

# ANATOMY OF THE LOWER LIMBS

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# OBJECTIVES

1 - TO CHARACTERIZE DIFFERENT PARTS OF EACH BONE

2 - TO DISCUSS THE NERVE SUPPLY OF THE LOWER LIMBS

3- TO DISCUSS GENERAL FEATURES OF THE BLOOD SUPPLY OF  
THE LOWER LIMBS

4- TO STUDY THE MAIN MUSCLES ACTING ON THE HIP, KNEE AND ANKLE JOINTS



Henry Gray (1827–1861) is shown here in the foreground, seated by the feet of the cadaver. The photograph was taken by a medical student, Joseph Langhorn. The room is the dissecting room of St George's Hospital medical school in Kinnerton Street, London. Gray is shown surrounded by staff and students. The second edition of *Gray's Anatomy* was in its proof stages, to appear in December 1860. **Gray died just over a year later, in June 1861, at the height of his powers.**

# Major concepts of muscle's actions

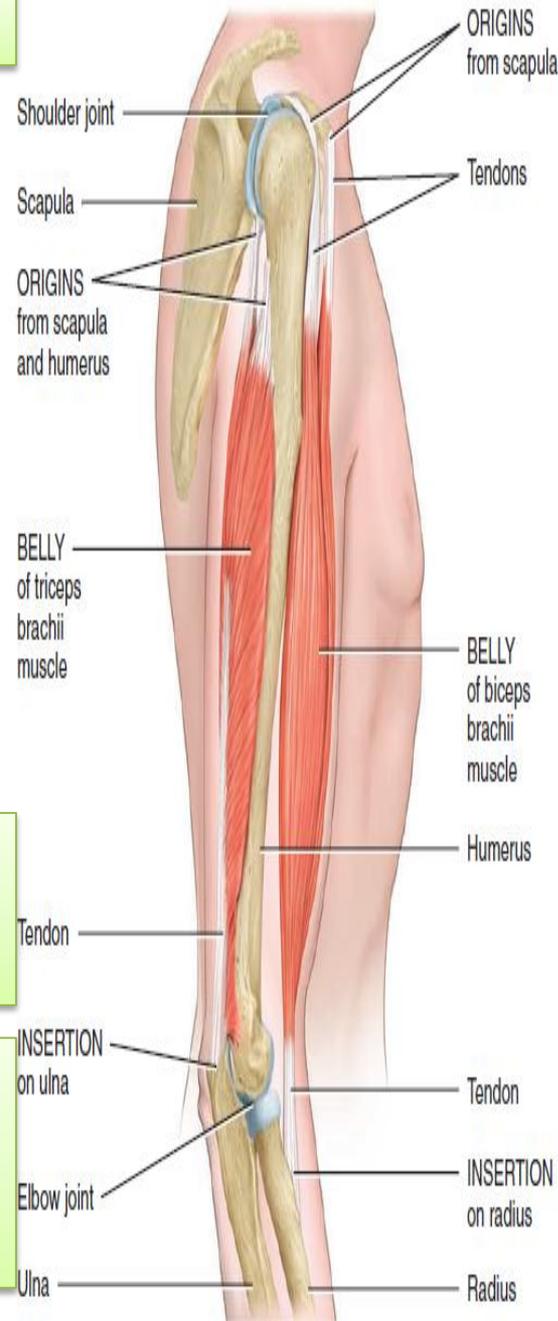
1- Each muscle has to be supplied by a nerve

2- For a muscle to produce a movement it has to cross over a joint

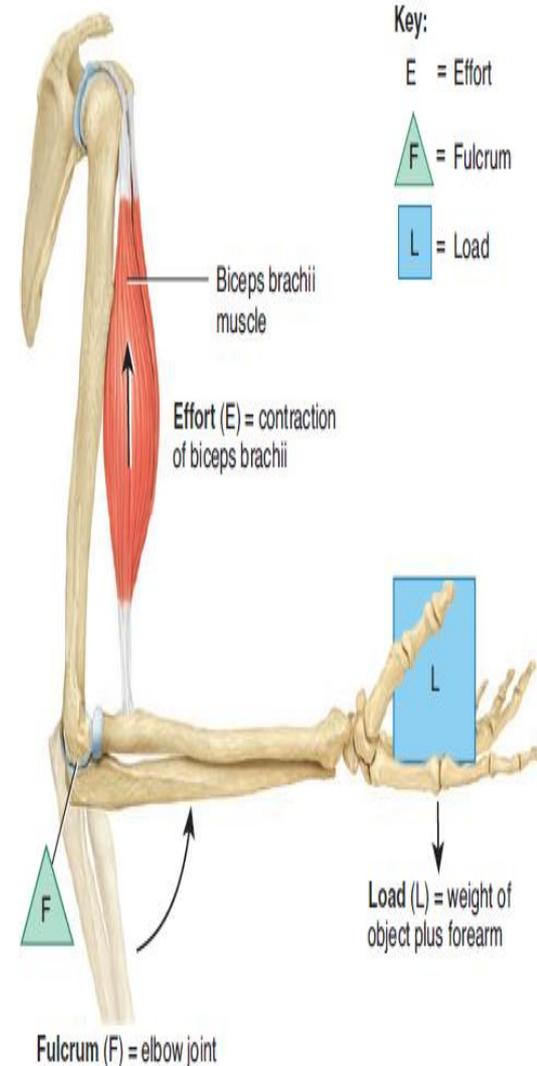
3- Muscles are attached to bones through points of attachments called **origin and insertion**

4- Usually the (insertion) moves towards the origin during contraction of the muscle

5- During contraction usually the muscle fibers shorten and this results in pulling the insertion towards the origin over a joint



(a) Origin and insertion of a skeletal muscle



(b) Movement of the forearm lifting a weight

# THE JOINTS

# Joints

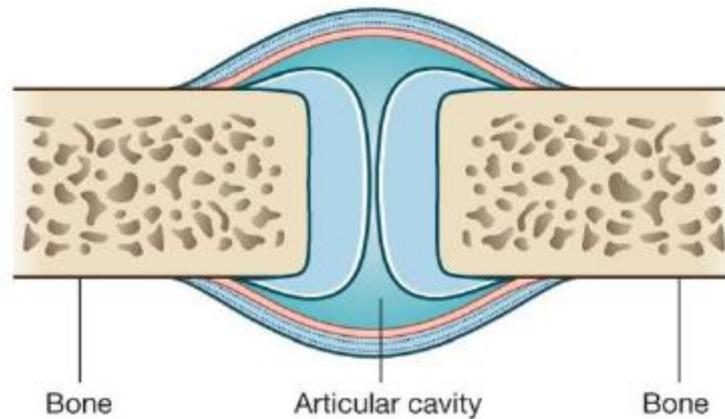
When two bones or more come together wither there is movement between them or not.

According to the tissue laying between the articulating bones ,joints are classified into:

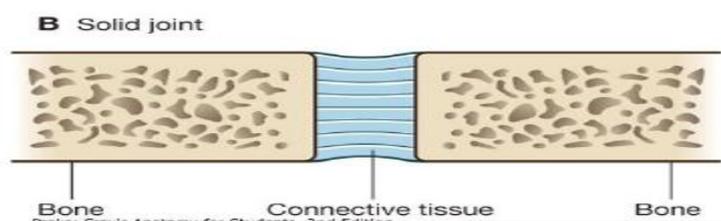
## 1-Synovial joints

Synovial joints are connections between skeletal components where the elements involved are separated by a narrow articular cavity

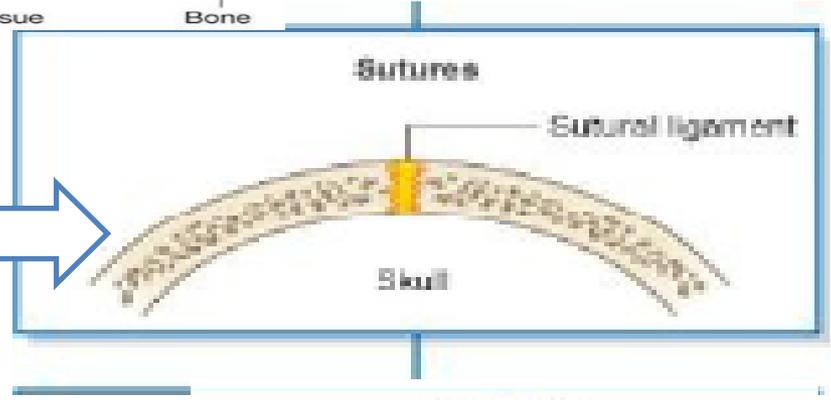
A Synovial joint



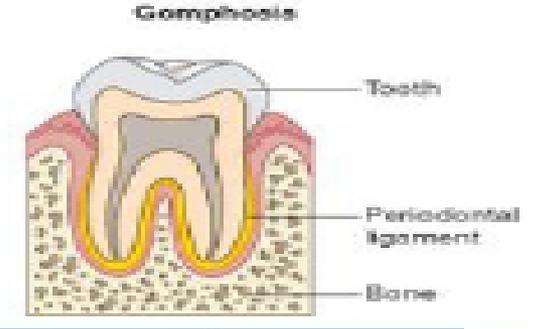
# 2-Fibrous joints



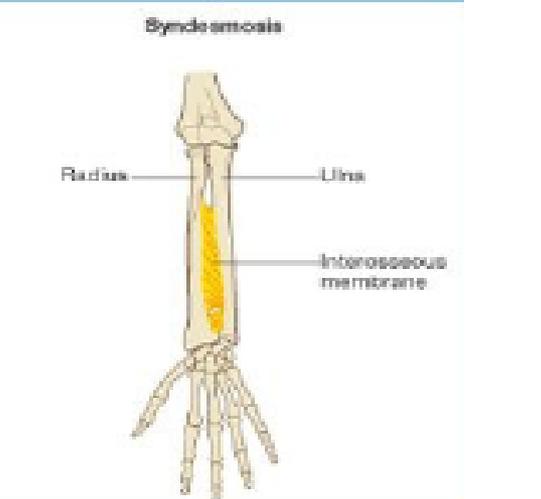
**A- Sutures** occur only in the skull where adjacent bones are linked by a thin layer of connective tissue termed a *sutural ligament*.



**B- Gomphoses** occur only between the **teeth and adjacent bone**. In these joints, short collagen tissue fibers in the periodontal ligament run between the root of the tooth and the bony socket.

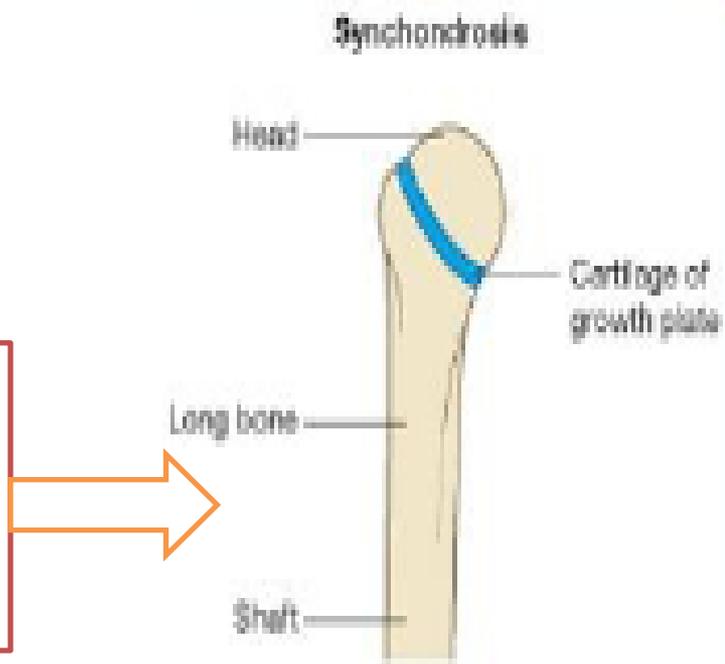


**C- Syndesmoses** are joints in which two adjacent bones are linked by a ligament. Examples are the **ligamentum flavum**, which connects adjacent vertebral laminae, and **an interosseous membrane**, which links, for example, the radius and ulna in the forearm.

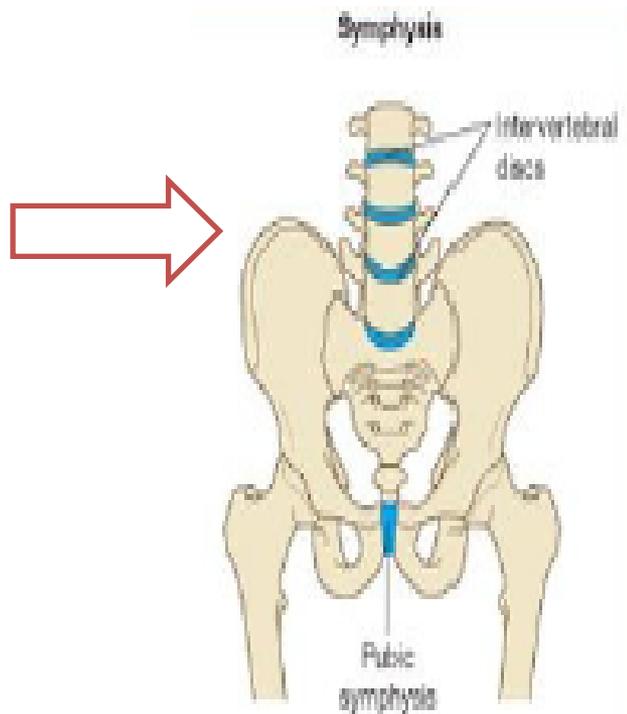


# 3-Cartilaginous joints

**A-Synchondroses** occur where two ossification centers in a developing bone remain separated by a layer of cartilage, for example the growth plate that occurs between the head and shaft of developing long bones. These joints allow bone growth and eventually become completely ossified.



**B-Symphyses** occur where two separate bones are interconnected by cartilage. Most of these types of joints occur in the midline and include the pubic symphysis between the two pelvic bones, and intervertebral discs between adjacent vertebrae



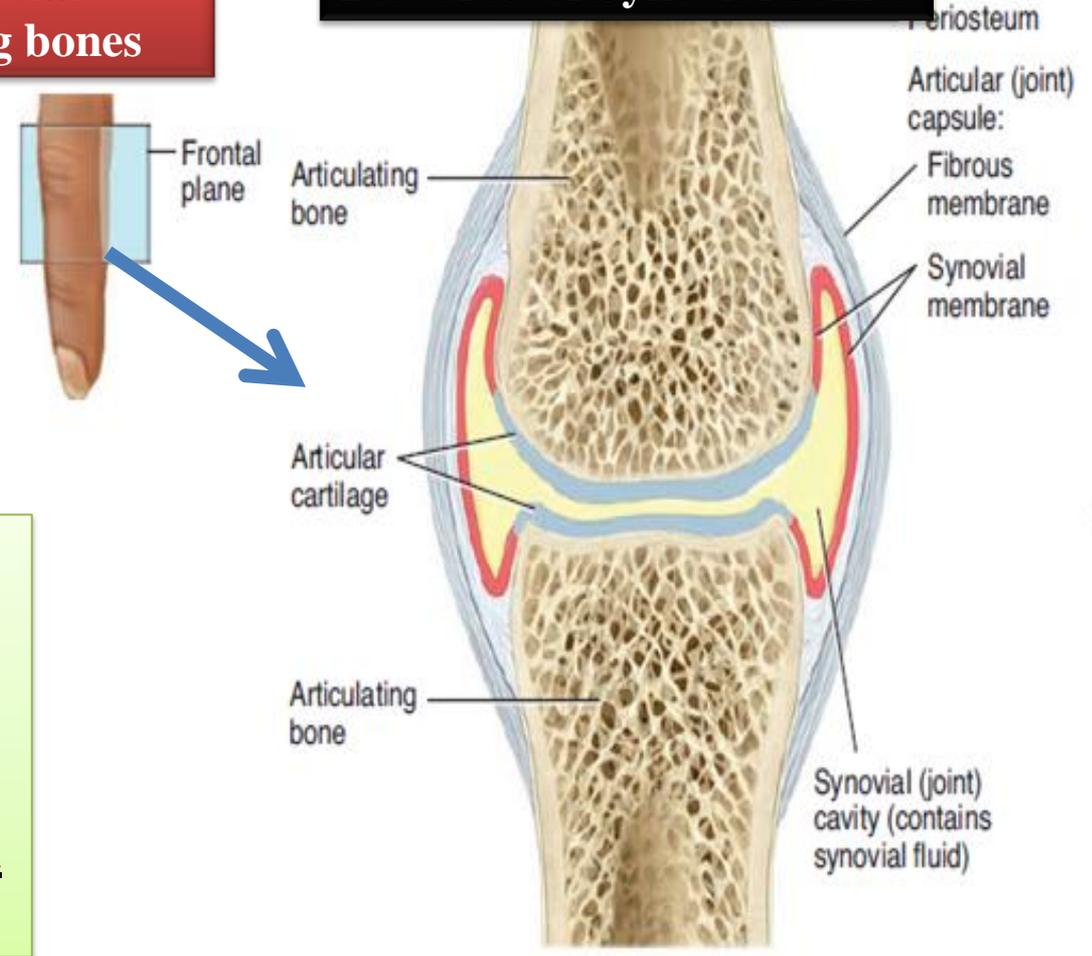
1-The presence of a space called a **synovial (joint) cavity** between the articulating bones

2-The bones are covered by a layer of ***hyaline cartilage*** called **articular cartilage**.  
The cartilage covers the articulating surface of the bones with a smooth, slippery surface

**3-Articular Capsule**  
A sleeve-like **articular (joint) capsule** surrounds a synovial joint, The articular capsule is composed of two layers, **an outer fibrous membrane** and **an inner synovial membrane**

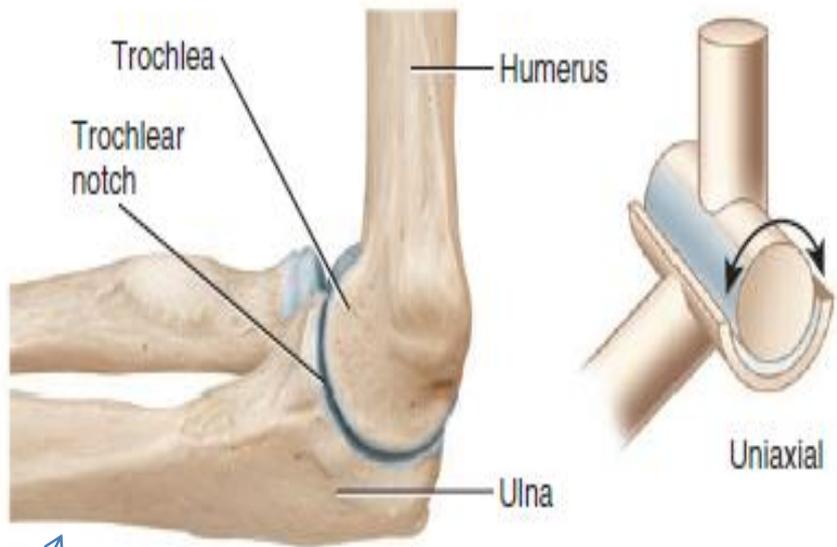
**4-Synovial Fluid**  
The synovial membrane secretes **synovial fluid** Its functions include reducing friction and supplying oxygen and nutrients to and removing carbon dioxide and metabolic wastes from the chondrocytes within articular cartilage.

## Features of Synovial Joints



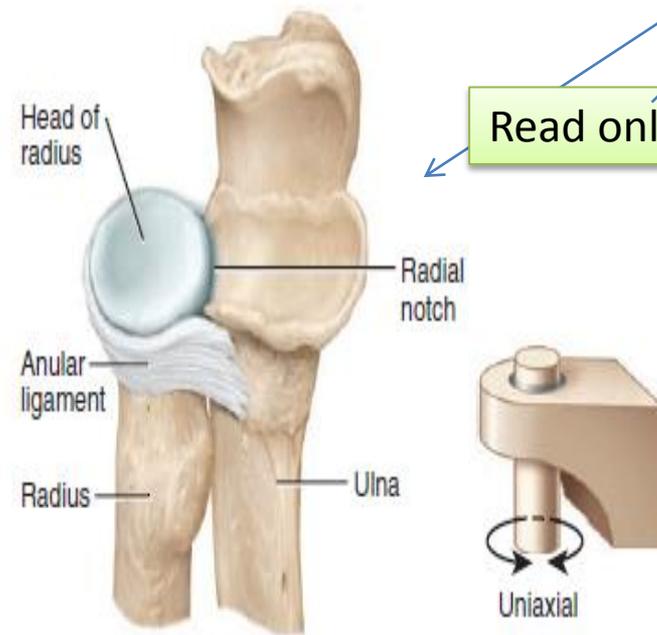
**5-Accessory Ligaments, Articular Discs**  
Many synovial joints also contain **accessory ligaments** called extracapsular ligaments and intracapsular ligaments

# Selected Types of synovial joints



(b) Hinge joint between trochlea of humerus and trochlear notch of ulna at the elbow

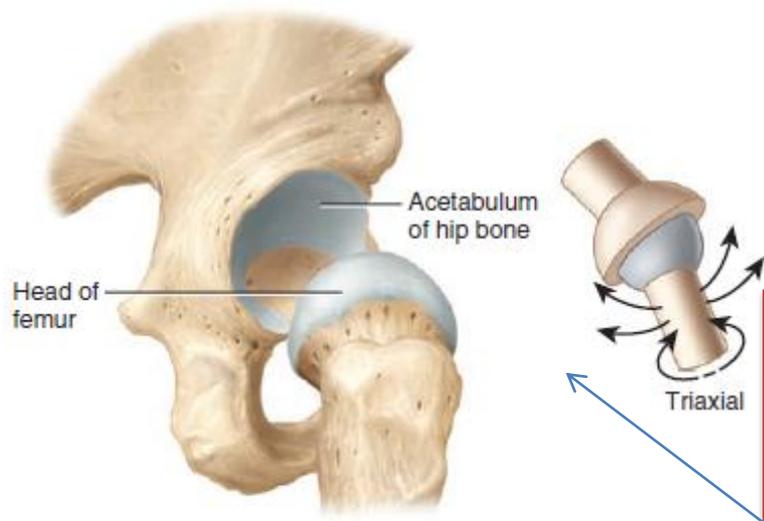
**1-Hinge Joints**  
 In a **hinge joint**, *the convex surface* of one bone fits into the concave surface of another bone



(c) Pivot joint between head of radius and radial notch of ulna

Read only

**2-Pivot Joints**  
 In a **pivot joint**, *the rounded or pointed surface* of one bone articulates with a ring formed partly by another bone and partly by a ligament



(f) Ball-and-socket joint between head of femur and acetabulum of hip bone

**3-Ball-and-Socket Joints**  
*consists of* the ball-like surface of one bone fitting into a cuplike depression of another bone

# shoulder joint

Type: is a ball-and-socket joint

Articulating bones: formed by the head of the humerus and the glenoid cavity of the scapula

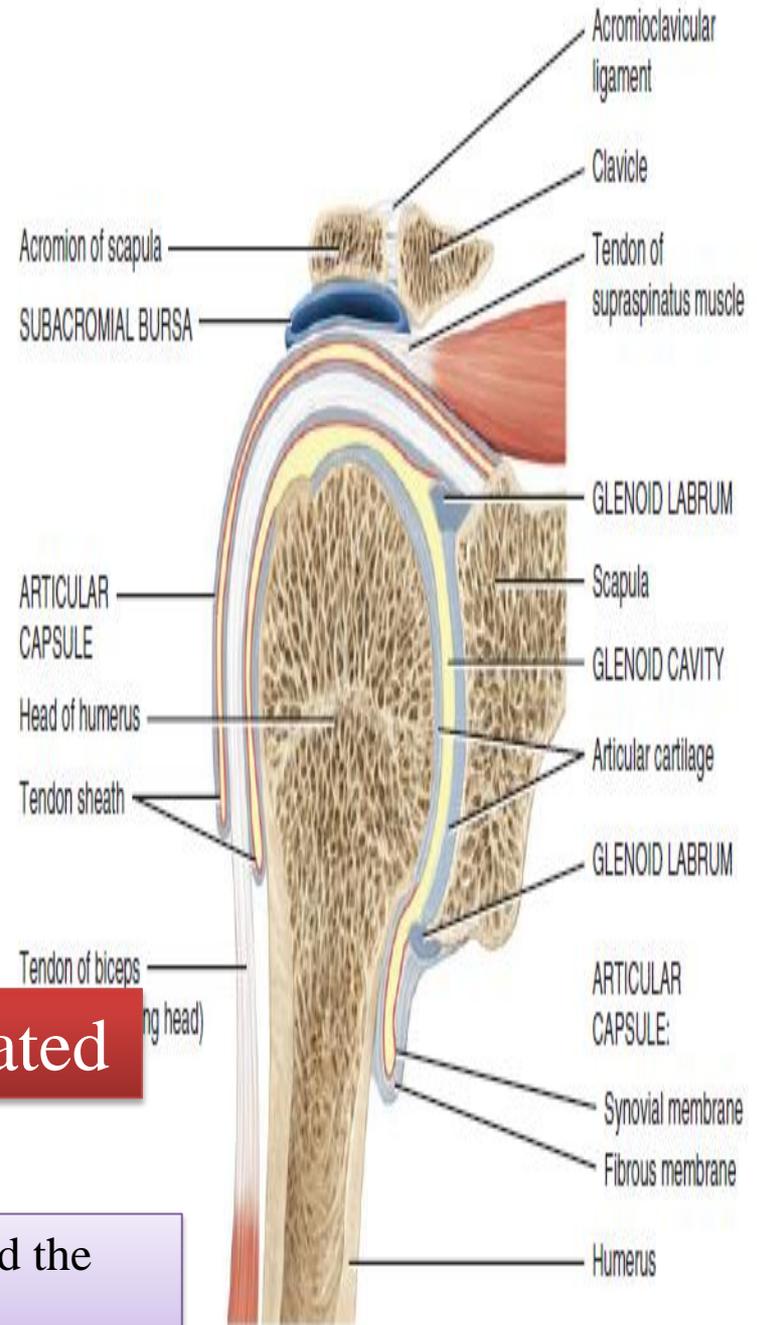
## Movements

The shoulder joint allows flexion, extension, hyperextension, abduction, adduction, medial rotation, lateral rotation, and circumduction of the arm

All movement

Freely mobile joint but easily dislocated

most of the strength results from the muscles that surround the joint, especially the rotator cuff muscles

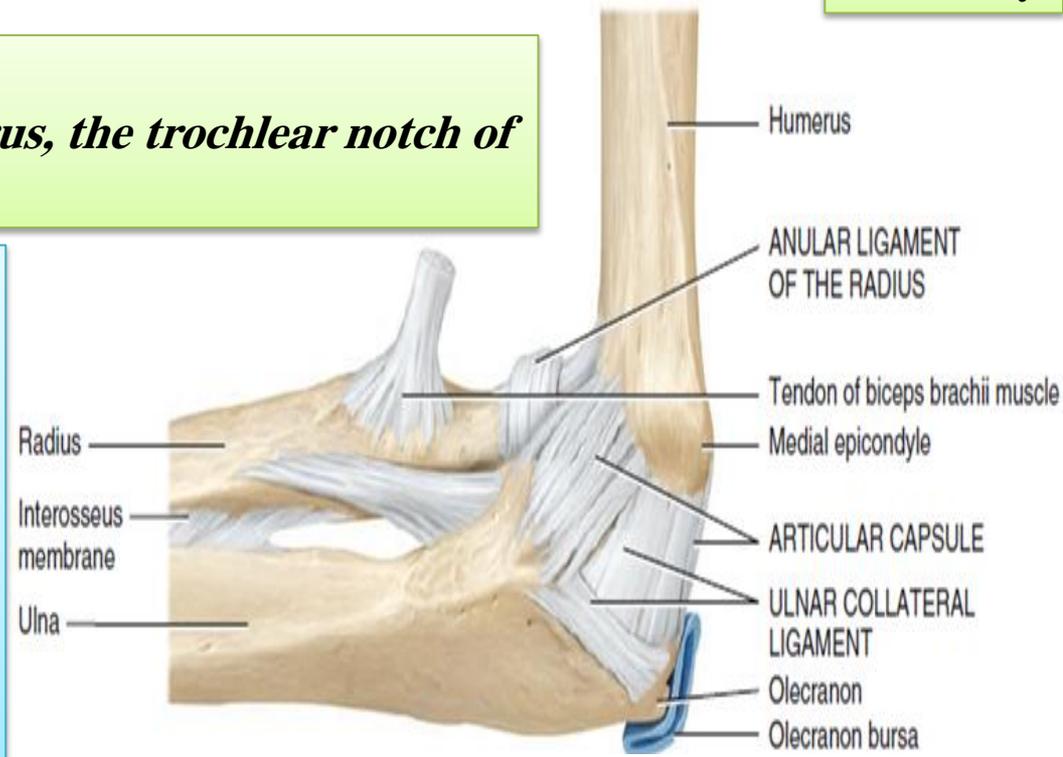


# The elbow joint

Read only

is a hinge joint formed by:  
*the trochlea and capitulum of the humerus, the trochlear notch of the ulna, and the head of the radius.*

**Movements**  
The elbow joint allows ***flexion and extension*** of the forearm (**only!!!!!!!**) **how about supination and pronation ? At which joint it takes place?**



Ligaments that support the joint

***Ulnar collateral ligament.***  
***Radial collateral ligament.***

## TYPES OF MOVEMENTS AT SYNOVIAL JOINTS

The major movements are:

1-FLEXION

2-EXTENSION

3-ABDUCTION

4-ADDUCTION

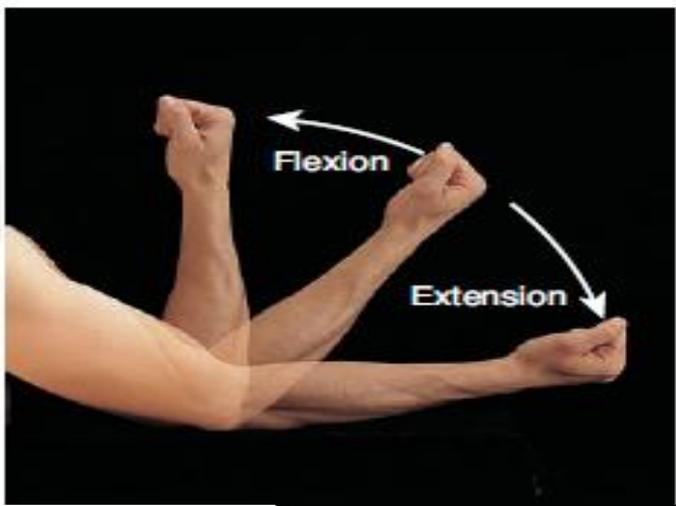
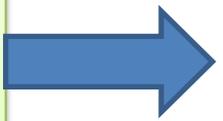
5- MEDIAL AND LATERAL ROTATION

5-CIRCUMDUCTION

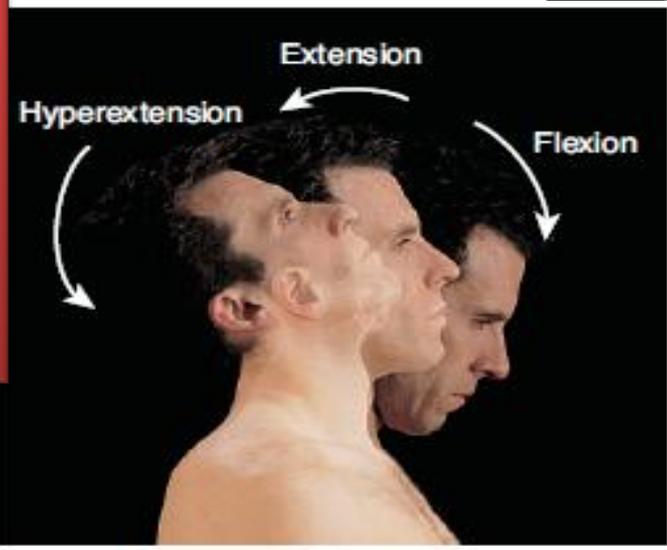
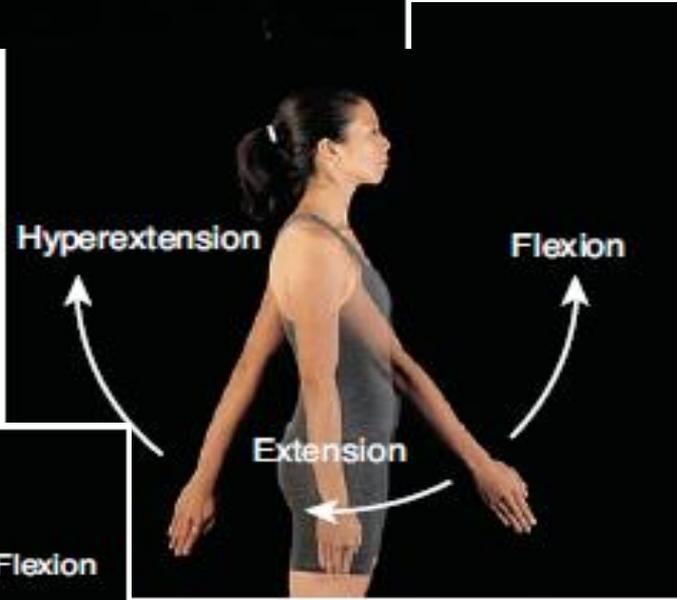
# *Flexion, Extension*

Flexion and extension are opposite movements.

**In flexion**  
there **is a decrease**  
in the angle between  
articulating  
bones



**in extension** (to stretch out)  
there is  
**an increase in the**  
**angle** between articulating  
bones, often to restore a part of the  
body to the anatomical position  
after it has been flexed



## *Abduction, Adduction*

**Abduction** *is the* movement of **a bone away from the midline**  
**adduction** *is the* movement of a **bone toward the midline**

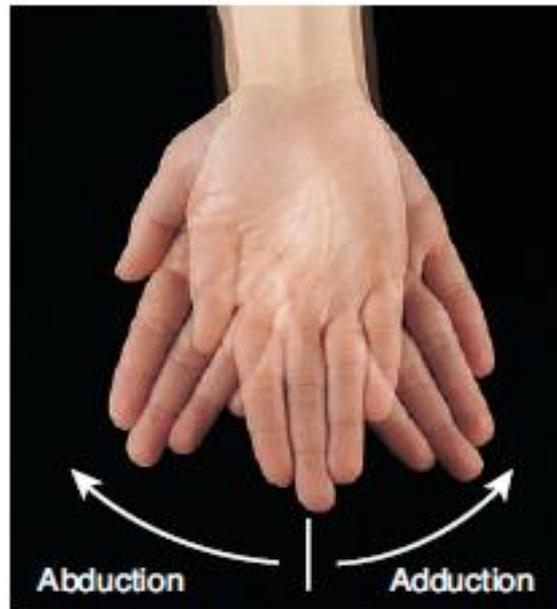
### Examples of abduction include

moving the humerus  
laterally at  
the shoulder joint



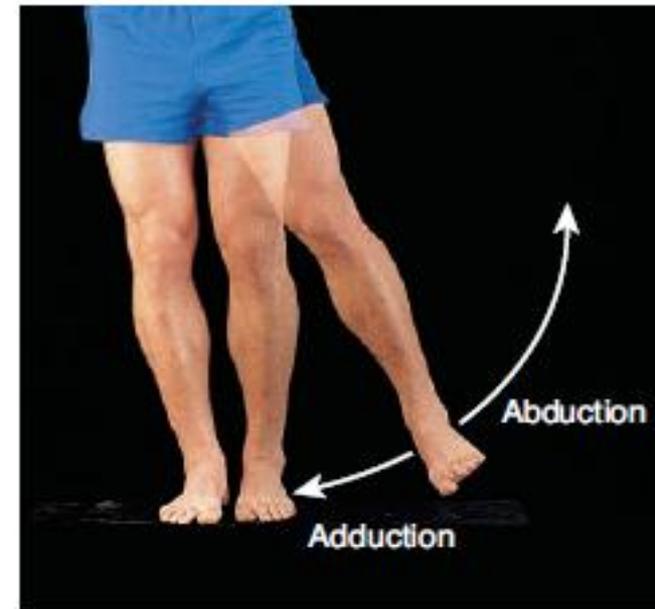
(a) Shoulder joint

moving the palm laterally  
at the wrist joint



(b) Wrist joint

moving the femur laterally  
at the hip joint



(c) Hip joint

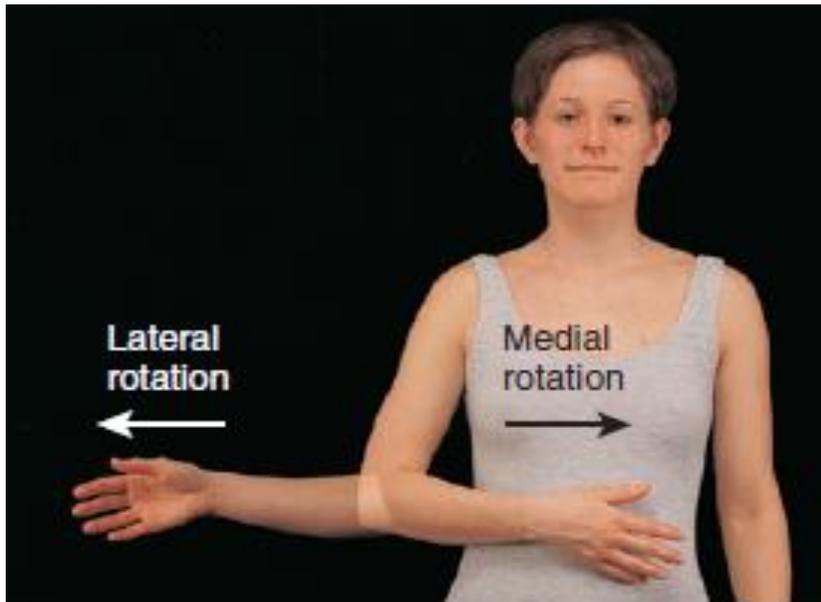
The movement that returns each of these body parts to the anatomical position is **adduction**

## Rotation

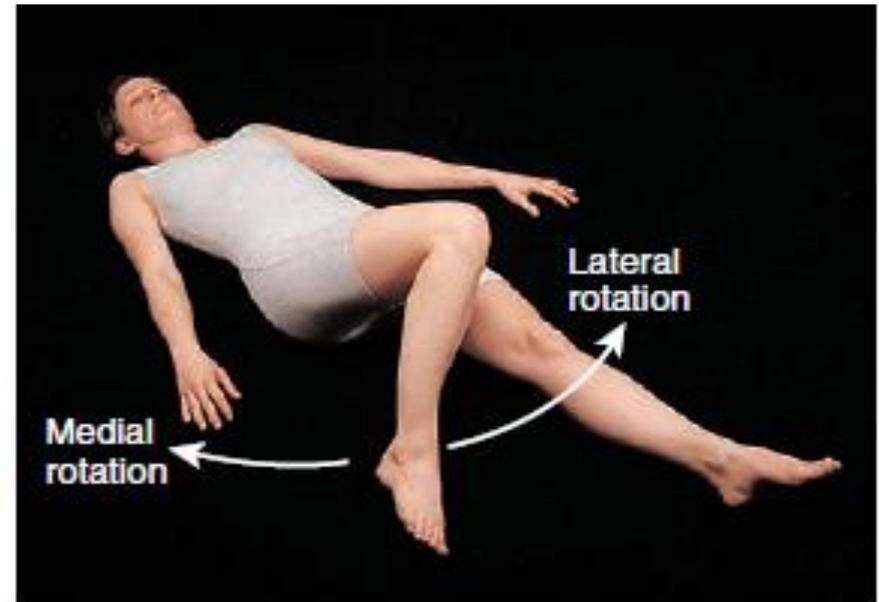
In rotation *a bone revolves* around its own longitudinal axis

If the anterior surface of a bone of the limb is turned toward the midline, the movement is called *medial (internal)*

If the anterior surface of the bone of a limb is turned away from the midline, the movement is called *lateral (external) rotation*



(b) Shoulder joint



(c) Hip joint

**Inversion**  
is movement of the sole medially at the intertarsal joints (between the tarsals)

**Eversion** is a movement of the sole laterally at the intertarsal joints.

- **Dorsiflexion** refers to bending of the foot at the ankle joint (Dorsiflexion occurs when *you stand on your heels.*

- **Plantar flexion** involves bending of the foot at the ankle joint as when you elevate your body by *standing on your toes.*



(e) Intertarsal joints



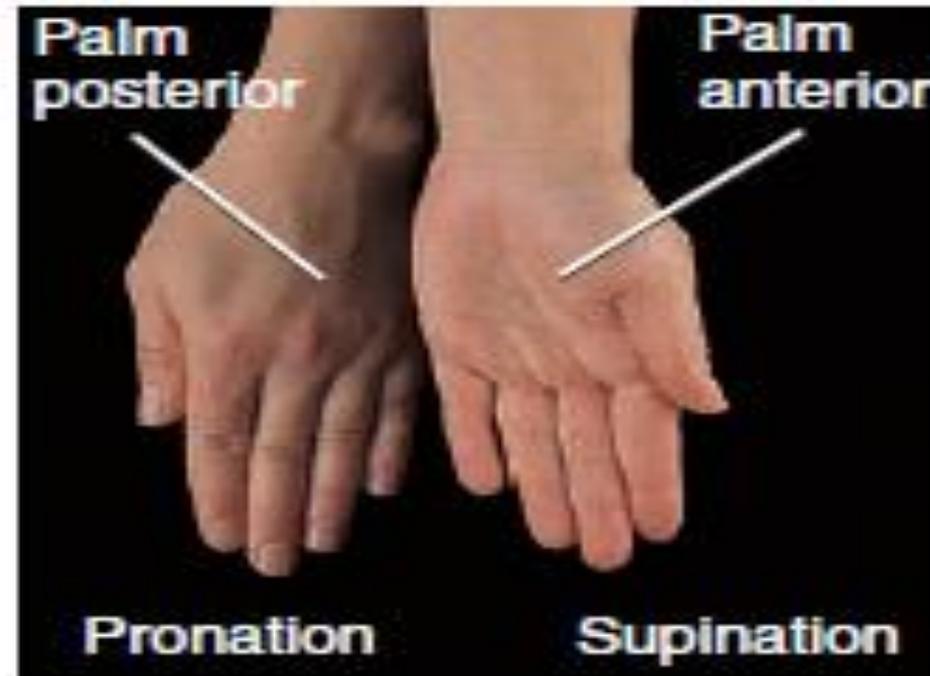
(f)



(g) Ankle joint

**Supination is a movement of the forearm at the proximal and distal radioulnar joints in which the palm is turned anteriorly**

**Pronation is a movement of the forearm at the proximal and distal radioulnar joints in which the palm is turned posteriorly**



(h) Radioulnar joint

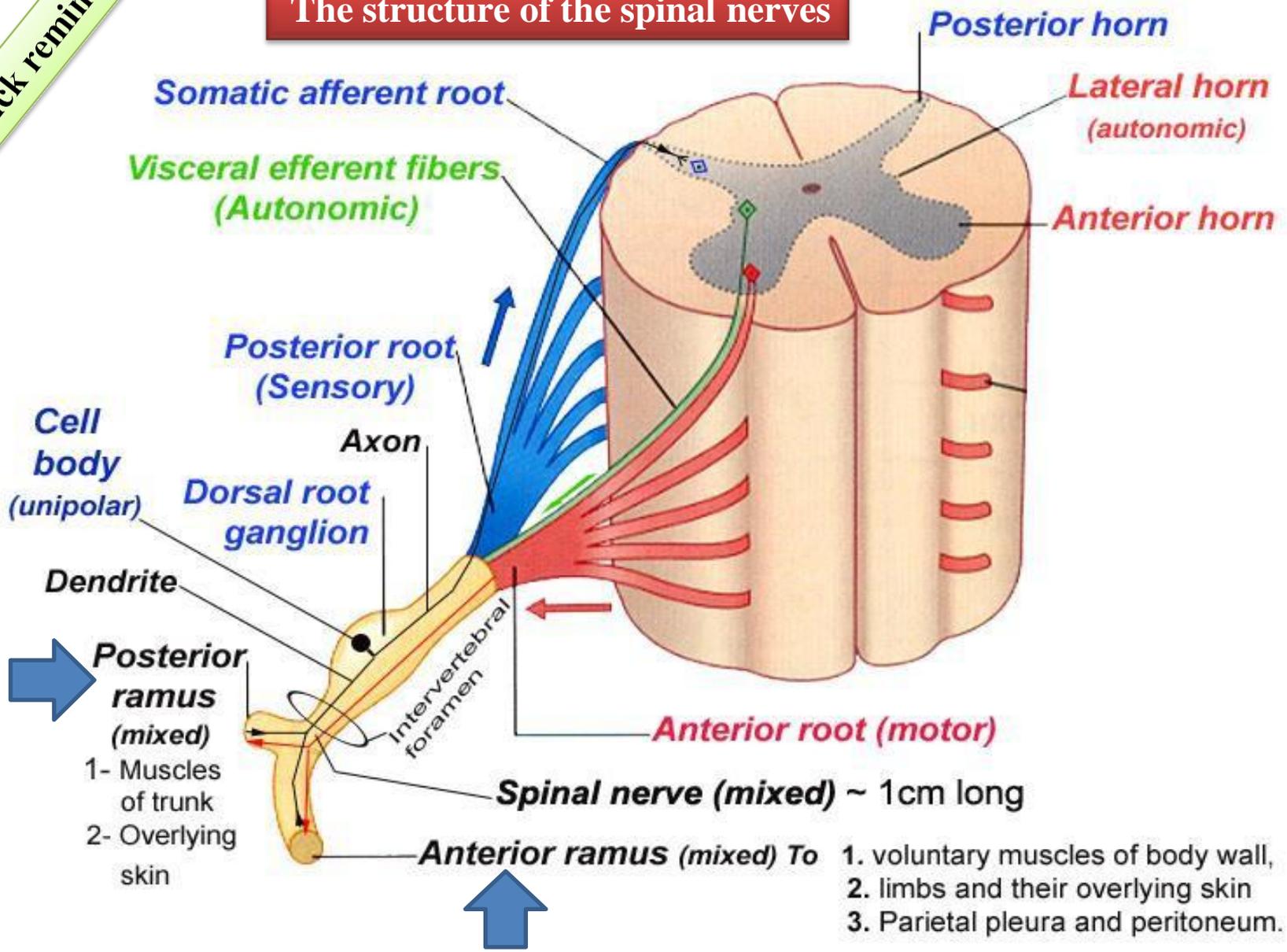
# Nerves of the lower limbs

# NERVES OF THE LOWER LIMB

## LUMBER PLEXUS

**Quick reminder**

# The structure of the spinal nerves



Before we proceed! You should Remember the following



The spinal nerves form

C1- C5

participate in the formation of the cervical plexus The cervical plexuses is responsible for the innervation of the diaphragm and other muscles, we will talk about them later

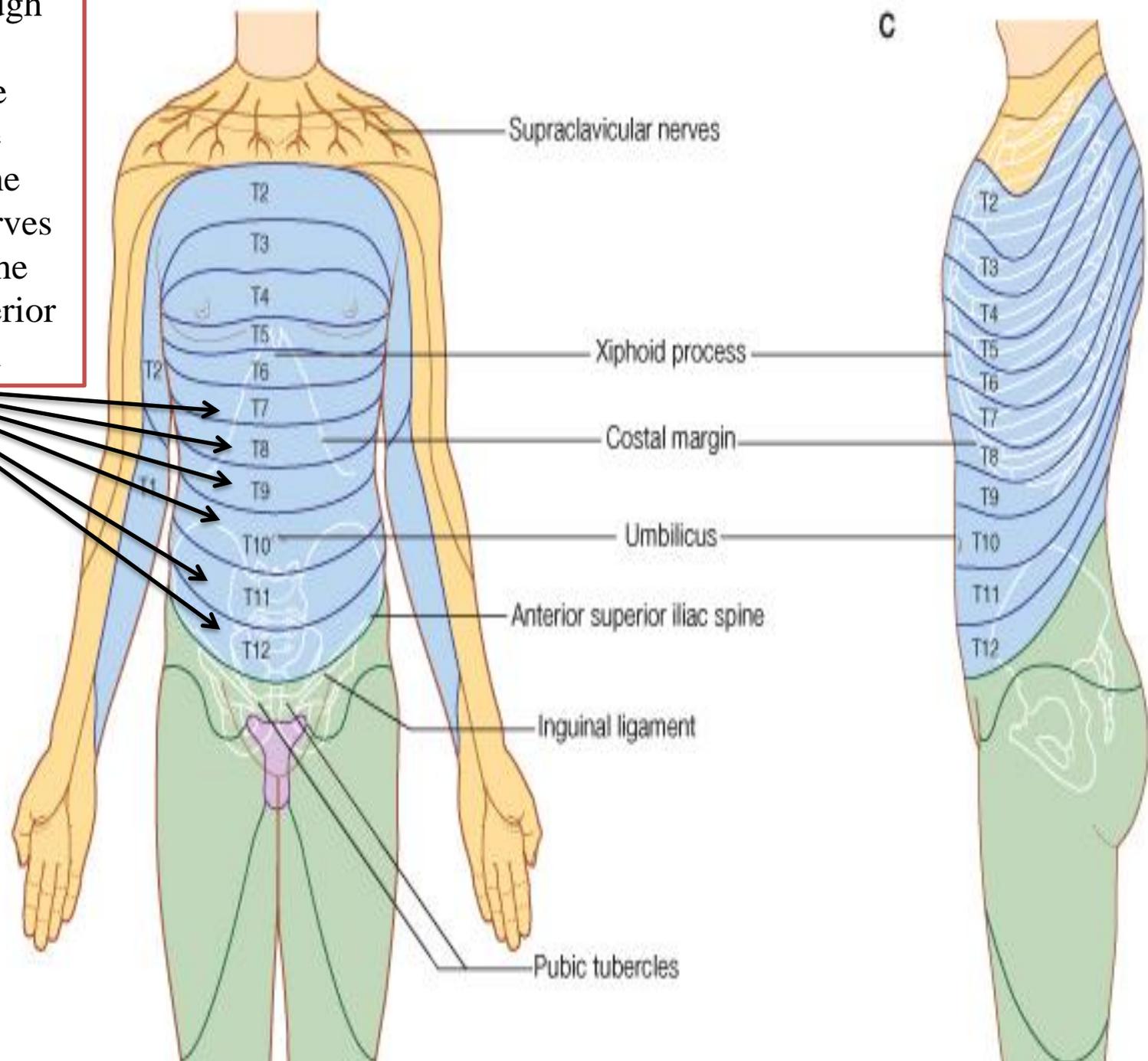
C5-T1

participate in the formation of the **Brachial plexus**

T1- T12

There are 12 pairs of thoracic ventral rami. The upper 11 lie between the ribs (Intercostal nerves), and the twelfth lies below the last rib (subcostal nerve)

Notice, that although the lower five Intercostal + the subcostal nerve originate from the thoracic spinal Nerves but they supply the muscles of the anterior abdominal wall



**What about the lumbar spinal nerves?**

# The lumbar plexus

what about the posterior?  
↑

Is formed by

**the anterior primary rami** of the upper four lumbar nerves in the substance of psos major muscle

**It also** receives a contribution from **T12** (subcostal) nerve

4 small nerves ? + 2 main nerves ?

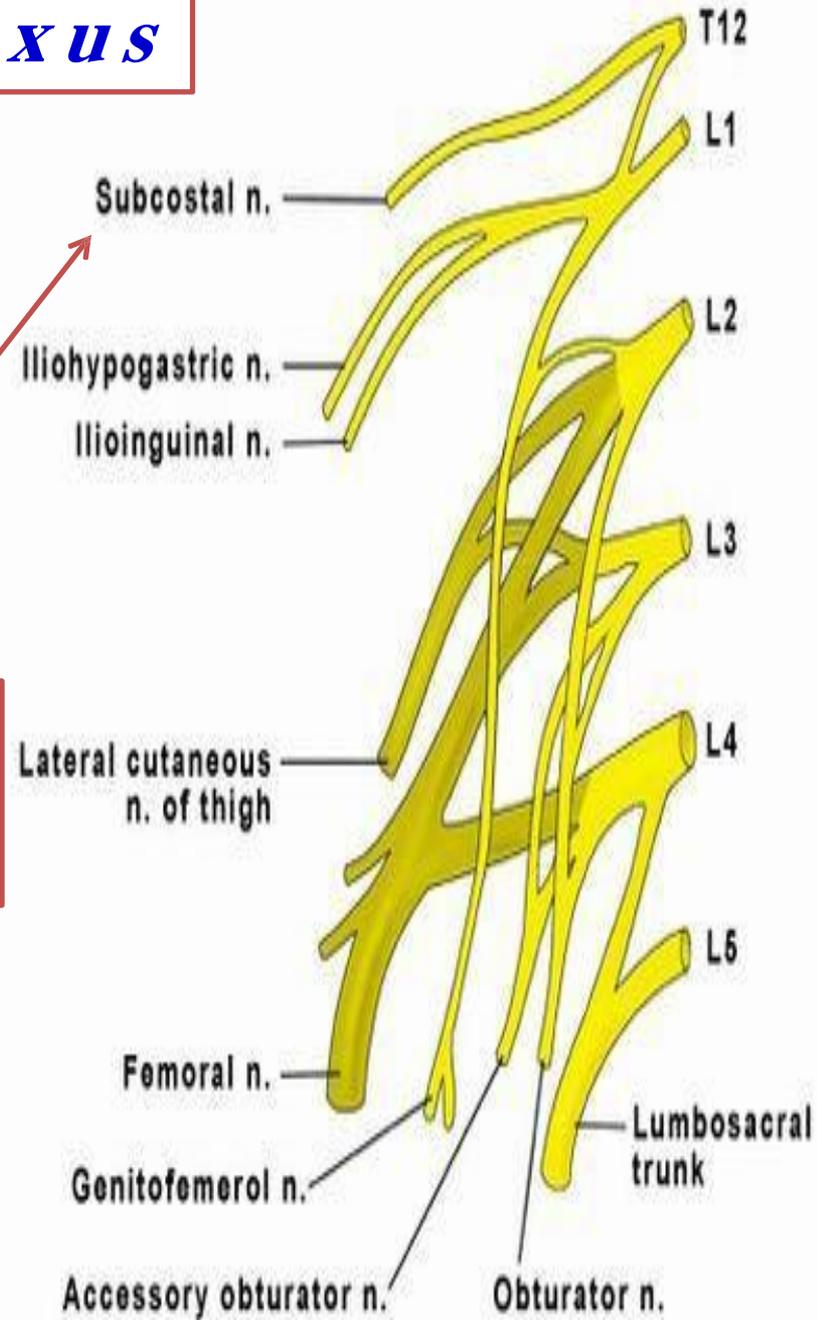
*Ilio-hypogastric*

*Ilio-inguinal*

*Genitofemoral*

*Lateral cutaneous nerve of the thigh*

**Femoral  
Obturator**



What is the key to memorize the lumbar plexus?

### L1 gives

- 1 Ilio-hypogastric nerve*
- 2 Ilio-inguinal*
- 3 The first root of the genito-femoral*

### L2 gives (four branches)

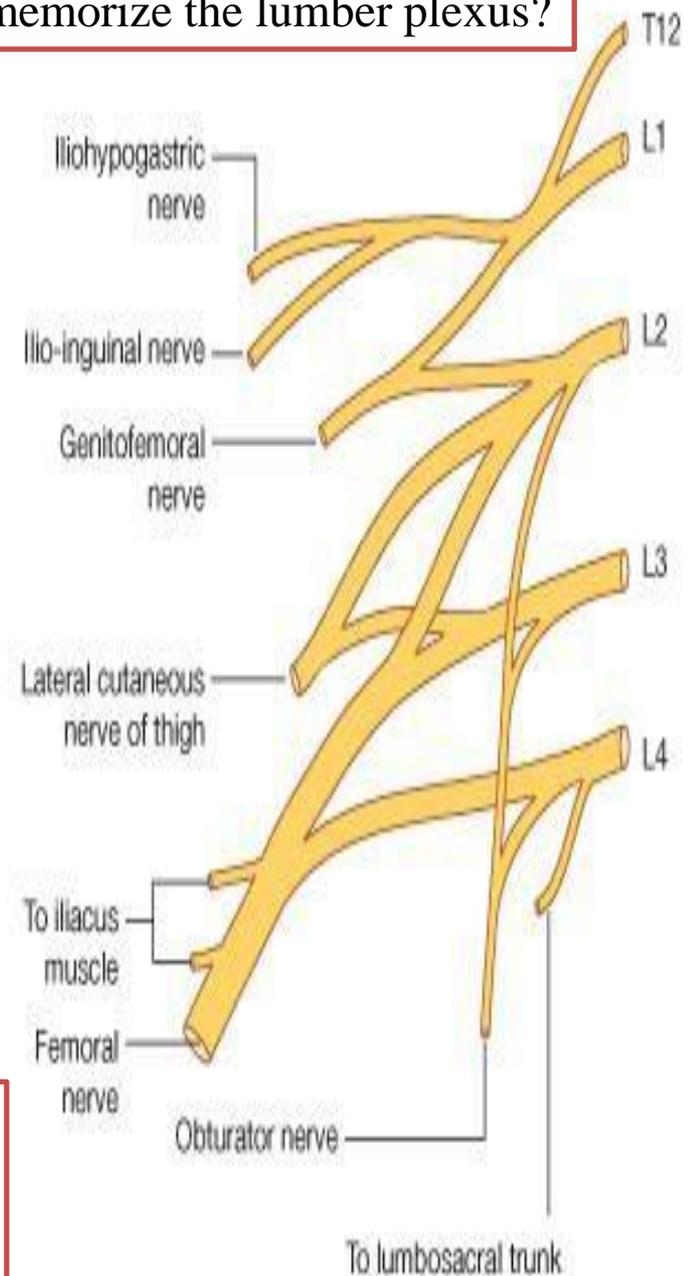
- 1 The second root of the genito-femoral*
- 2 The first root of the lateral cutaneous nerve of the thigh*
- 3 The first root of the femoral nerve*
- 4 The first root of the obturator nerve*

### L3 gives

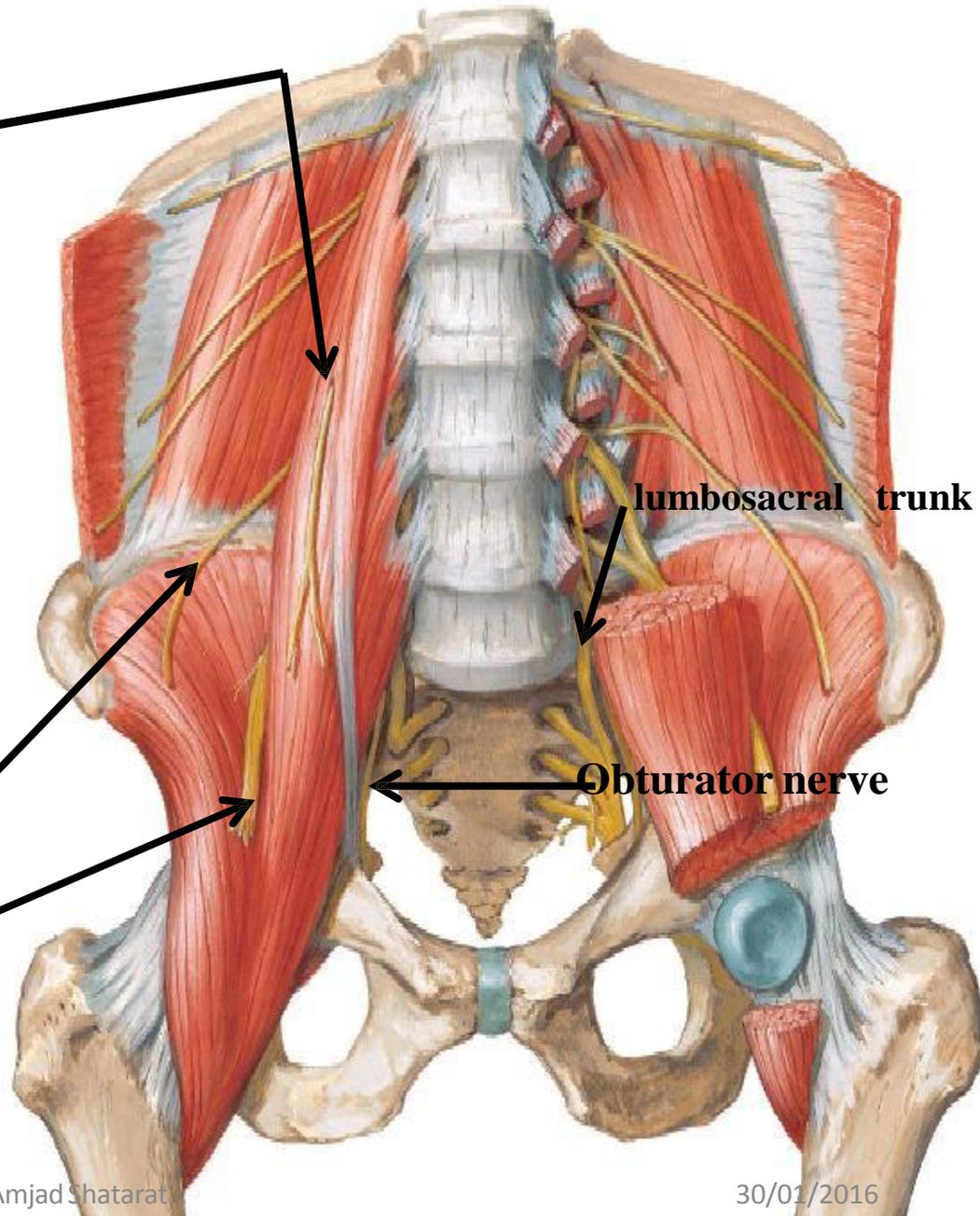
- 1 The second root of the lateral cutaneous nerve of the thigh*
- 1 The second root of the femoral nerve*
- 2 The second root of the obturator nerve*

### L4 gives

- 1 The third root of the femoral nerve*
- 2 The third root of the obturator nerve*
- 3 The upper root of the lumbo-sacral trunk*



## Psoas and Iliacus Muscles



Each nerve of the lumbar **plexus** emerges ( **exits**) from the substance of **the psoas major muscle** as flows:

➤ **Genitofemoral nerve** from the **anterior surface**.

➤ **Obturator nerve and lumbo-sacral trunk** from **the medial side**.

➤ **The Iliohypogastric**

➤ **The Ilioinguinal**

➤ **The Lateral cutaneous nerve of the thigh**

➤ **Femoral nerve**

exit from the **lateral side of the psoas**

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**major muscle**

Pay attention to this during practicals

The ilio-hypogastric and ilio-inguinal nerves arise as a **single trunk** from the anterior ramus of L1

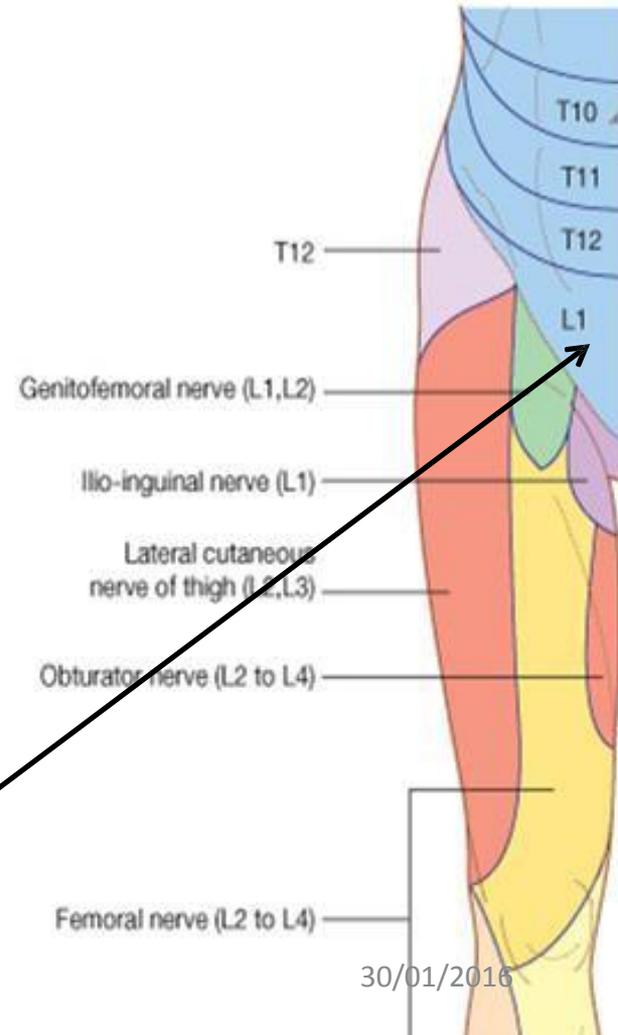
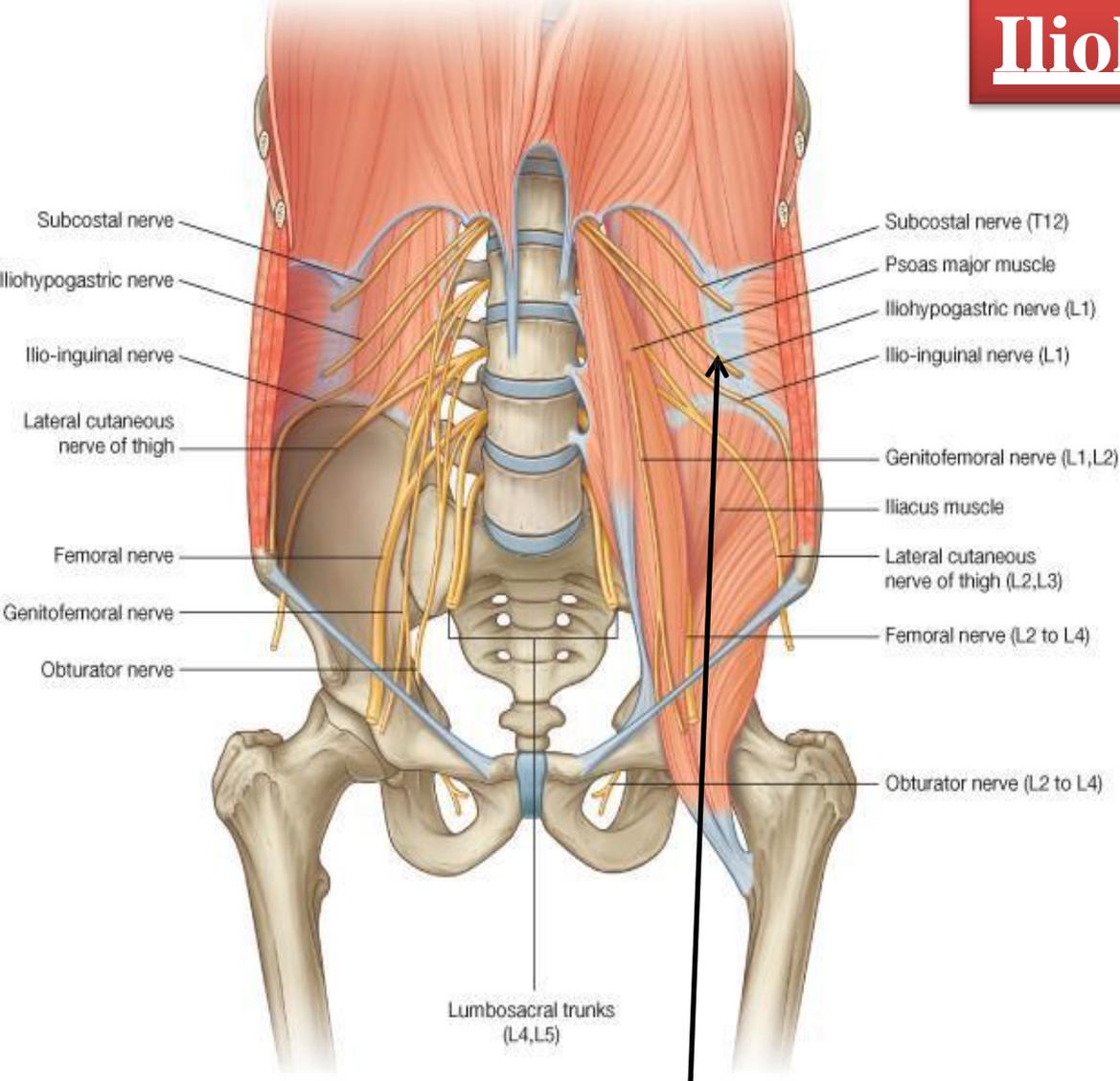


Either before or soon after emerging from the lateral border of the psoas major muscle, this single trunk divides into:  
**the ilio-hypogastric and the ilio-inguinal nerves**



Note:  
1 The iliohypogastric nerve is larger than the ilio-inguinal nerve  
2 The iliohypogastric nerve runs superior to the ilio-inguinal nerve

# Iliohypogastric nerve



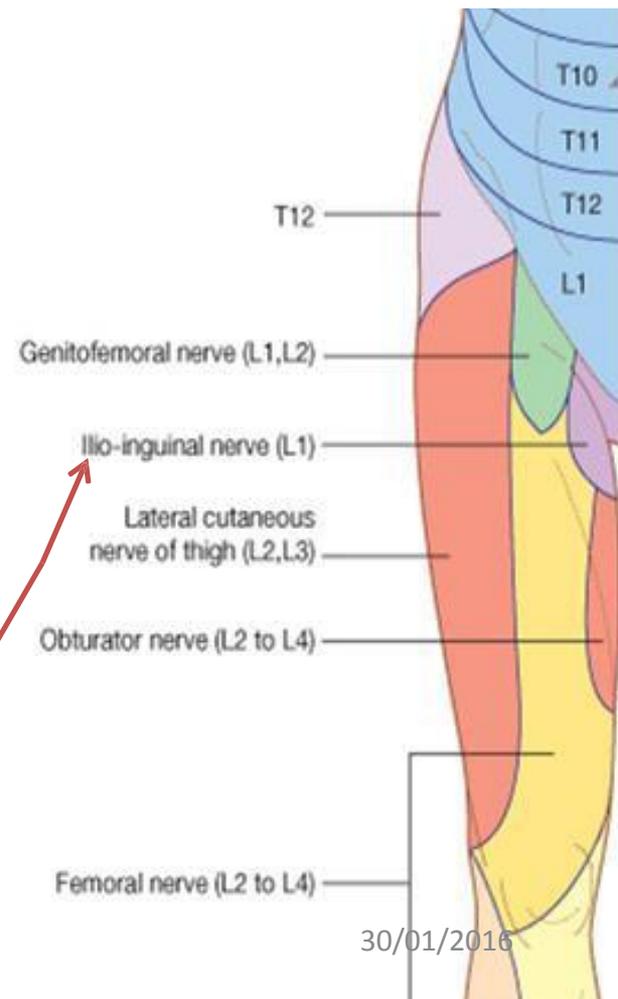
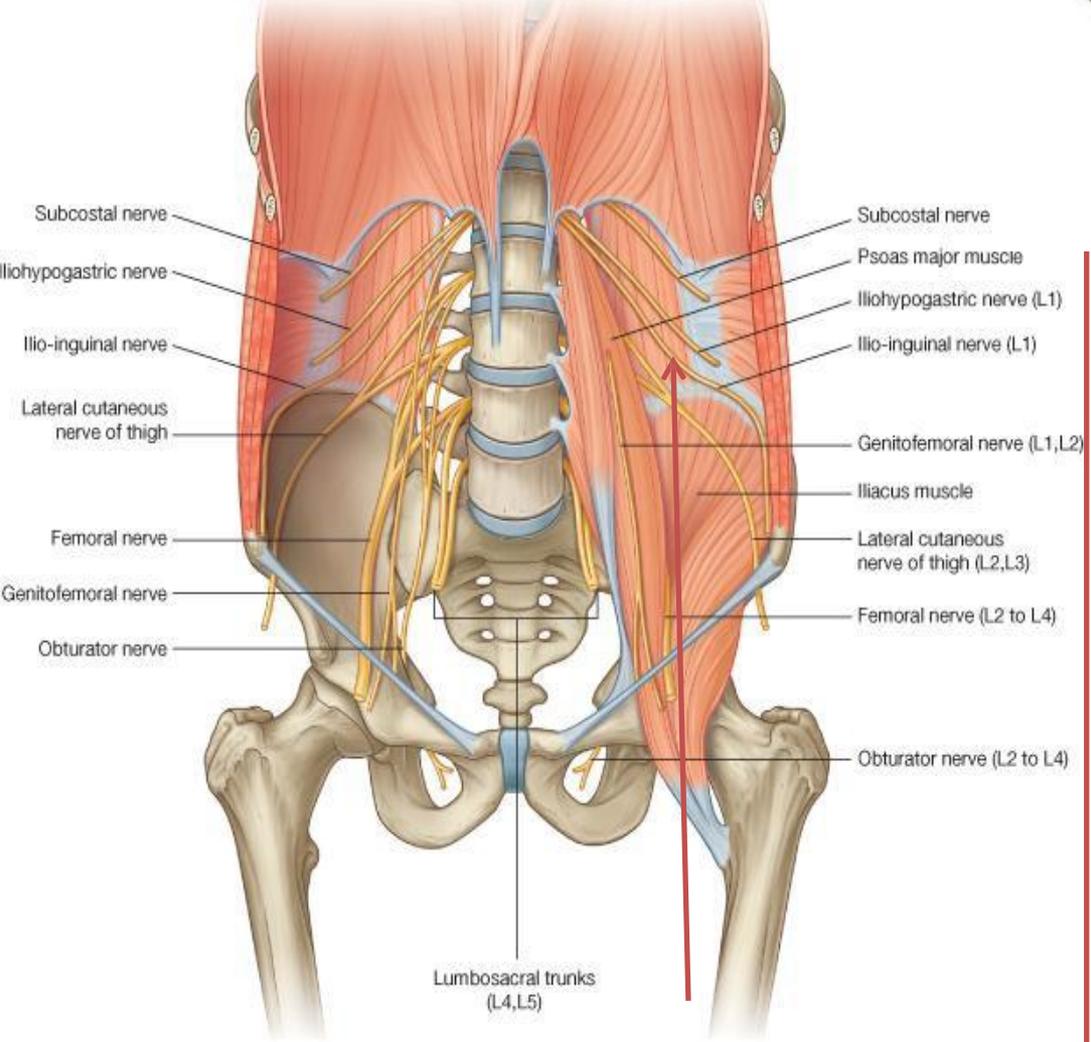
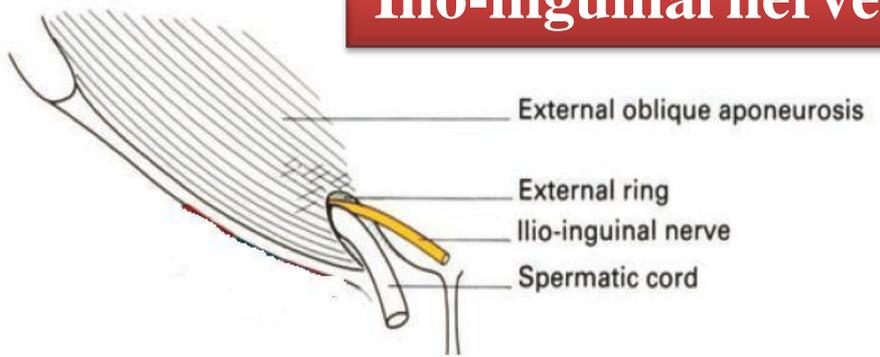
**supplies the posterolateral gluteal skin and just above the superficial inguinal ring, and it distributes to the skin in the pubic region**

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The surgeon should be very careful to the Ilio-inguinal nerve while giving incision and hernia repair as it could be injured during these procedures

# Ilio-inguinal nerve



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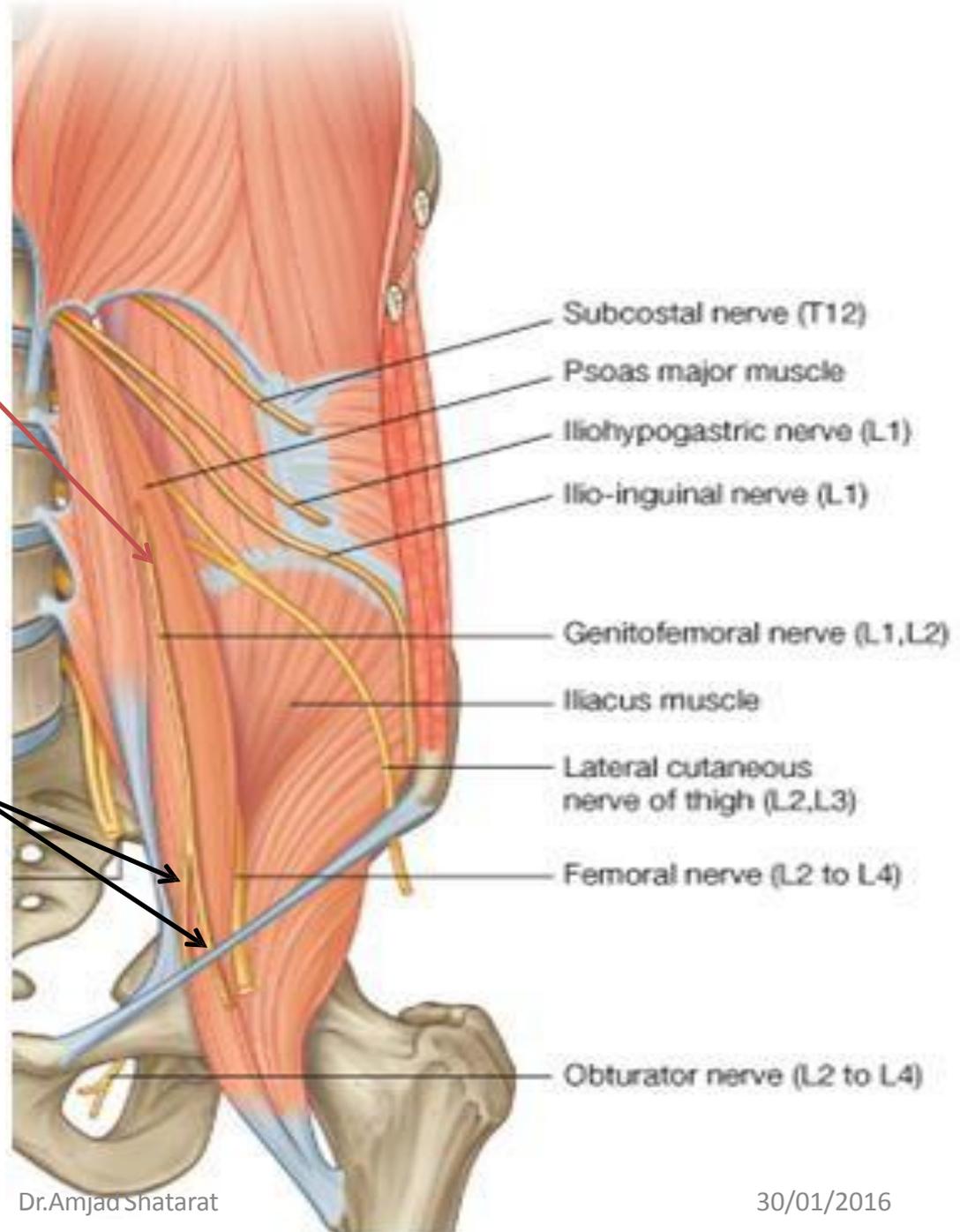
**provides cutaneous innervation to the upper medial thigh, the root of the penis, and the anterior surface of the scrotum in men, or the mons pubis and labium majus in women**

# Genitofemoral nerve

Genitofemoral nerve  
(L1 and L2)

The genitofemoral nerve arises from the anterior rami of the nerves of L1 and L2 **emerges on the anterior surface of psoas major.**

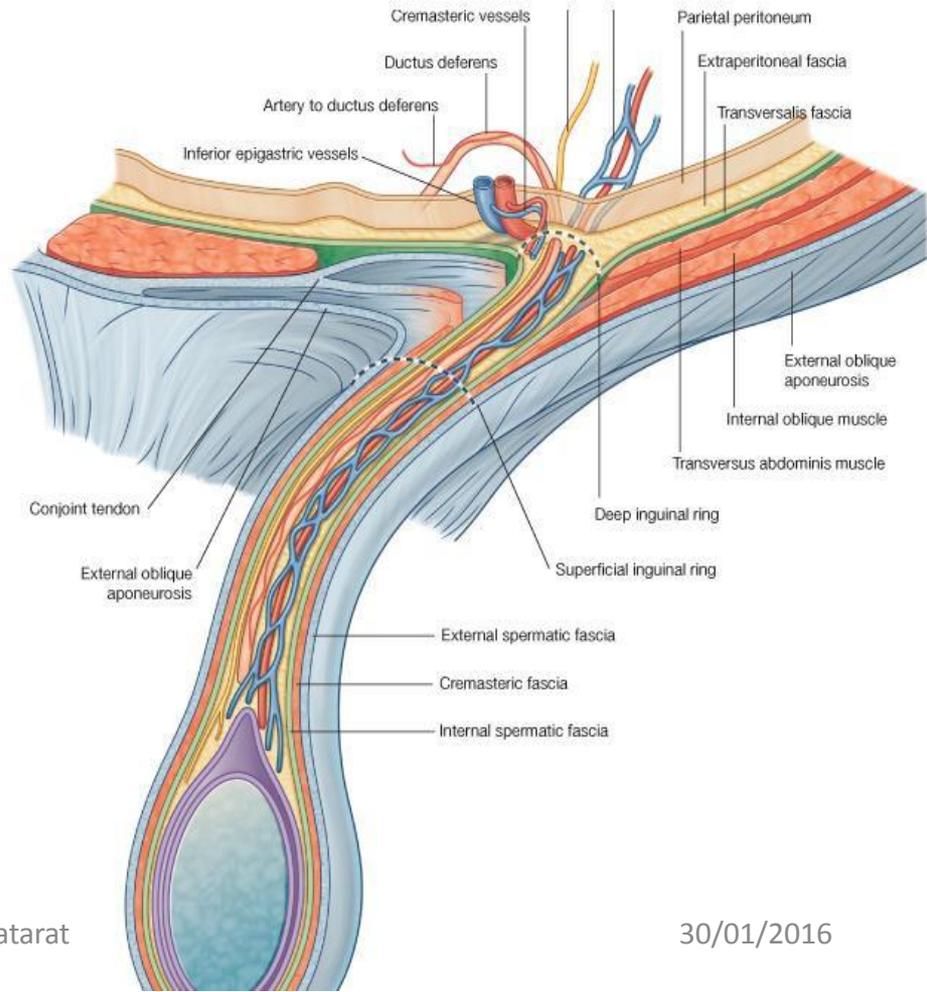
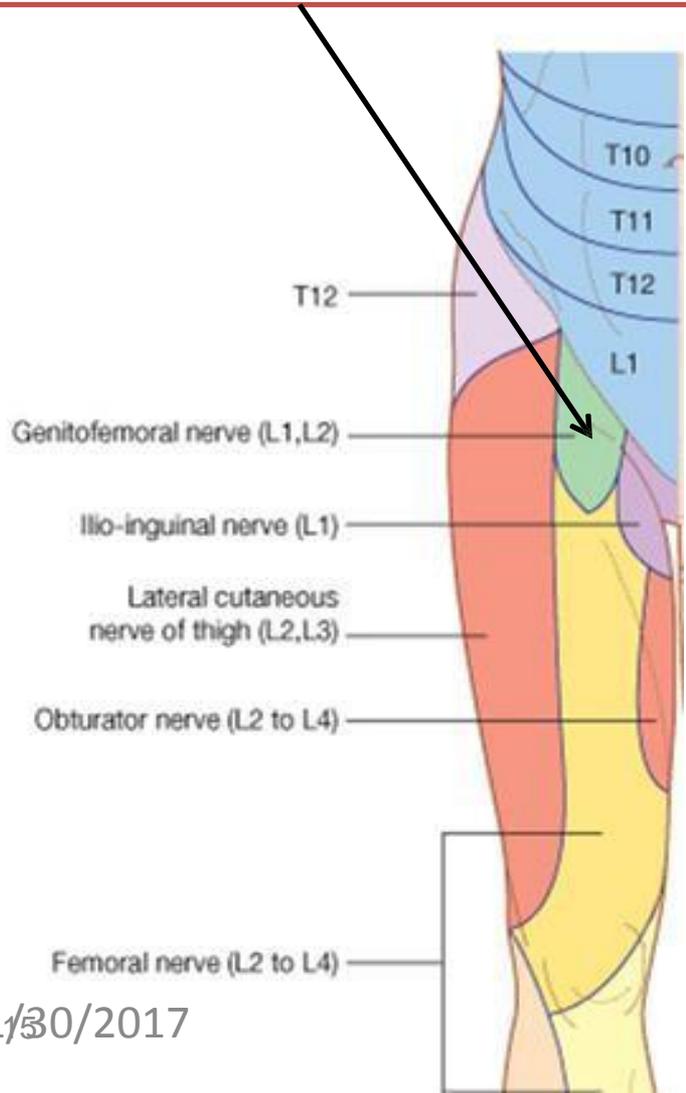
It eventually divides into genital and femoral branches.



**The femoral branch** descends on the lateral side of the external iliac artery and passes posterior to the inguinal ligament, entering the femoral sheath lateral to the femoral artery. It pierces the anterior layer of the *femoral sheath* and the fascia lata to supply the skin of the upper anterior thigh

The **genital branch**

- **in men**, innervates the **cremasteric** muscle and terminates on the skin in the upper anterior part of the scrotum;
- **in women**, accompanies the round ligament of the uterus and terminates on the skin of the mons pubis and labium majus.



## Lateral cutaneous nerve of thigh (L2 and L3)

The lateral cutaneous nerve of thigh arises from the anterior rami of nerves L2 and L3

It emerges from the lateral border of the psoas major muscle

It passes posterior to the inguinal ligament and enters the thigh.

The lateral cutaneous nerve of thigh supplies the skin on the anterior and lateral thigh to the level of the knee

**Intrapelvic:** causes include pregnancy, abdominal tumors

**extrapelvic:** causes include trauma to the region of the ASIS (eg, from a seatbelt in a motor vehicle accident), ***tight garments, belts, girdles***, or ***stretch from obesity***

**Mechanical:** factors include **prolonged sitting** or **standing.**

**Diabetes** or all the above in the setting of polyneuropathy

1/30/2017

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Clinical application  
Injury of this nerve

Graft for bone marrow

Genitofemoral nerve (L1,L2)

Ilio-inguinal nerve (L1)

Lateral cutaneous nerve of thigh (L2,L3)

Obturator nerve (L2 to L4)

Femoral nerve (L2 to L4)

T12

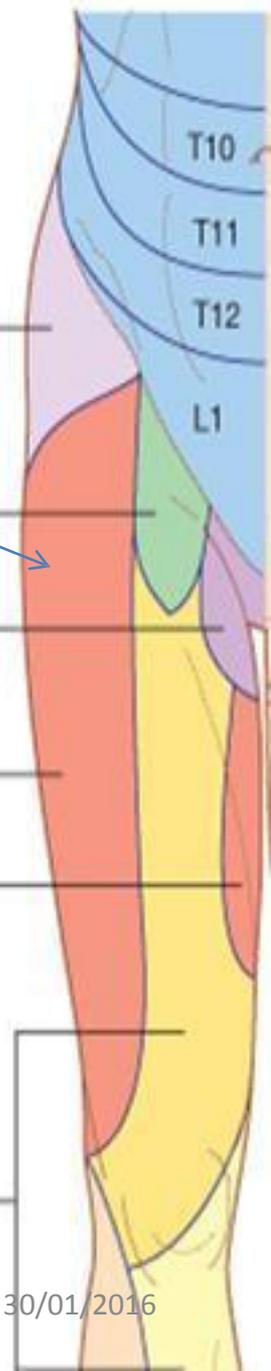
T10

T11

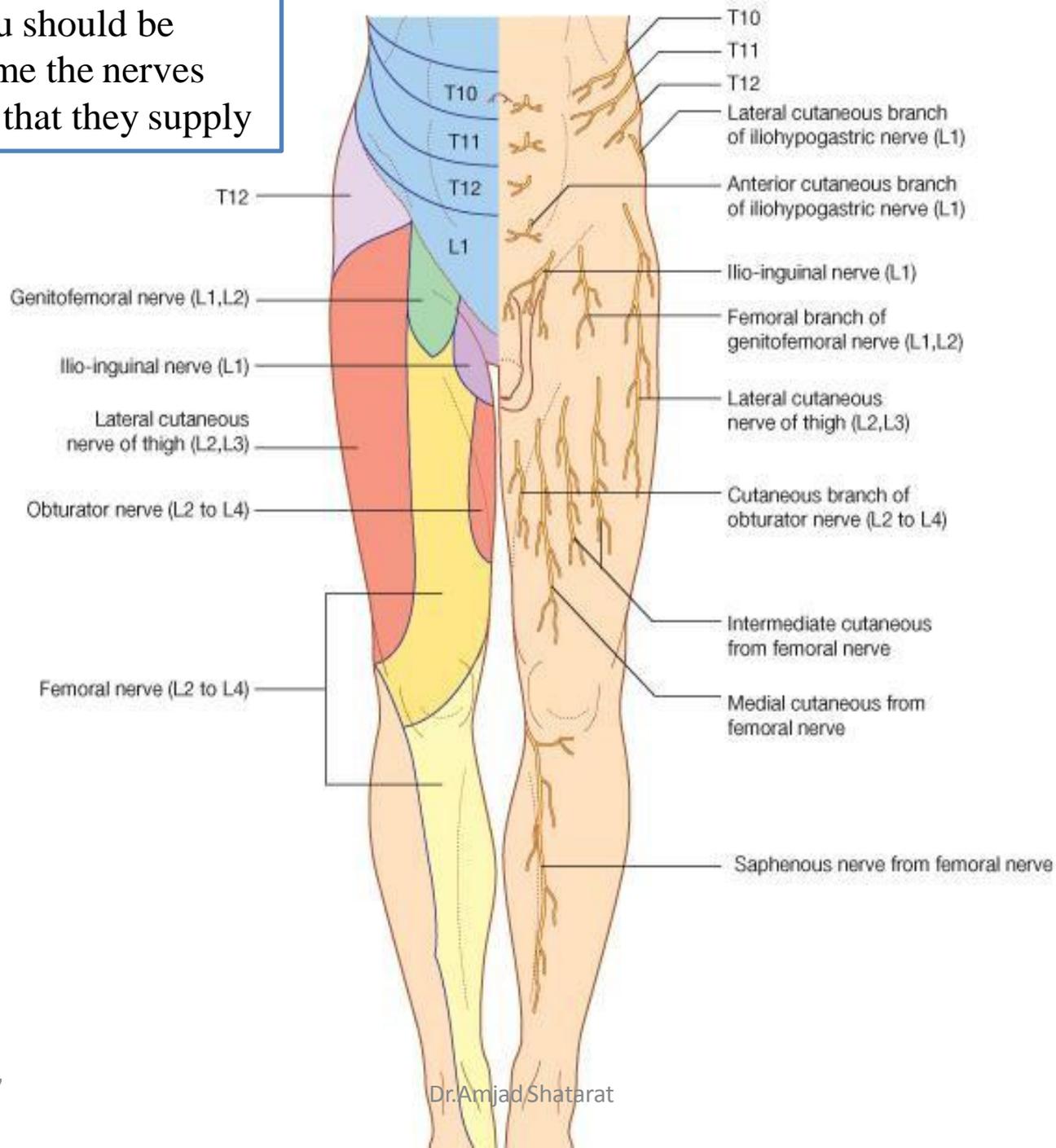
T12

L1

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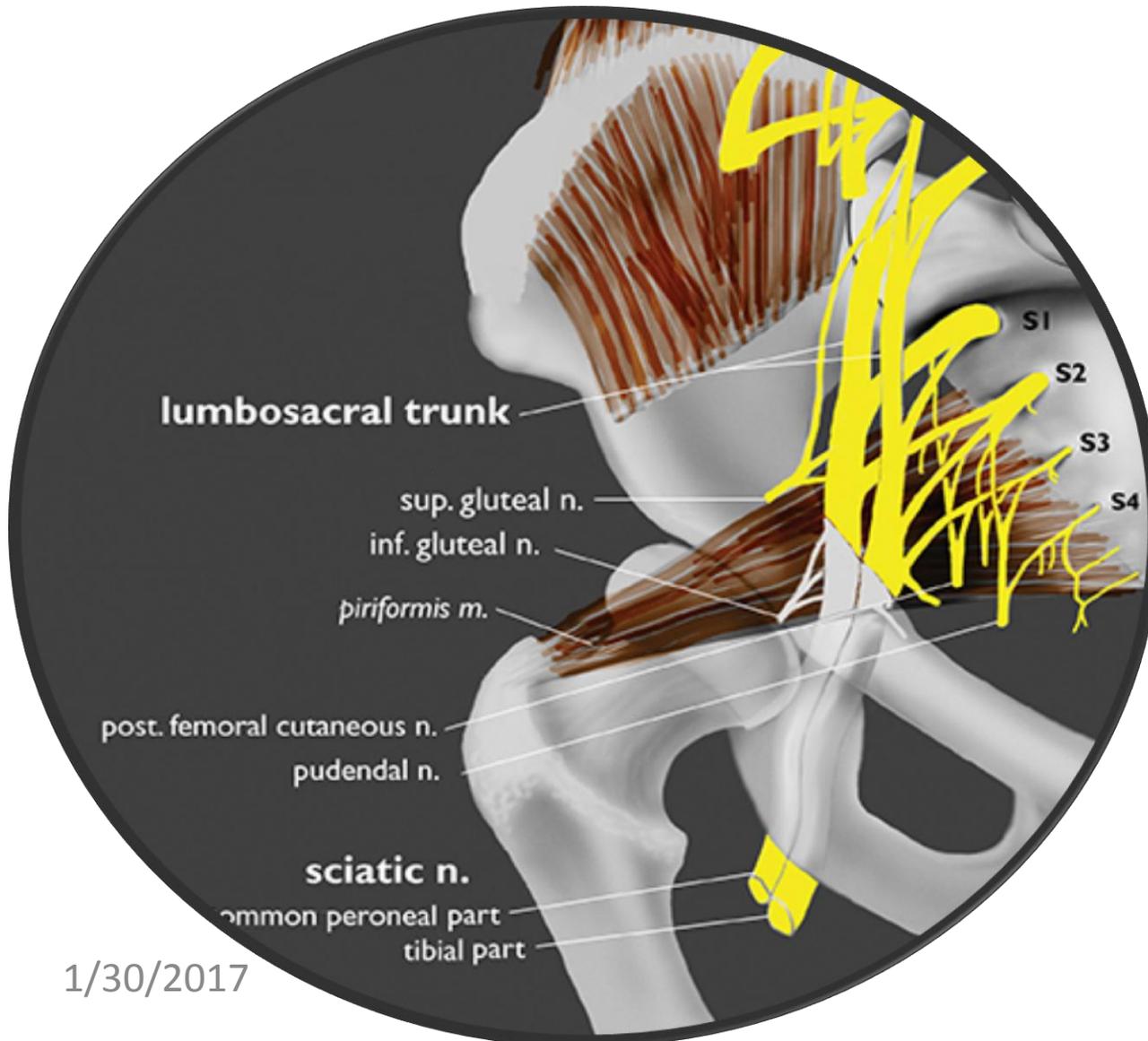


Now you should be able to name the nerves and the areas that they supply



# SACRAL PLEXUS

# Sacral plexus

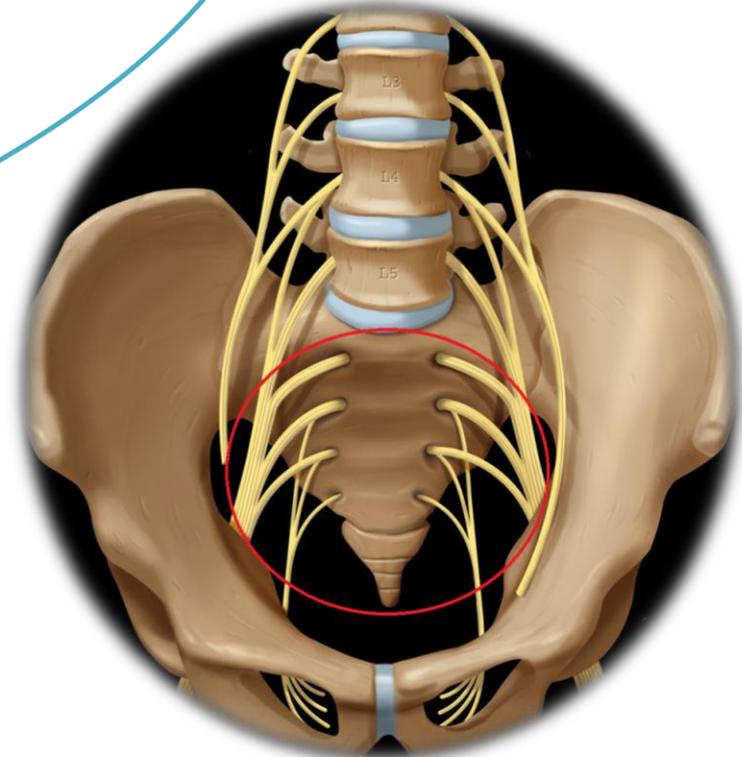


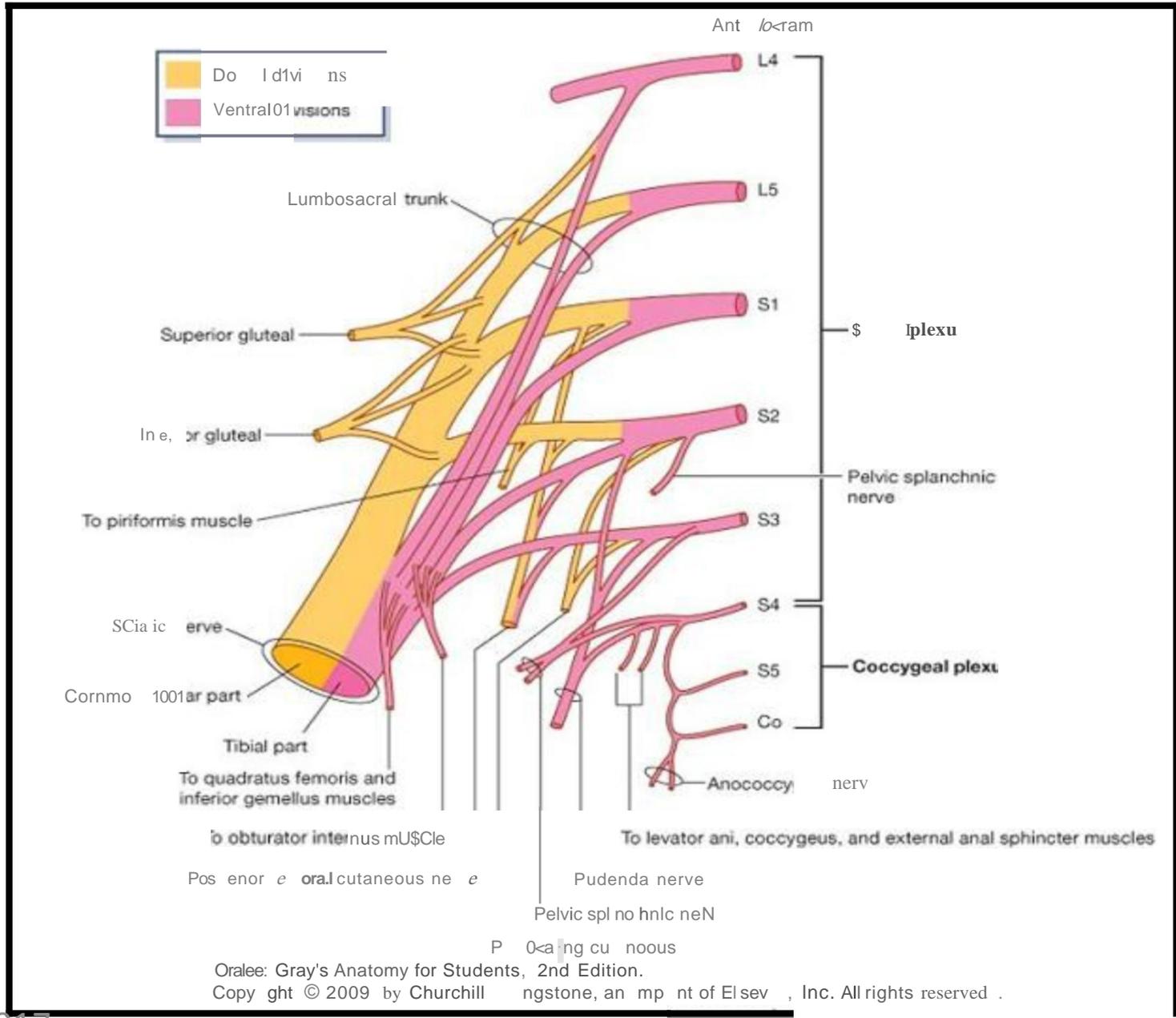
❖ Located on the posterior wall of pelvis on the anterior surface of piriformis muscle.

❖ Formed by the lumbosacral trunk and ventral rami of S1-S4.

# Sacral plexus

- ❖ Branches supply: lower limb; pelvic floor and wall and perineum.
- ❖ Most branches leave the pelvis through greater sciatic foramina.





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Gluteal region

Superior gluteal nerve **L4, L5 and S1**

Superior gluteal nerve **L5 and S1 and S2**

Posterior cutaneous nerve of the thigh **S1, S2 and S3**

The sacral plexus is formed by **L4-L5 and S1-S4**

The sciatic nerve **L4-L5 and S1-S3**

All roots  
except  
S4

The tibial nerve **L4-L5 and S1-S3**

The same  
as sciatic

The common peroneal nerve **L4-L5 and S1-S2**

The same  
root value  
as the tibial  
except S3

Read only

Nerve to obturator internus & superior gemellus

Nerve to quadratus femoris & inferior gemellus

Perforating cutaneous nerve

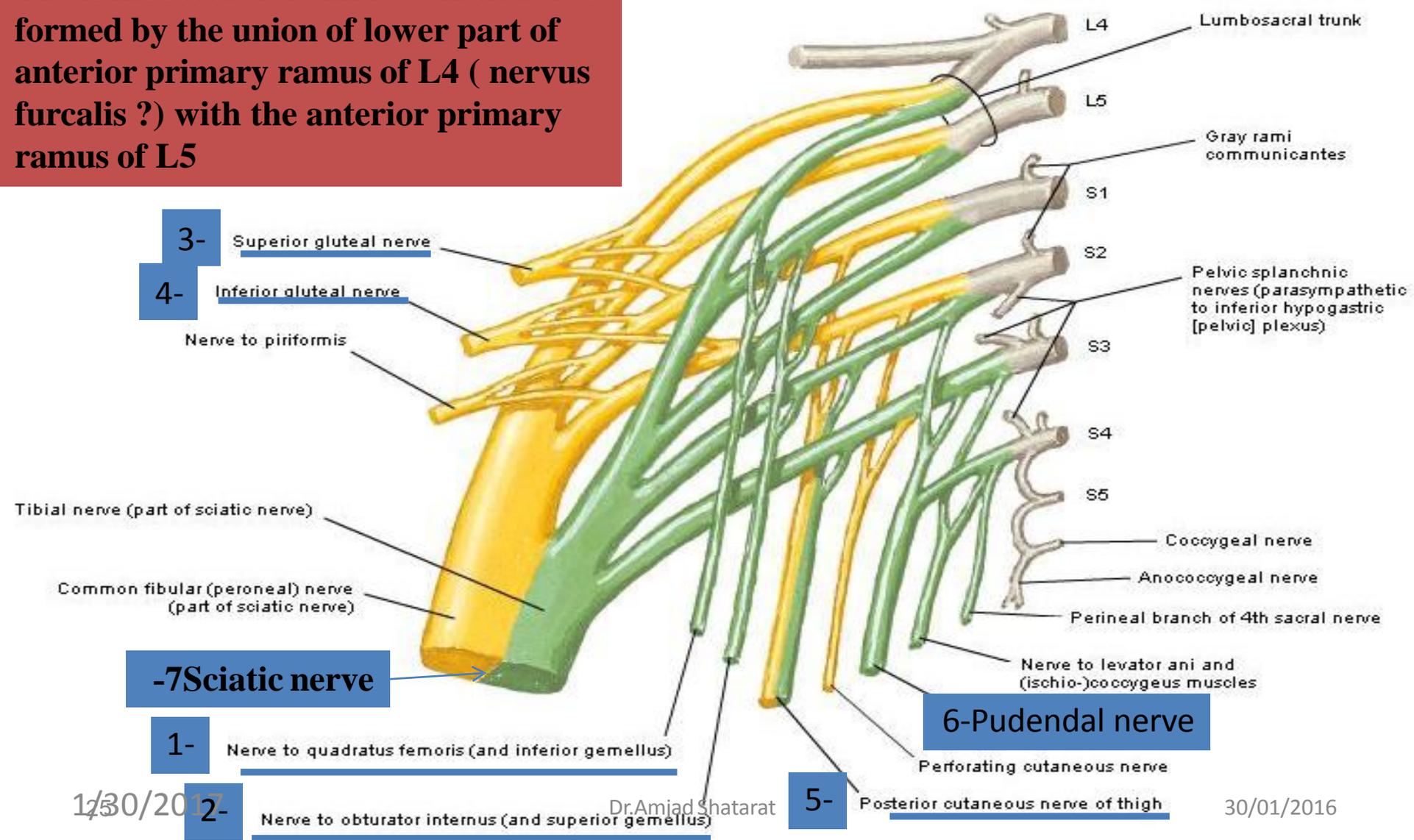
Nerve to piriformis

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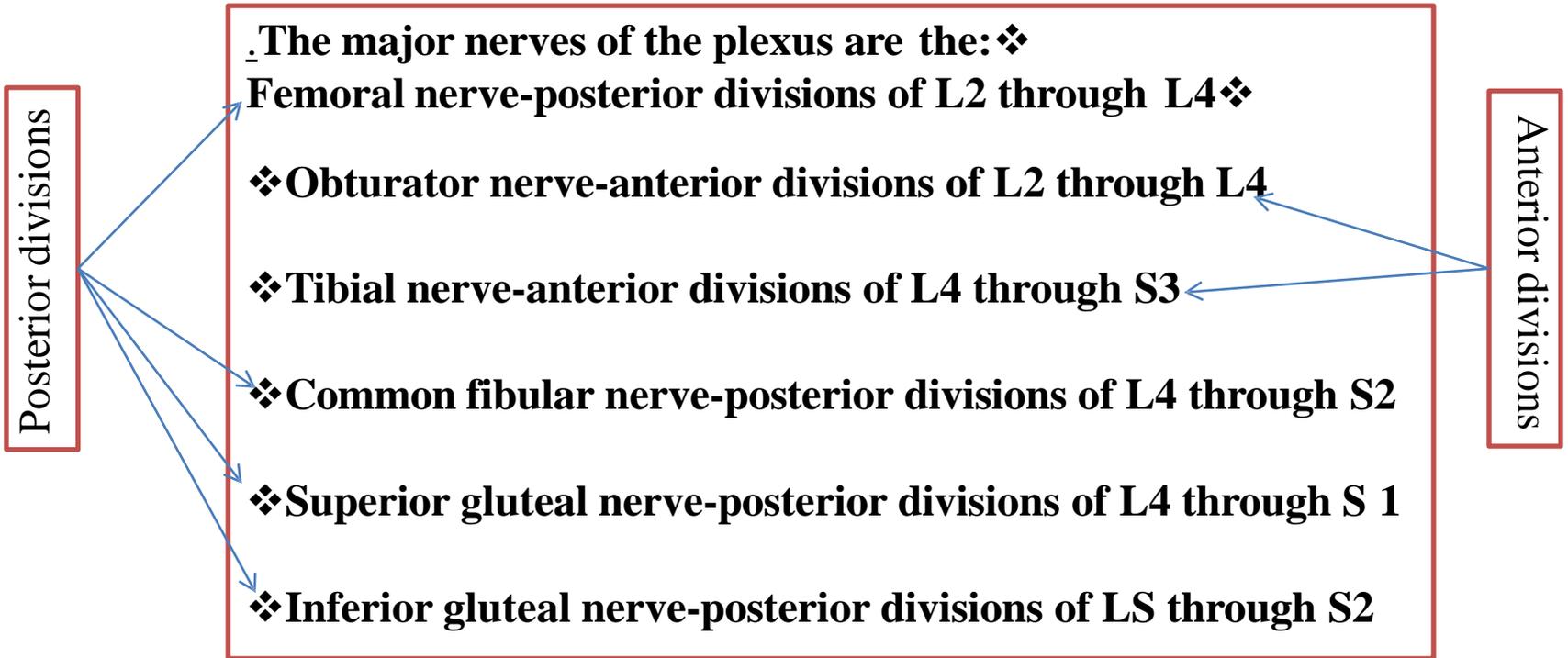
Notice that the superior gluteal artery which arises from the internal iliac artery, ***usually passes between S1 and S2 nerves***

**The sacral plexus is formed by the union of lumbosacral trunk and anterior primary rami of the S1, S2, S3 and the upper part of S4 in the pelvis in front of sacrum**

**The lumbosacral trunk is a thick nerve formed by the union of lower part of anterior primary ramus of L4 (nervus furcalis?) with the anterior primary ramus of L5**



# LUMBOSACRAL PLEXUS



Lumbosacral Plexus

Femoral nerve

Obturator nerve

Superior gluteal nerve

Inferior gluteal nerve

Common fibular nerve

Tibial nerve

L<sub>2</sub>

L<sub>3</sub>

L<sub>4</sub>

L<sub>5</sub>

S<sub>1</sub>

S<sub>2</sub>

S<sub>3</sub>



THANK YOU

Dr.Amjad Shatarat

30/01/2016