

## ANATOMY OF THE FEMORAL TRIANGLE, SHEATH AND CANAL Learning Objectives:

By the end of this lecture, students should be able to:

### 1. DEFINE the location and boundaries of the femoral triangle

- Understand that it's located in the upper anterior thigh
- Identify all three boundaries: superior, medial, and lateral
- Recognize the clinical importance of these boundaries

### 2. IDENTIFY the floor and roof of the femoral triangle

- Know the muscular floor formed by iliopsoas and pectineus
- Understand the fascial roof and its layers
- Appreciate the clinical significance of these structures

### 3. DESCRIBE the contents and their arrangement

- Remember the mnemonic NAVY (from lateral to medial)
- Understand the femoral sheath and its compartments
- Know the relationship between vessels and nerves

### 4. UNDERSTAND clinical significance

- Femoral pulse palpation
- Catheterization procedures
- Femoral hernia pathways
- Regional anesthesia applications

### 5. APPLY knowledge to clinical scenarios

- Emergency vascular access
- Assessment of lower limb circulation
- Surgical approaches to the femoral vessels

What is the Femoral Triangle?

#### DEFINITION:

The femoral triangle (also known as Scarpa's triangle) is a triangular depression in the upper anterior aspect of the thigh. It's a subfascial space that appears as a depression below the fold of the groin.

#### LOCATION:

- Found in the proximal third of the thigh
- Located immediately below the inguinal ligament
- Bounded by the inguinal ligament above and the crossing of sartorius over adductor longus below
- When the thigh is flexed, abducted, and laterally rotated, it becomes a visible depression

#### CLINICAL SIGNIFICANCE:

The femoral triangle is one of the most clinically important regions in human anatomy because:

1. **VASCULAR ACCESS:** It provides easy access to the femoral artery and vein for:

- Cardiac catheterization
- Angiography
- Dialysis access
- Emergency vascular access in trauma

2. **PULSE PALPATION:** The femoral artery pulse is easily palpable here, making it important for:

- Assessing lower limb circulation
- CPR effectiveness monitoring
- Pediatric pulse assessment

3. **NERVE BLOCKS:** The femoral nerve is accessible here for regional anesthesia

4. **ANATOMICAL LANDMARK:** Understanding this triangle is essential for comprehending the transition of structures from the abdomen to the lower limb

**HISTORICAL NOTE:**

Named after Antonio Scarpa (1752-1832), an Italian anatomist and surgeon who made significant contributions to anatomical knowledge.

### **BOUNDARIES OF THE FEMORAL TRIANGLE**

The femoral triangle has three boundaries that define its triangular shape:

1. **SUPERIOR BOUNDARY** (Base of the triangle):

- Formed by the **INGUINAL LIGAMENT**
- The inguinal ligament extends from the anterior superior iliac spine (ASIS) to the pubic tubercle
- This is a rolled-under inferior edge of the external oblique aponeurosis
- Clinical relevance: Structures passing beneath the inguinal ligament enter the femoral triangle
- This boundary is palpable in thin individuals

2. **MEDIAL BOUNDARY:**

- Formed by the MEDIAL BORDER of ADDUCTOR LONGUS muscle
- Adductor longus is the most anterior of the adductor muscles
- Origin: Body of pubis, just lateral to pubic symphysis
- This muscle forms a clear medial wall of the triangle
- Clinical relevance: The adductor canal begins at the apex where this muscle meets sartorius

### 3. LATERAL BOUNDARY:

- Formed by the MEDIAL BORDER of SARTORIUS muscle
- Sartorius is the longest muscle in the human body
- Origin: Anterior superior iliac spine (ASIS)
- It runs obliquely across the thigh in a medial and inferior direction
- Clinical relevance: Surgical approaches often use sartorius as a landmark

### 4. APEX (Inferior limit):

- NOT a boundary but the pointed inferior end of the triangle
- Formed where the medial border of sartorius CROSSES OVER the medial border of adductor longus
- This point is located approximately at the junction of the upper and middle thirds of the thigh
- At the apex, the femoral vessels enter the adductor (subsartorial) canal
- Clinical relevance: The apex represents the transition point where vessels become deeper

### MEMORY TIP:

Think of the triangle pointing downward (apex inferior):

- Superior = Inguinal Ligament (horizontal base)

- Lateral = Sartorius (runs from lateral to medial)
- Medial = Adductor Longus (vertical-ish orientation)
- These three boundaries meet at their respective corners to fo

#### 4. APEX (Inferior limit):

- NOT a boundary but the pointed inferior end of the triangle
- Formed where the medial border of sartorius CROSSES OVER the medial border of adductor longus
- This point is located approximately at the junction of the upper and middle thirds of the thigh
- At the apex, the femoral vessels enter the adductor (subsartorial) canal
- Clinical relevance: The apex represents the transition point where vessels become deeper

#### MEMORY TIP:

Think of the triangle pointing downward (apex inferior):

- Superior = Inguinal Ligament (horizontal base)
- Lateral = Sartorius (runs from lateral to medial)
- Medial = Adductor Longus (vertical-ish orientation)
- These three boundaries meet at their respective corners to

#### 4. APEX (Inferior limit):

- NOT a boundary but the pointed inferior end of the triangle
- Formed where the medial border of sartorius CROSSES OVER the medial border of adductor longus
- This point is located approximately at the junction of the upper and middle thirds of the thigh
- At the apex, the femoral vessels enter the adductor (subsartorial) canal
- Clinical relevance: The apex represents the transition point where vessels become deeper

## MEMORY TIP:

Think of the triangle pointing downward (apex inferior):

- Superior = Inguinal Ligament (horizontal base)
- Lateral = Sartorius (runs from lateral to medial)
- Medial = Adductor Longus (vertical-ish orientation)
- These three boundaries meet at their respective corners to of the triangle.

## Floor and Roof of the Femoral Triangle:

The femoral triangle is a three-dimensional space with a muscular floor and a fascial roof.

## FLOOR (Deep/Posterior Surface):

The floor is formed by muscles from lateral to medial:

### 1. ILIOPSOAS MUSCLE (Lateral part of floor):

- This is actually a combination of two muscles: iliacus and psoas major
- Iliacus: originates from the iliac fossa
- Psoas major: originates from lumbar vertebrae T12-L5
- They merge to form iliopsoas, inserting on the lesser trochanter of femur
- Function: Powerful hip flexor
- Clinical relevance: The femoral nerve lies in the groove between iliacus and psoas
- An iliopsoas abscess can present as a mass in the femoral triangle

### 2. PECTINEUS MUSCLE (Medial part of floor):

- Origin: Pectineal line of pubis (superior pubic ramus)
- Insertion: Pectineal line of femur (posterior surface, below lesser trochanter)

- Function: Hip flexion and adduction
- Innervation: Femoral nerve (primarily), sometimes accessory obturator nerve
- Forms the medial portion of the floor

### 3. ADDUCTOR LONGUS (Small medial portion):

- The upper part of adductor longus forms the most medial part of the floor
- Remember: The medial border of adductor longus is also the medial boundary

### ROOF (Superficial/Anterior Surface):

The roof is formed by layers from superficial to deep:

#### 1. SKIN:

- The skin over the femoral triangle is relatively thin
- Contains hair follicles and sebaceous glands
- Highly mobile over underlying structures

#### 2. SUPERFICIAL FASCIA:

- Contains two layers in the lower part of the anterior abdominal wall and upper thigh:
  - \* Superficial fatty layer (Camper's fascia)
  - \* Deep membranous layer (Scarpa's fascia)
- Contains superficial structures:
  - \* Superficial inguinal lymph nodes (horizontal and vertical groups)
  - \* Great saphenous vein (before it pierces the cribriform fascia)
  - \* Superficial branches of femoral artery
  - \* Cutaneous nerves (iliohypogastric, ilioinguinal, genitofemoral)

### 3. DEEP FASCIA (FASCIA LATA):

- Strong deep fascia of the thigh
- Continuous with similar fasciae of the leg and abdomen
- Has an opening called the saphenous opening (fossa ovalis)

### 4. CRIBRIFORM FASCIA:

- Perforated fascia covering the saphenous opening
- Allows passage of the great saphenous vein
- Contains multiple small openings (hence "cribriform" = sieve-like)
- Clinical relevance: Site where femoral hernias emerge

### CLINICAL SIGNIFICANCE:

- The superficial position of the floor muscles makes them easily accessible for examination
- The thin roof makes the femoral pulse easily palpable
- Infections can track through the fascial layers
- The cribriform fascia is the weak point where femoral hernias occur.

### Contents of the Femoral Triangle - Overview:

The femoral triangle contains important neurovascular structures that pass between the abdomen and the lower limb. The classic mnemonic "NAVY" helps remember the lateral-to-medial arrangement.

### MNEMONIC: NAVY (Lateral to Medial)

N = NERVE (Femoral Nerve)

- Most LATERAL structure

- Lies OUTSIDE the femoral sheath
- Position: In the groove between iliopsoas and pectineus
- Largest branch of the lumbar plexus (L2, L3, L4)

A = ARTERY (Femoral Artery)

- Located medial to the nerve
- INSIDE the femoral sheath (in the arterial compartment)
- Continuation of the external iliac artery
- Palpable against the pectineus muscle
- Most commonly accessed vessel for catheterization

V = VEIN (Femoral Vein)

- Located medial to the artery
- INSIDE the femoral sheath (in the venous compartment)
- Continuation of the popliteal vein
- Larger diameter than the artery
- Commonly used for central venous access

Y = Y-FRONTS (Lymphatics)

- Most MEDIAL structures
- INSIDE the femoral sheath (in the lymphatic/femoral canal)
- Includes deep inguinal lymph nodes
- Receives drainage from lower limb
- Site of Cloquet's node (sentinel node)
- Clinical relevance: Femoral hernias occur in this compartment

## WHY "Y-FRONT"?

This is British slang for men's underwear (briefs), chosen because:

1. It starts with "Y" to complete the NAVY mnemonic
2. Lymph nodes in the groin region drain the external genitalia
3. It's memorable and slightly humorous, which aids retention

## ADDITIONAL CONTENTS:

The triangle also contains:

- Branches of the femoral nerve (multiple motor and cutaneous branches)
- Branches of the femoral artery (superficial and deep)
- Tributaries of the femoral vein
- Fatty tissue and connective tissue

## FEMORAL SHEATH:

Important to note that the femoral sheath contains only the artery, vein, and lymphatics (A, V, Y).

The femoral nerve is NOT in the sheath - it lies lateral to it.

## CLINICAL PEARL:

When performing femoral procedures:

- Palpate the femoral artery (strongest pulse)
- The vein is immediately medial to it
- The nerve is lateral (and deeper)
- Always approach from the lateral side to avoid the vein
- "Never Avoid Venipuncture" - another variation of NAVY

Femoral Nerve - Detailed Information:

## ANATOMICAL DETAILS:

### Origin and Course:

- Nerve roots: L2, L3, L4 (dorsal divisions of ventral rami)
- Largest branch of the lumbar plexus
- Descends through the psoas major muscle
- Emerges from the lateral border of psoas at the level of L5
- Passes beneath the inguinal ligament into the femoral triangle
- Positioned lateral to the femoral artery and outside the femoral sheath

### Position in Femoral Triangle:

- Enters the triangle in the groove between iliopsoas (laterally) and pectineus (medially)
- This is the most lateral structure in the "NAVY" arrangement
- Approximately 2-3 cm lateral to the femoral artery pulse
- Divides into anterior and posterior divisions shortly after (or sometimes before) entering the triangle

## BRANCHES:

The femoral nerve gives off numerous branches, which can be categorized as:

### MUSCULAR BRANCHES (Motor):

#### Anterior Division supplies:

1. Sartorius - hip flexor and knee flexor
2. Pectineus - hip flexor and adductor (shared innervation with obturator)

Posterior Division supplies:

3. Quadriceps femoris:

- Rectus femoris (crosses both hip and knee)
- Vastus lateralis
- Vastus intermedius
- Vastus medialis
- All extend the knee; rectus femoris also flexes the hip

4. Articularis genus - small muscle that lifts knee joint capsule

SENSORY BRANCHES (Cutaneous):

Anterior Division:

- Medial cutaneous nerve of thigh
- Intermediate cutaneous nerve of thigh
- These supply skin on the anterior and medial thigh

Posterior Division:

- Saphenous nerve - the longest branch
  - \* Descends through femoral triangle
  - \* Enters adductor canal with femoral vessels
  - \* Provides cutaneous innervation to medial leg and foot
  - \* Only branch that extends below the knee

ARTICULAR BRANCHES:

- Supply the hip joint and knee joint

## CLINICAL SIGNIFICANCE:

### 1. FEMORAL NERVE BLOCK:

- Used for anesthesia/analgesia of anterior thigh
- Useful for hip and knee surgery
- Can be performed using nerve stimulator or ultrasound guidance
- Block performed lateral to femoral artery

### 2. NERVE INJURY:

Can occur from:

- Pelvic fractures
- Hip surgery (particularly anterior approach)
- Femoral artery catheterization
- Hematoma in iliopsoas muscle (anticoagulation complication)
- Lithotomy position during surgery

Results in:

- Loss of knee extension (quadriceps paralysis)
- Loss of hip flexion
- Sensory loss on anterior thigh and medial leg
- Loss of patellar reflex
- Difficulty walking, especially up stairs

### 3. EXAMINATION:

- Test knee extension against resistance
- Check patellar reflex (L2, L3, L4)

- Assess sensation on anterior thigh and medial leg

#### 4. FEMORAL NERVE STRETCH TEST:

- Patient prone, knee flexed
- Hip extended
- Tests for upper lumbar nerve root pathology
- Positive test reproduces back/anterior thigh pain

#### ANATOMICAL VARIATION:

- The exact level of division varies
- Sometimes divides before entering the triangle
- Branch pattern to quadriceps muscles is relatively constant
- Saphenous nerve course is consistent.

#### Femoral Artery - Detailed Information:

#### ANATOMY AND COURSE:

##### Origin and Entry:

- The femoral artery is the continuation of the EXTERNAL ILIAC ARTERY
- Name changes as it passes beneath the inguinal ligament
- Enters the femoral triangle at the MID-INGUINAL POINT
  - \* Mid-inguinal point = midpoint between ASIS and pubic symphysis
  - \* NOT the same as midpoint of inguinal ligament (which is midway between ASIS and pubic tubercle)
  - \* This is an important landmark for arterial palpation and access

### Course Through Triangle:

- Descends through the femoral triangle from base to apex
- Lies within the FEMORAL SHEATH in the intermediate (arterial) compartment
- Travels anterior to the pectineus muscle
- Can be compressed against the pectineus and underlying bone
- Exits at apex to enter the adductor canal

### Relations in Triangle:

- Lateral: Femoral nerve (outside sheath)
- Medial: Femoral vein (within sheath)
- Posterior: Pectineus muscle, then adductor longus as it descends
- Anterior: Fascia lata and skin (superficial)

### BRANCHES WITHIN THE FEMORAL TRIANGLE:

The femoral artery gives off several branches in the triangle:

#### SUPERFICIAL BRANCHES (arise near inguinal ligament):

##### 1. Superficial Epigastric Artery

- Runs upward toward umbilicus
- Supplies lower abdominal wall
- Anastomoses with superior epigastric artery

##### 2. Superficial Circumflex Iliac Artery

- Runs laterally toward ASIS
- Supplies skin and superficial fascia

- Parallel to inguinal ligament

### 3. Superficial External Pudendal Artery

- Runs medially
- Supplies skin of external genitalia and lower abdomen
- Crosses spermatic cord/round ligament

### 4. Deep External Pudendal Artery

- Deeper than superficial external pudendal
- Supplies skin of genitalia and medial thigh

### PROFUNDA FEMORIS (Deep Artery of Thigh):

- LARGEST and most important branch
- Arises from POSTERIOR aspect of femoral artery
- Usually 3-4 cm below inguinal ligament
- Passes BEHIND the femoral vessels
- Descends between adductor longus (medially) and vastus medialis (laterally)
- Supplies deep structures of thigh
- Gives off:
  - \* Medial circumflex femoral artery (important for femoral head blood supply)
  - \* Lateral circumflex femoral artery
  - \* Perforating arteries (3-4) that supply posterior thigh muscles

### Terminal Continuation:

- At the apex of triangle, becomes SUPERFICIAL FEMORAL ARTERY
- Continues into adductor canal

## CLINICAL SIGNIFICANCE:

### 1. PULSE PALPATION:

- Strongest peripheral pulse
- Palpated at mid-inguinal point
- Used to assess lower limb circulation
- Important in CPR and emergency assessment
- In infants and children, preferred site for pulse check

### 2. ARTERIAL ACCESS (Catheterization):

- Most common site for arterial access
- Used for:
  - \* Cardiac catheterization
  - \* Coronary angiography
  - \* Percutaneous coronary intervention (PCI/stenting)
  - \* Peripheral angiography
  - \* Intra-aortic balloon pump insertion

#### Technique:

- Patient supine with leg extended and slightly abducted
- Palpate pulse below inguinal ligament
- Seldinger technique for access
- Entry should be below inguinal ligament to avoid retroperitoneal bleeding
- Aim for common femoral artery (before bifurcation into profunda and superficial femoral)

### 3. COMPLICATIONS OF FEMORAL ACCESS:

- Hematoma (most common)
- Retroperitoneal hemorrhage (if puncture too high)
- Pseudoaneurysm
- Arteriovenous fistula
- Thrombosis
- Distal embolization
- Infection

### 4. FEMORAL ARTERY ANEURYSM:

- True aneurysms rare (atherosclerotic or mycotic)
- Pseudoaneurysms more common (post-catheterization)
- Presents as pulsatile mass in groin
- Can compress femoral vein causing edema

### 5. ATHEROSCLEROSIS:

- Common site for atherosclerotic disease
- Can cause claudication (calf pain with walking)
- Reduced or absent femoral pulse indicates iliac or aortic disease

### 6. SURGICAL EXPOSURE:

- Vertical incision over femoral pulse
- Commonly accessed for vascular surgery
- Femoral-popliteal bypass grafts
- Embolectomy procedures

## 7. TRAUMA:

- Penetrating injuries can cause life-threatening hemorrhage
- Direct pressure over pectineus can control bleeding
- Common in motor vehicle accidents and penetrating trauma

## MID-INGUINAL POINT vs MIDPOINT OF INGUINAL LIGAMENT:

This is a common source of confusion:

- Mid-inguinal point = halfway between ASIS and pubic SYMPHYSIS
- Midpoint of inguinal ligament = halfway between ASIS and pubic TUBERCLE
- The femoral artery is found at the MID-INGUINAL POINT
- Deep inguinal ring is at midpoint of inguinal ligament
- These points are about 1-2 cm apart

Femoral Vein - Detailed Information:

## ANATOMY AND COURSE:

Origin and Formation:

- The femoral vein is the continuation of the POPLITEAL VEIN
- Name changes as it passes through the adductor hiatus
- Enters the femoral triangle at its apex
- Ascends through the triangle from apex to base

Course and Relations:

- Ascends through the femoral triangle
- Lies within the FEMORAL SHEATH in the medial (venous) compartment

- Position: MEDIAL to the femoral artery throughout its course in the triangle
- At the inguinal ligament level, it is partially overlapped by the artery anteriorly
- Posterior: Muscles forming the floor (pectineus, adductor longus)
- Becomes the EXTERNAL ILIAC VEIN as it passes deep to the inguinal ligament

#### Size and Characteristics:

- Larger diameter than the accompanying femoral artery
- Thin-walled and easily compressible
- Contains valves (preventing retrograde flow)
- Valves are more numerous in distal portions

#### TRIBUTARIES:

Major tributaries in the femoral triangle include:

##### 1. PROFUNDA FEMORIS VEIN (Deep Femoral Vein):

- Largest tributary
- Drains deep structures of thigh
- Usually joins femoral vein about 6-8 cm below inguinal ligament
- May join as multiple vessels

##### 2. GREAT SAPHENOUS VEIN:

- Longest vein in the body
- Joins femoral vein through the saphenous opening (fossa ovalis)
- Entry point is about 3 cm below and lateral to pubic tubercle
- Junction called the saphenofemoral junction (SFJ)

- Has 5-7 tributaries near its termination:
  - \* Superficial epigastric vein
  - \* Superficial circumflex iliac vein
  - \* Superficial external pudendal veins
  - \* Deep external pudendal vein
  - \* Anterolateral and posteromedial tributaries

### 3. CIRCUMFLEX FEMORAL VEINS:

- Medial and lateral circumflex femoral veins
- Usually drain into profunda femoris vein
- Can occasionally drain directly into femoral vein

### CLINICAL SIGNIFICANCE:

#### 1. CENTRAL VENOUS ACCESS:

- Alternative to internal jugular and subclavian veins
- Advantages:
  - \* Easily compressible if bleeding occurs
  - \* No risk of pneumothorax
  - \* Anatomical landmarks are consistent
- Disadvantages:
  - \* Higher infection risk
  - \* Less comfortable for patient
  - \* Limits mobility
  - \* Higher thrombosis risk

Technique:

- Seldinger technique
- Insert medial to arterial pulsation
- Aim cephalad toward umbilicus
- Real-time ultrasound guidance recommended

## 2. DIALYSIS ACCESS:

- Temporary dialysis catheters commonly placed in femoral vein
- Typically used when upper extremity access not available
- Can accommodate large-bore catheters
- Changed regularly due to infection risk

## 3. DEEP VEIN THROMBOSIS (DVT):

- Common site for DVT formation
- Risk factors:
  - \* Immobility
  - \* Surgery (especially orthopedic)
  - \* Malignancy
  - \* Inherited thrombophilias
  - \* Pregnancy and postpartum
  - \* Central venous catheters

Clinical presentation:

- Unilateral leg swelling
- Pain and tenderness along venous distribution
- Warmth and erythema

- May be asymptomatic

Diagnosis:

- D-dimer testing (screening)
- Compression ultrasound (non-compressible vein)
- Venography (gold standard, rarely used)

#### 4. VARICOSE VEINS:

- Saphenofemoral junction incompetence leads to great saphenous vein varicosities
- Assessment includes:
  - \* Trendelenburg test
  - \* Doppler ultrasound of SFJ
  - \* Duplex ultrasonography
- Treatment may involve SFJ ligation and stripping

#### 5. VENOUS BLOOD SAMPLING:

- Can be used for venous blood gas sampling
- Larger bore makes it easier than peripheral veins
- Particularly useful in emergency situations
- Central venous sampling for certain studies

#### 6. COMPLICATIONS OF FEMORAL VEIN PROCEDURES:

- Hematoma formation
- Inadvertent arterial puncture
- Thrombosis
- Infection/sepsis (higher rate than neck lines)

- Venous thromboembolism
- Air embolism (rare)

#### 7. ANATOMICAL VARIATIONS:

- Femoral vein may be duplicated in 10-20% of individuals
- Position relative to artery can vary slightly
- Profunda femoris vein may enter at different levels

#### 8. SURGICAL CONSIDERATIONS:

- Femoral vein can be harvested for vascular reconstruction
- Must be carefully protected during femoral artery surgery
- Injury during hip or pelvis surgery can cause significant hemorrhage

#### RELATIONSHIP TO FEMORAL ARTERY:

Understanding the vein-artery relationship is crucial:

- At apex of triangle: vein is posterior and slightly medial to artery
- As they ascend: vein moves progressively more medial
- At inguinal ligament: vein is directly medial to artery
- When performing femoral procedures, always identify the artery first (by pulsation), then locate the vein medial to it

#### SAPHENOFEMORAL JUNCTION (SFJ):

The junction of the great saphenous vein and femoral vein is clinically important:

- Located approximately 3 cm below and 3 cm lateral to pubic tubercle
- Site of valvular incompetence in varicose veins
- Target for surgical treatment of varicose veins

- Ultrasound assessment of competency is important
- Multiple tributaries converge here, creating a "crow's foot" pattern.

Femoral Sheath and Femoral Canal - Detailed Information:

## FEMORAL SHEATH:

### Definition and Structure:

The femoral sheath is a FUNNEL-SHAPED fascial compartment that surrounds the femoral vessels as they pass beneath the inguinal ligament.

### Formation:

- Formed by downward prolongation of fasciae from the abdomen
- ANTERIOR wall: continuation of transversalis fascia
- POSTERIOR wall: continuation of iliopsoas fascia (covering psoas and iliacus)
- These fasciae blend together laterally and medially
- Forms a sleeve around the femoral vessels

### Extent:

- Begins at the inguinal ligament (superior extent)
- Extends distally for approximately 3-4 cm into the thigh
- Tapers to blend with adventitia of femoral vessels
- Only present in upper part of femoral triangle

### Three Compartments:

The femoral sheath is divided into THREE compartments by vertical septa:

### 1. LATERAL COMPARTMENT (Arterial):

- Contains the femoral ARTERY
- Most lateral of the three compartments
- Bounded laterally by the sheath wall
- Bounded medially by a septum

### 2. INTERMEDIATE COMPARTMENT (Venous):

- Contains the femoral VEIN
- Middle compartment
- Bounded on both sides by septa
- Slightly larger than arterial compartment

### 3. MEDIAL COMPARTMENT (Femoral Canal):

- Contains LYMPHATICS and lymph nodes
- Most medial of the three compartments
- Site of femoral hernias
- Approximately 1.25 cm long
- Described in detail below

### Important Note:

The FEMORAL NERVE does NOT lie within the femoral sheath. It passes lateral to the sheath, between iliopsoas and pectineus muscles.

### FEMORAL CANAL:

### Structure and Contents:

The femoral canal is the most MEDIAL compartment of the femoral sheath.

Contents:

1. Lymphatic vessels ascending from deep inguinal nodes
2. CLOQUET's NODE (also called Rosenmuller's node)
  - Deep inguinal lymph node at the femoral ring
  - Sentinel node for lower limb and perineal drainage
  - Can be enlarged in infections or malignancy of lower limb
3. Loose connective tissue and fat
4. Occasionally small branches of vessels

Function:

- Allows distension of the femoral vein when venous return increases
- Provides space for lymphatic drainage
- Unfortunately also provides a pathway for femoral hernias

FEMORAL RING:

The femoral ring is the ABDOMINAL OPENING of the femoral canal.

Boundaries of the Femoral Ring (Clinically Important):

ANTERIOR: Inguinal ligament

- Forms the anterior wall
- Superficial boundary

POSTERIOR: Pectineus muscle and its fascia, overlying superior pubic ramus

- Forms the posterior wall
- Deepest boundary

MEDIAL: Lacunar ligament (medial portion of inguinal ligament)

- Sharp, crescentic edge
- Can cause strangulation of femoral hernias
- Blends with periosteum of pubic tubercle

LATERAL: Septum separating femoral canal from femoral vein

- Thin partition
- Can be stretched or disrupted

Normally, the femoral ring is closed by a condensation of extraperitoneal tissue called the FEMORAL SEPTUM (or Cloquet's fascia).

CLINICAL SIGNIFICANCE:

#### 1. FEMORAL HERNIA:

Most important clinical relevance of the femoral canal.

Characteristics:

- Protrusion of abdominal contents (usually peritoneum, sometimes bowel) through femoral ring
- More common in WOMEN (wider pelvis, larger femoral ring)
- Despite this, inguinal hernias are still more common overall in women
- Accounts for ~3-5% of all abdominal hernias

- Higher risk of strangulation than inguinal hernias

Path of Hernia:

- Protrudes through femoral ring
- Descends within femoral canal
- Emerges through saphenous opening
- Appears below and LATERAL to pubic tubercle
- Can extend upward over inguinal ligament when large

Differentiation from Inguinal Hernia:

FEMORAL HERNIA:

- Below and lateral to pubic tubercle
- Does NOT extend above inguinal ligament initially
- Smaller, firm swelling
- Cannot be reduced easily
- Higher risk of strangulation
- Neck is narrow (femoral ring)

INGUINAL HERNIA:

- Above and medial to pubic tubercle
- Can extend into scrotum/labium majus
- Usually larger
- Often reducible
- Lower strangulation risk
- Neck is wider (inguinal canal)

### Strangulation Risk:

- Femoral hernias have a higher risk of strangulation because:
  - \* Rigid boundaries of femoral ring (especially sharp lacunar ligament)
  - \* Narrow neck
  - \* Cannot expand easily
- 40-50% of femoral hernias present as emergencies
- Urgent surgery required for strangulated hernias

### Surgical Repair:

#### Various approaches:

- Lockwood's operation (infrainguinal/low approach)
- McEvedy's operation (high/extraperitoneal approach)
- Lotheissen's operation (transinguinal approach)
- Laparoscopic repair (TEP or TAPP)
- Repair involves closing femoral ring with sutures or mesh
- Must avoid damaging femoral vein during repair

## 2. FEMORAL VEIN CANNULATION:

- Knowledge of femoral sheath anatomy guides safe cannulation
- Vein is in intermediate compartment
- Can expand into femoral canal if needed
- Risk of inadvertent arterial puncture if anatomy not respected

## 3. LYMPHATIC DRAINAGE:

- Cloquet's node assessment in cancer staging
- Enlarged in lower limb or perineal malignancies

- Can be biopsied through femoral canal

#### 4. VASCULAR PROCEDURES:

- Understanding sheath anatomy prevents complications
- Femoral nerve lies outside sheath (lateral)
- Separations between compartments usually respected

#### ANATOMICAL VARIATIONS:

- Size of femoral canal varies (larger in females)
- Position of femoral ring can vary slightly
- Presence and size of Cloquet's node varies
- Rarely, femoral vein may be duplicated, affecting canal size

#### DIFFERENTIAL DIAGNOSIS OF GROIN LUMPS:

Knowledge of femoral triangle anatomy helps differentiate:

- Femoral hernia (through femoral canal)
- Inguinal hernia (above inguinal ligament)
- Saphena varix (at saphenofemoral junction)
- Enlarged lymph nodes
- Femoral artery aneurysm or pseudoaneurysm
- Psoas abscess

Position relative to pubic tubercle is the key landmark!

Clinical Significance of the Femoral Triangle:

The femoral triangle is one of the most clinically important anatomical regions. Its superficial position and crucial contents make it relevant to numerous clinical procedures and pathologies.

## 1. FEMORAL PULSE PALPATION:

Location and Technique:

- Palpated at the MID-INGUINAL POINT
  - \* Midway between ASIS and pubic symphysis
  - \* Just below the inguinal ligament
  - \* Against the pectineus muscle posteriorly
- Patient should be supine with leg extended
- Use index and middle fingers
- Press posteriorly against pectineus and pubic bone

Clinical Uses:

- ASSESSMENT OF LOWER LIMB CIRCULATION:
  - \* Presence of pulse indicates patent iliac and femoral arteries
  - \* Strength compared to opposite side
  - \* Character of pulse (bounding, weak, absent)
  - \* Presence of bruits indicates stenosis
- EMERGENCY SITUATIONS:
  - \* Preferred site for pulse check in infants and children
  - \* Monitored during CPR to assess effectiveness of compressions
  - \* Checked in trauma to assess vascular injury
  - \* One of the "central pulses" (along with carotid)

## - DIFFERENTIAL DIAGNOSIS:

\* Absent femoral pulse with present pedal pulses = superficial femoral artery occlusion with good collaterals

\* Absent femoral pulse with absent pedal pulses = iliac or common femoral artery occlusion

\* Delayed femoral pulse (radio-femoral delay) = coarctation of aorta

## 2. VASCULAR ACCESS PROCEDURES:

### A. ARTERIAL CATHETERIZATION:

The femoral artery is the most commonly used site for arterial catheterization.

#### Indications:

- Cardiac catheterization and coronary angiography
- Percutaneous coronary intervention (PCI/angioplasty/stenting)
- Peripheral angiography
- Intra-aortic balloon pump insertion
- Arterial line for hemodynamic monitoring

#### Technique:

- Patient supine, leg extended and slightly abducted
- Palpate strongest pulsation below inguinal ligament
- Seldinger technique:
  1. Needle inserted at 30-45° angle
  2. Guidewire advanced through needle
  3. Needle removed, catheter inserted over wire

4. Wire removed, catheter secured

- Entry should be in common femoral artery (CFA)
- Too high (above inguinal ligament) risks retroperitoneal hemorrhage
- Too low (superficial femoral or profunda) increases failure rate

Advantages:

- Larger vessel, easier to access
- Easily palpable landmark
- Can accommodate large bore catheters
- Compressible if bleeding occurs

Disadvantages:

- Requires patient to lie flat
- Limits post-procedure mobility
- Higher risk of hematoma than radial approach
- Risk of retroperitoneal hemorrhage if too high

## B. CENTRAL VENOUS CATHETERIZATION:

The femoral vein is an alternative site for central venous access.

Indications:

- When internal jugular or subclavian access not available/contraindicated
- Emergency vascular access
- Temporary dialysis catheters
- Drug administration requiring central access
- Hemodynamic monitoring

#### Technique:

- Identify femoral artery by palpation
- Femoral vein is medial to the artery
- Insert at mid-inguinal point
- Direct needle cephalad (toward umbilicus)
- Ultrasound guidance strongly recommended
- Seldinger technique as above

#### Advantages:

- No risk of pneumothorax
- Easily compressible
- Anatomical landmark always palpable
- Can be performed during CPR

#### Disadvantages:

- Higher infection rate than internal jugular
- Patient discomfort and limited mobility
- Higher thrombosis risk
- More difficult to keep dressing clean

### 3. REGIONAL ANESTHESIA:

#### FEMORAL NERVE BLOCK:

Very useful technique for hip and knee surgery analgesia.

#### Anatomy:

- Femoral nerve lies lateral to femoral artery
- Outside femoral sheath
- In groove between iliopsoas and pectineus
- Divides shortly after entering triangle

#### Technique:

- Identify femoral artery pulse
- Insertion point 1-2 cm lateral to pulse, just below inguinal ligament
- Directed slightly cephalad
- Can use nerve stimulator or ultrasound guidance
- Ultrasound is gold standard (visualize nerve directly)

#### Indications:

- Hip surgery (especially hip fractures in elderly)
- Knee surgery
- Femoral shaft fractures
- Thigh procedures
- Analgesia for lower limb trauma

#### Effects:

- Blocks anterior thigh sensation
- Blocks quadriceps muscle (knee extension)
- Saphenous nerve blocked (medial leg and foot sensation)

#### Complications:

- Vascular puncture (artery or vein)
- Local anesthetic toxicity
- Nerve injury
- Hematoma formation
- Falls (due to quadriceps weakness)

#### FASCIA ILIACA BLOCK:

Alternative technique blocking femoral and lateral femoral cutaneous nerves.

- Safer (further from vessels)
- Deposited deep to fascia iliaca
- Good for hip fractures

#### 4. FEMORAL HERNIA:

Pathophysiology:

- Protrusion through femoral canal
- Follows path: femoral ring → femoral canal → saphenous opening
- Contains peritoneum (sac) and potentially bowel or omentum

Epidemiology:

- 3-5% of all hernias
- More common in WOMEN (wider pelvis) but still less common than inguinal hernias in women
- More common in older patients
- Right side more common than left

#### Clinical Features:

- Small, firm lump in groin
- BELOW and LATERAL to pubic tubercle (key differentiating feature)
- May be irreducible
- Often painful
- May present with obstruction or strangulation

#### Diagnosis:

- Clinical examination
- Ultrasound or CT if uncertain
- Must differentiate from inguinal hernia, lymphadenopathy, saphena varix

#### Treatment:

- ALWAYS surgical repair (high strangulation risk)
- Emergency surgery if strangulated
- Various approaches (see previous notes on femoral canal)

#### Complications:

- HIGH RISK OF STRANGULATION (40-50%)
  - \* Sharp lacunar ligament can compress contents
  - \* Narrow, rigid femoral ring
  - \* Cannot expand
- Bowel obstruction
- Bowel ischemia and perforation
- Mortality if not treated promptly

## 5. OTHER CLINICAL RELEVANCE:

### Deep Vein Thrombosis:

- Femoral vein is common site
- Risk factors: immobility, surgery, malignancy, catheters
- Diagnosis: compression ultrasound
- Treatment: anticoagulation

### Varicose Veins:

- Saphenofemoral junction incompetence
- Assessed by Doppler ultrasound
- May require surgical or endovenous treatment

### Femoral Artery Aneurysm:

- Atherosclerotic or mycotic
- Pseudoaneurysm post-catheterization
- Presents as pulsatile mass
- Risk of rupture or thrombosis

### Iliopsoas Abscess:

- Can present as mass in femoral triangle
- May compress femoral nerve
- Patient holds hip flexed and externally rotated for comfort

### Lymphadenopathy:

- Deep inguinal nodes in femoral triangle

- Enlarged in lower limb or perineal infections/malignancy
- May need biopsy

Surgical Landmark:

- Understanding anatomy essential for:
  - \* Vascular surgery (bypass grafts, endarterectomy)
  - \* Orthopedic approaches to hip
  - \* Hernia repair
  - \* Lymph node biopsy

Summary and Conclusion:

KEY TAKEAWAYS:

### 1. DEFINITION AND LOCATION:

The femoral triangle is a subfascial triangular space in the upper anterior thigh, immediately below the inguinal ligament. It serves as a critical transitional zone where major structures pass from the abdomen to the lower limb.

### 2. BOUNDARIES (Remember the triangle points downward):

- SUPERIOR (Base): Inguinal ligament
- LATERAL: Medial border of sartorius muscle
- MEDIAL: Medial border of adductor longus muscle
- APEX: Where sartorius crosses over adductor longus

### 3. FLOOR AND ROOF:

- FLOOR: Formed by muscles from lateral to medial:

- \* Iliopsoas
- \* Pectineus
- \* Adductor longus (small portion)
- ROOF: Formed by layers of fascia and skin

#### 4. CONTENTS (NAVY - lateral to medial):

- N: Femoral NERVE (outside femoral sheath)
- A: Femoral ARTERY (inside sheath)
- V: Femoral VEIN (inside sheath)
- Y: Lymphatics and Y-fronts (inside sheath, in femoral canal)

#### 5. FEMORAL SHEATH:

- Surrounds femoral vessels (not nerve)
- Three compartments: lateral (artery), intermediate (vein), medial (femoral canal)
- Femoral canal is pathway for femoral hernias

#### 6. CLINICAL SIGNIFICANCE:

- Pulse palpation at mid-inguinale point
- Vascular access for diagnostic and therapeutic procedures
- Regional anesthesia (femoral nerve block)
- Site of femoral hernia formation
- Anatomical landmark for multiple surgical approaches

#### CLINICAL PEARLS TO REMEMBER:

1. Mid-inguinal point (for femoral artery) = midway between ASIS and pubic SYMPHYSIS

(NOT the same as midpoint of inguinal ligament)

2. Femoral hernia appears BELOW and LATERAL to pubic tubercle

Inguinal hernia appears ABOVE and MEDIAL to pubic tubercle

3. When performing femoral vascular access:

- Palpate artery first
- Vein is immediately MEDIAL
- Nerve is LATERAL (and deeper)
- Stay below inguinal ligament to avoid retroperitoneal hemorrhage

4. The femoral nerve is NOT in the femoral sheath

It lies lateral to the sheath in the groove between iliopsoas and pectineus

5. Femoral triangle is only the PROXIMAL part of the pathway

Vessels continue into the adductor canal at the apex

#### IMPORTANCE IN MEDICAL PRACTICE:

Understanding femoral triangle anatomy is fundamental for:

- Emergency medicine physicians (vascular access, pulse checks)
- Cardiologists (cardiac catheterization)
- Vascular surgeons (vascular procedures)
- Anesthesiologists (regional blocks)

- General surgeons (hernia repair)
- Orthopedic surgeons (hip approaches)
- Radiologists (interventional procedures)

#### FINAL THOUGHTS:

The femoral triangle exemplifies the importance of anatomical knowledge in clinical medicine. Its superficial location makes it readily accessible, but this also means that errors in technique or lack of anatomical understanding can lead to significant complications.

Safe practice in this region requires:

- Thorough knowledge of the anatomy
- Understanding of anatomical variations
- Proper technique
- Recognition of landmarks
- Awareness of potential complications

Students should:

- Practice identifying surface landmarks on themselves and others
- Understand the three-dimensional relationships of structures
- Be able to draw the triangle and label all structures
- Know the clinical applications and how anatomy relates to them
- Be prepared to apply this knowledge in clinical scenarios

#### FURTHER STUDY:

To consolidate this knowledge:

- Review the anatomical relationships on cadaver or anatomical models
- Practice palpating the femoral pulse and identifying landmarks
- Observe (or participate in) femoral procedures when possible
- Study ultrasound images of the femoral triangle
- Review case studies of femoral triangle pathology
- Learn the surgical approaches that use the femoral triangle

#### QUESTIONS FOR SELF-ASSESSMENT:

1. Can you draw and label the femoral triangle?
2. What is the lateral-to-medial order of structures?
3. Why is the femoral nerve not in the femoral sheath?
4. How do you differentiate a femoral from an inguinal hernia?
5. Where exactly would you palpate the femoral pulse?
6. What are the boundaries of the femoral ring?
7. What structures form the floor of the triangle?
8. Why do femoral hernias have a high strangulation risk?

Thank you for your attention. Understanding the femoral triangle is a fundamental building block in your anatomical education and will serve you throughout your medical career.