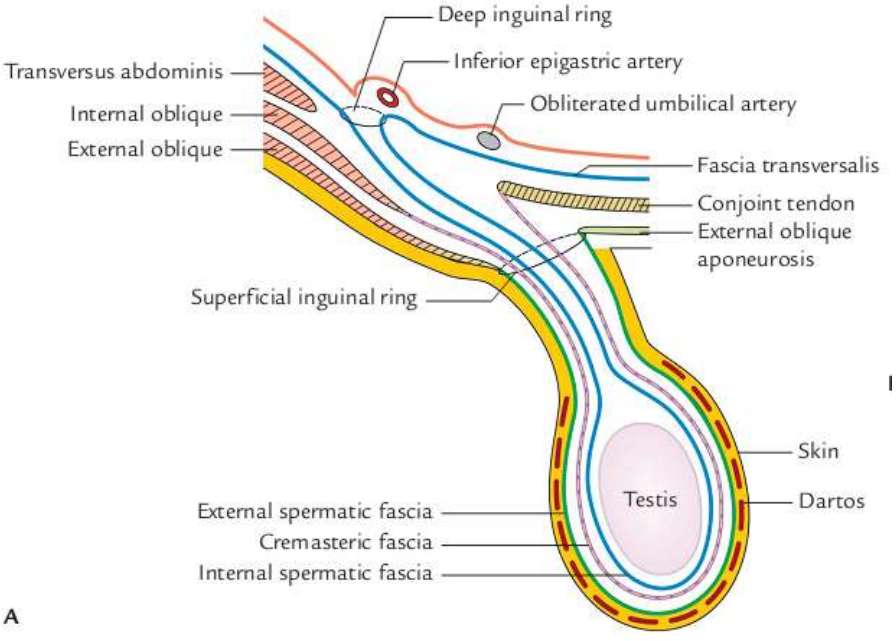
Coverings of spermatic cord :

From within outwards,

Internal spermatic fascia – derived from fascia transversalis

Cremasteric fascia – derived from the internal oblique muscle

External spermatic fascia – derived from external oblique aponeurosis



A

Contents of spermatic cord:

Vas deferens

Artery to vas deferens & sympathetic plexus around it

Cremasteric artery

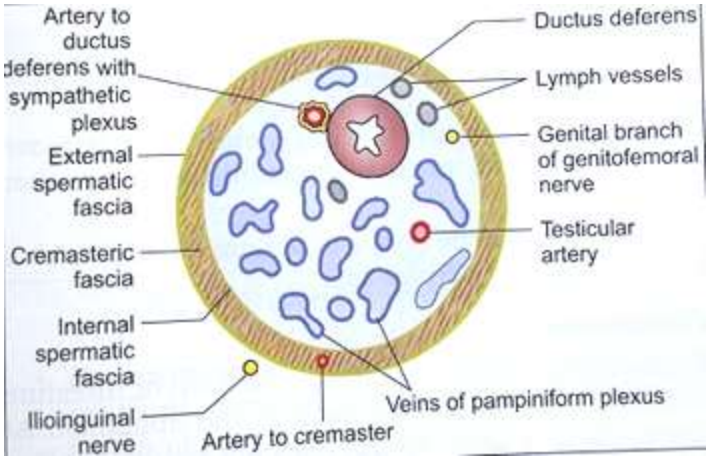
Testicular artery

Pampiniform plexus of veins

Lymphatics from testis

Genital branch of Genitofemoral nerve

Remains of processus vaginalis



PROTECTIVE MECHANISM OF INGUINAL CANAL (SE)

Obliquity of inguinal canal

Superficial & Deep inguinal ring don't lie opposite to each other

When intra abdominal pressure rises, anterior & posterior walls of canal approximate with each other like a flap valve & obliterates the passage

Guarding of inguinal rings

Superficial inguinal ring is guarded from behind by conjoint tendon

Deep inguinal ring is guarded from front by internal oblique muscle

Shutter mechanism of internal oblique muscle

Tmuscle forms the anterior wall, roof, floor of inguinal canal

When the muscle contracts, the roof approximates to the floor like a shutter

Ball valve mechanism

Contraction of cremaster pulls the testis upwards & superficial inguinal ring is plugged by spermatic cord

Slit valve mechanism

Contraction of external oblique results in approximation of 2 crura of superficial inguinal ring like a slit valve

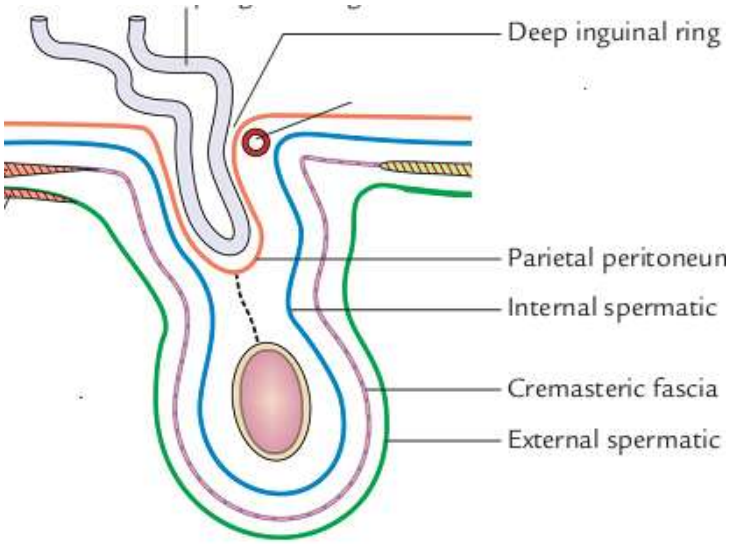
INGUINAL HERNIA – TYPES & COVERINGS

Protrusion of any of the abdominal contents through the inguinal wall or inguinal canal is called inguinal Hernia

Types of inguinal hernia:

Direct inguinal hernia

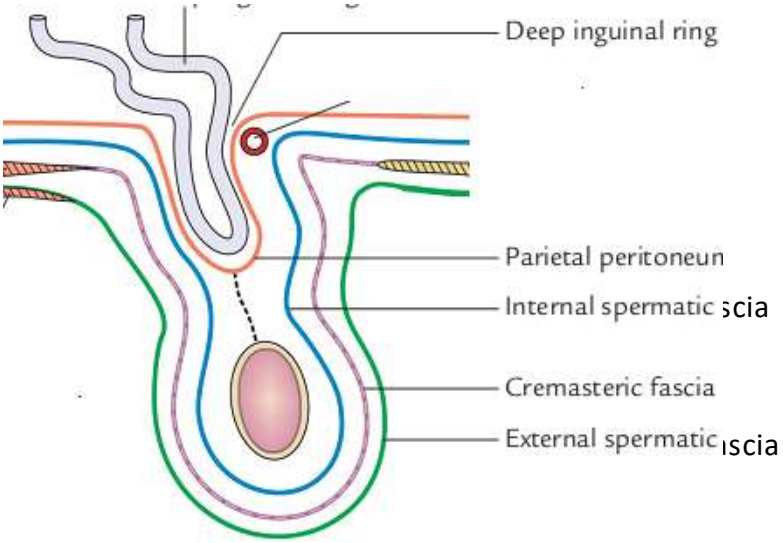
Indirect inguinal herni



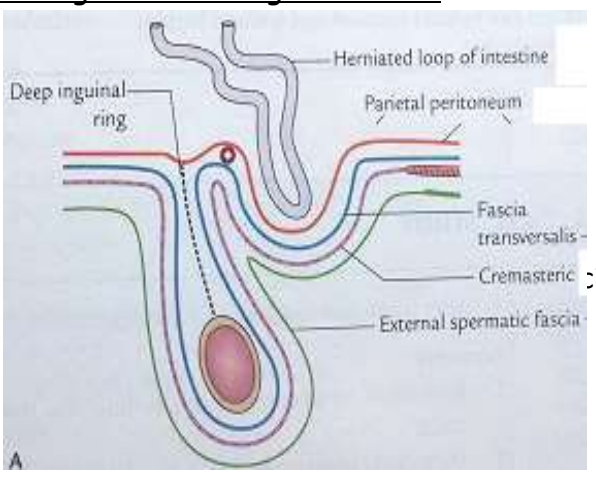
		Direct inguinal hernia	**Indirect inguinal hernia**
1.	Definition	protrusion of abdominal contents occurs through the weak posterior wall of inguinal canal (Hesselbach's triangle)	protrusion of abdominal contents occurs through the deep inguinal ring
2.	Congenital / Acquired	Acquired	Congenital or Acquired
3.	Etiology	Weakness of Abdominal wall muscles, factors increasing intra abdominal pressure like chronic cough, constipation	Persistence of patent processus vaginalis
4.	Age	Old	Children ,Young age
5.	Unilateral / bilateral	Bilateral	Unilateral / bilateral
6.	Relation to inferior epigastric artery	Medial	Lateral
7.	Enters inguinal canal through	Inguinal triangle	Deep inguinal ring

8.	Hernial sac neck	wider	Narrow
9.	Coverings	From within outwards, Peritoneum Extra peritoneal tissue Fascia transversalis Cremasteric fascia External spermatic fascia Skin	From within outwards, Peritoneum Extra peritoneal tissue Internal spermatic fascia Cremasteric muscle & fascia External spermatic fascia skin

Coverings of indirect inguinal hernia

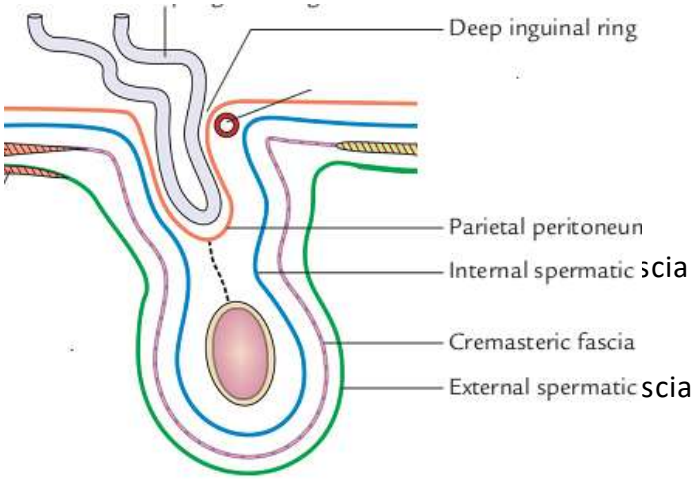


Coverings of direct inguinal hernia



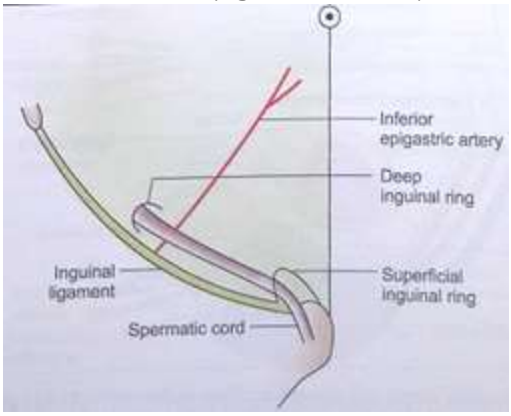
6.INDIRECT INGUINAL HERNIA (SE)

Indirect inguinal hernia is protrusion of abdominal contents through the deep inguinal ring
may be congenital/ acquired
congenital – due to patency of processus vaginalis
acquired – due to increased intra abdominal pressure
occurs in children ,young adults
predisposing factor is partial or complete patency of processus vaginalis.
may be unilateral or bilateral
hernia sac neck is narrower
lies lateral to inferior epigastric artery
Coverings:
From within outwards,
Peritoneum
Extra peritoneal tissue
Internal spermatic fascia
Cremasteric muscle & fascia
External spermatic fascia
skin



RELATION OF INFERIOR EPIGASTRIC ARTERY TO DEEP INGUINAL RING (SE)

Inferior epigastric artery is a branch of external iliac artery & arises just above the inguinal ligament
Deep inguinal ring lies lateral to stem of inferior epigastric artery



INGUINAL RINGS (SUPERFICIAL/DEEP) (SA)

Deep inguinal ring:

Is an oval gap in fascia transversalis situated about 1.25 cm above the midinguinal point & lateral to

Stem of inferior epigastric artery

Superficial inguinal ring:

Is a triangular gap in external oblique aponeurosis

Base is formed by pubic crest

2 sides of triangle are called as medial & lateral crura

MENTION THE CONTENTS OF INGUINAL CANAL (SA)

Spermatic cord in males or Round ligament of uterus in females (entire content)

Ilioinguinal nerve (partial content)– enters canal by piercing internal oblique muscle about 2.5 cm below & medial to anterior superior iliac spine. It is situated superficial to spermatic cord

CONTENTS OF INGUINAL CANAL IN FEMALE (SA)

Round ligament of uterus (entire content)

Ilioinguinal nerve (partial content)– enters canal by piercing internal oblique muscle about 2.5 cm below & medial to anterior superior iliac spine. It is situated superficial round ligament

INGUINAL TRIANGLE - BOUNDARIES (SA)

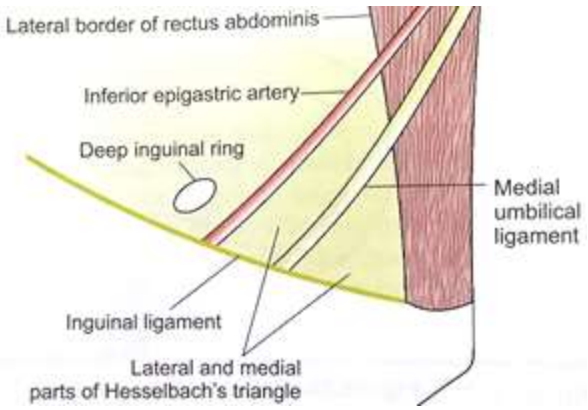
Inguinal triangle is bounded

Medially – lateral border of rectus abdominis

Laterally – inferior epigastric artery

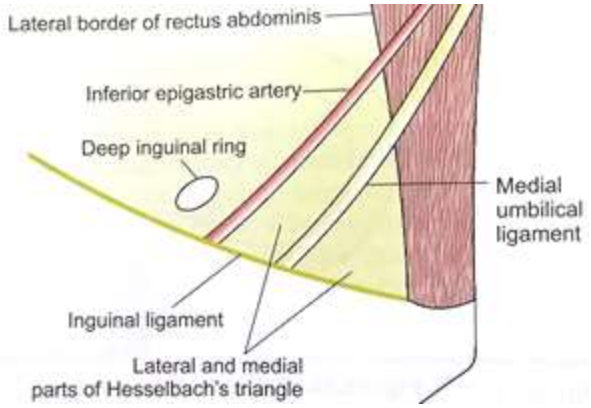
Below – inguinal ligament

Floor – peritoneum, extra peritoneal tissue, fascia transversalis



It is divided into medial & lateral parts by obliterated umbilical artery/ medial umbilical ligament

HESSELBACH'S TRIANGLE (SA)



Inguinal triangle is bounded

Medially – lateral border of rectus abdominis

Laterally – inferior epigastric artery

Below – inguinal ligament

It is divided into medial & lateral parts by obliterated umbilical artery/ medial umbilical ligament

Direct inguinal hernia occurs through this triangle when there is weakness of abdominal wall

SPERMATIC CORD – COVERINGS, CONTENTS (SA)

Coverings of spermatic cord:

From within outwards,

Internal spermatic fascia – derived from fascia transversalis

Cremasteric fascia – derived from the internal oblique muscle

External spermatic fascia – derived from external oblique aponeurosis

Contents of spermatic cord:

Vas deferens

Artery to vas deferens & sympathetic plexus around it

Cremasteric artery

Testicular artery

Pampiniform plexus of veins

Lymphatics from testis

Genital branch of Genitofemoral nerve

Remains of processus vaginalis

NAME THE STRUCTURES PROTECTING THE SUPERFICIAL & DEEP INGUINAL RING (SA)

Superficial inguinal ring is guarded from behind by conjoint tendon & reflected part of inguinal ligament

Deep inguinal ring is guarded from front by internal oblique muscle

SITES OF HERNIA IN THE ABDOMEN (SA)

External sites:

Epigastric region
Umbilicus
Paraumbilical region
Inguinal region
Lumbar region
Incisional hernia

Internal sites:

Paraduodenal recess
Epiploic foramen

COVERINGS OF OBLIQUE INGUINAL HERNIA (SA)

From within outwards
Peritoneum
Extra peritoneal tissue
Internal spermatic fascia
Cremasteric muscle & fascia
External spermatic fascia
Skin.

THE DIFFERNCE BETWEEN DIRECT AND INDIRECT INGUINAL HERNIA (SA)

		INDIRECT INGUINAL HERNIA	DIRECT INGUINAL HERNIA
1	Aetiology	Preformed sac	Weakness of posterior wall of inguinal canal
2	Precipitating	-	Chronic bronchitis, enlarged prostate
3	On standing	Does not come out	Come out
4	Direction of the sac	Sac comes through the deep inguinal ring	It comes out of Hesselbachs triangle
5.	Obstruction	Common, as neck is narrow	Not common because neck is wide
6.	Internal ring occlusion test	Not seen	The swelling is seen