Functional outcome after dynamic hip screw fixation of trochanteric fracture femur

Thesis

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Abstract

This pitfall can be avoided by obtaining both AP and cross-table lateral x-rays when evaluating proximal femur fractures. If these x-rays do not clarify the nature of the fracture pattern, an x-ray taken with the extremity internally rotated should be taken.We recommend for the surgeon not to use a dynamic screw for the reverse obliquity type pattern, nor to place the lag screw away from the center-center position and farther than 1 cm from the subchondral bone.We recommend for the surgeon to avoid bending the guide pin during reaming, also avoiding bending the guide pin within the reamer resulting in intra-articular or intra-pelvic penetration.

Keyword: X-ray. Trochanteric. Femur. orthopedic

Introduction

Trochanteric and femoral neck fractures account for 90% of the proximal femoral fractures occurring in the elderly patients, and 50% of them are trochanteric [(1)].

Trochanteric fractures are common especially in the elderly with porotic bones, usually due to low-energy trauma like simple falls. These fractures are associated with significant morbidity and mortality with conservative management. The incidence of hip fractures is expected to increase with an increase in the life expectancy of a population [(2)].

Trochanteric fractures occur in the transitional bone between the femoral neck and the femoral shaft [(3)].

Surgery is the mainstay of treatment for both displaced and non-displaced trochanteric fractures. The aim of surgery is to allow the early mobilization of the patient. Weight bearing restriction depends on the stability of the reduction [(4).]

The most common internal fixation device used is the dynamic hip screw plate device. Recent studies on this method have shown rates of failure below 2% in stable fractures. In the case of unstable trochanteric fractures and subtrochanteric fractures, the treatment is more controversial and the rate of failure for the dynamic hip screw in these fractures is considerably higher, ranging from 4% to 15% [(5)].

Anatomy

Gross anatomy of the proximal femur:

The proximal part of the femur through its head constitutes with the acetabulum the hip joint (Figure 1) [6].

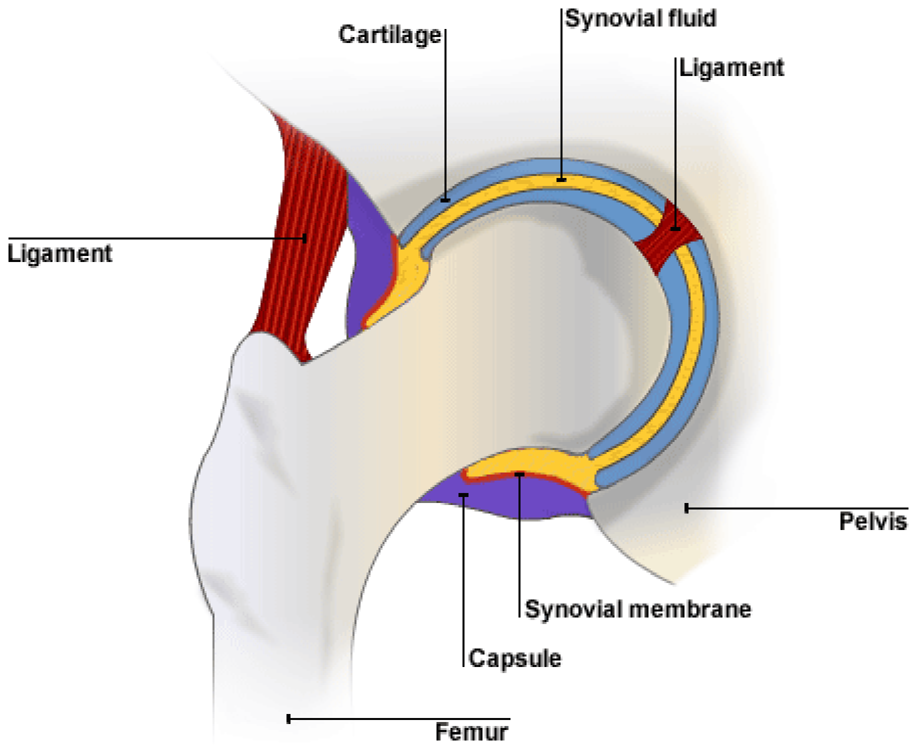

Figure 1: The hip joint

The hip has a unique combination of structural features that permit the transmission of tremendous forces (including the weight of the body) between the pelvis and the thigh, while still allowing for an extensive range of motion [7].

This joint is a synovial ball and socket which provides a particular high degree of stability and remarkable range of mobility. The stability of the hip joint is due to its geometry, strong ligaments and capsule [8].

- The head of the femur:

The head of the femur is entirely intracapsular and its articular surface is more than half a sphere, this surface is covered by articular cartilage except the non articulating convexity of the head which excavates into a pit called "fovea" which receives the ligamentum teres whose other end is attached to the other end of the acetabulum (Figure 2) [9].

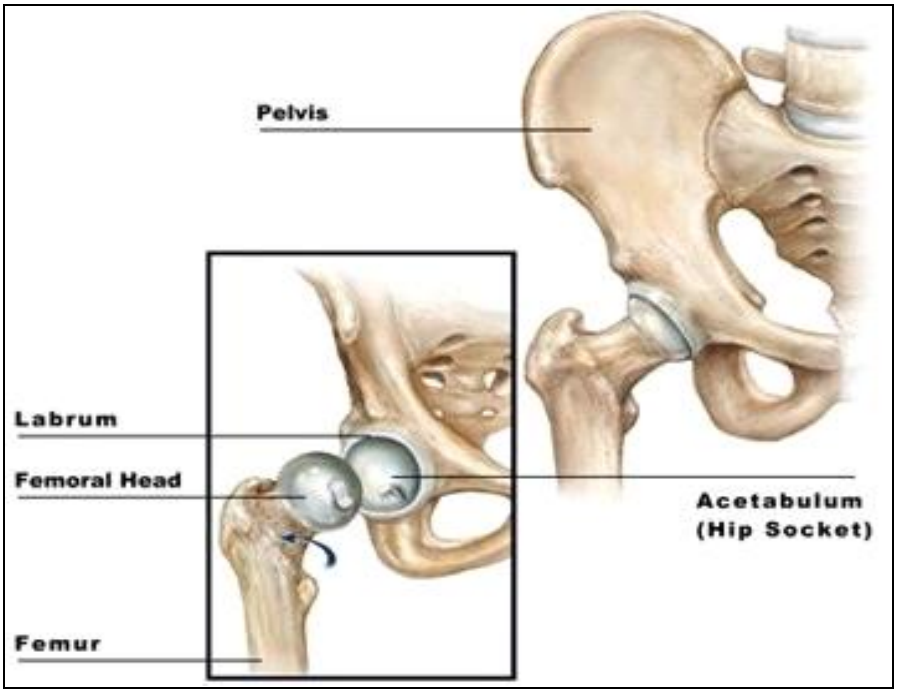

Figure 2: The head of the femur

- The neck of the femur:

It is covered by grooves and ridges on the surface which indicates the attachment of the hip joint capsule to the articular margin of the head [8]. The hip joint capsule surrounds the neck of the femur, and is attached, in front, to the intertrochanteric line ; behind, to the neck, about 1.25 cm. above the intertrochanteric crest close to the lesser trochanter. From its femoral attachment some of the fibers are reflected upward along the neck as longitudinal bands, termed retinacula [22].

The femoral neck is broader at its base laterally and narrower just below and lateral to the origin of the femoral head, the femoral neck is flattened in antro-posterior plane. Vascular foramina are present on the anterior inferior aspect of the neck [8].

The neck shaft angle of the adult femur in both sexes averages 130 degrees with a standard deviation of 7 degrees. Average femoral anteversion is 10 degrees with a standard deviation of 7 degrees. There are moderate interracial and intergender variations in these averages (Figure 3) [10].

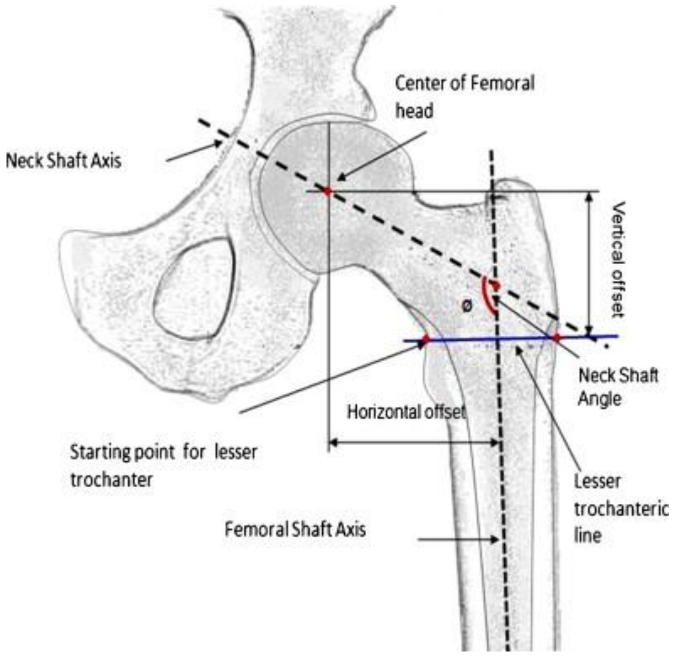

Figure 3: The neck shaft angle

Calcar femoral:

It is a dense vertical plate of bone. It springs from the posterior medial portion of the femoral shaft under the lesser trochanter and radiating laterally to the greater trochanter. It reinforces the femoral neck postromedially as it joins the inner surface of the posterior wall of the femoral neck. So it represents a lateral extension of the posterior wall of the femoral neck anterior to the trochanteric crest (Figure 4) [11].

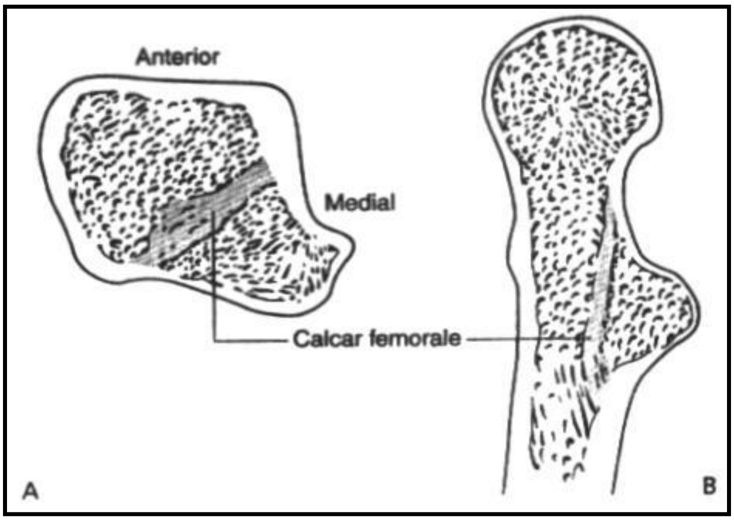

Figure 4: The calcar femoral

The calcar femoral is thickest medially and gradually thins as it passes laterally. The calcar femoral represents the upward extension of the original cylindrical shaft and is considered transitional from the tubular outline to the metaphyseal trochanteric area. It counteracts the postro-inferior compressive forces of the femoral external rotators [12].

In trochanteric fractures, the wedge of the calcar femoral often forces the thin walled trochanteric crest and the lesser trochanter posteriorly off the thick walled anterior parent shaft [13].

Carey et al related the architecture of the cancellous bone to the pressure forces of muscles action rather than to the static compression trabeculae and the influence of the flexor and adductor muscles action. He correlated between the tension trabeculae and the pull of the extensor and abductors of the hip joint. He also felt that the dynamic forces of the muscles may exceed the static reassure of the body weight [14].

- The greater trochanter:

The greater trochanter is quadrangular in shape and presents a roughened lateral surface giving attachment to many muscles. Its antro-lateral surface receives the insertion of gluteus minimus, while its postro-lateral surface receives the gluteus medius. An intervening space between these insertions is covered by a bursa to facilitate the motion of overlying anterior part of gluteus maximums [15].

The posterior edge of the greater trochanter is raised to form a prominence that overhangs a depression between it and the base of the femoral neck called the trochanteric fossa which receives the combined tendons of obturator internus and the piriformis muscle while the tendon of obturator externus insertion is just dorsal to the trochanteric fossa. The quadrate tubercle is a prominence inferior to the trochanteric crest and gives attachment to the tendon of quadratus femoris muscle [16].

- The lesser trochanter:

The lesser trochanter is a rounded postromedial directed prominence serving as insertion of ilio-psoas muscle [15].

Hip Joint Capsule and Ligaments:

The articular capsule of the hip is strong and dense, contributing substantially to joint stability. The capsule is attached along the anterior and posteior periphery of the acetabulum just outside the acetabular labrum. The capsule is attached to the femur anteriorly along the trochanteric line, but posteriorly it has an arched free border that results in only partial covering of the femoral neck. The femoral neck is intracapsular anteriorly, but posteriorly the basicervical portion and trochanteric crest are extracapsular [17].

The iliofemoral ligament often referred to as the Y ligament of Bigelow is a fan-shaped ligament that resembles an inverted letter Y. The apex of the ligament is attached to the lower portion of the anterior inferior iliac spine, and the diverging fibers of the Y fan out to attach along the trochanteric line. The fibers of the iliofemoral ligament become taut in full extension, providing a check to hip extension beyond neutral. The superior portion may resist excessive external rotation [18].

The pubofemoral ligament is applied to the inferior and medial part of the anterior capsule. It arises from the pubic portion of the acetabular rim and the obturator aspect of the superior pubic ramus, passing below to the neck of the femur to blend with the inferior-most fibers of the iliofemoral ligament. The fibers of the pubofemoral ligament become taut in hip extension and abduction [(19)].

The ischiofemoral ligament reinforces the posterior surface of the capsule. It arises from the ischial portion of the acetabular rim. Its fibers spiral laterally and upward, arching across the femoral neck to blend with the fibers of the zona orbicularis. The spiral fibers tighten during extension but loosen or unwind during hip flexion. Other fibers traverse horizontally and attach to the inner surface of the greater trochanter, providing a check to internal hip rotation [(20)].

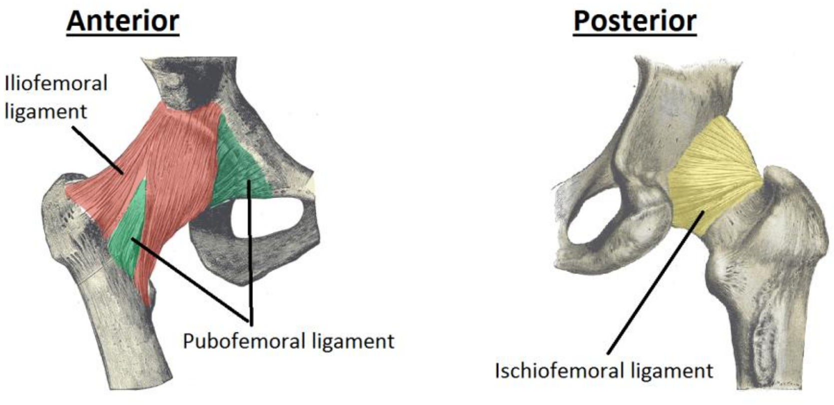

Figure 5: The ligaments of the proximal femur

The twisted orientation of the capsular ligaments surrounding the hip joint provides for a screw home effect in full extension. Hip extension tightens these ligaments, making extension the close-packed position of the joint and the position of maximum stability. The position of optimal articular contact (flexion, abduction, and external rotation) is the loose-packed position because flexion and lateral rotation tend to uncoil the ligaments [21].

Muscles acting on the proximal femur:

Anteriorly the flexors are innervated by the lumbar nerve roots, posteriorly the extensors and abductors get their nerve supply from the sacral plexus and medially the adductors are innervated by the obturator nerve [22].

- Abductor muscles:

  The glutei medius and minmus, passing from the dorsum of the ilim to the greater trochanter, cover the superior and lateral aspect of the joint. These two muscles together with the tenor fascia lata are innervated by the superior gluteal nerve [23].

  In walking, the thigh is fixed and the contraction of the abductors prevents sagging of the pelvis to the opposite side. Loss of the fulcrum from stable hip joint or incompetence of the abductor mechanism leads to contralateral pelvic sagging when standing on one limp (positive Trendelenburg' test) [23, 24, 25] .

- Adductor muscles:

Arising from the pubic bone, they are the adductor longus and brevis with parts of the adductor magnus and obturator externus all are innervated by obturator nerve. They adduct and help in flexion. The ischial component of the adductor magnus innervated y the sciatic nerve and adducts but also extends the thigh [(23)].

- Flexor muscles:

The flexors are the psoas major and iliacus. They are assisted by the pectinus, the rectus femoris and sartorius muscles. The adductor longus participates in the movement [(23)].

- Extensor muscles:

The main extensor muscle is the gluteus maximus. It is the true antagonist of the psoas major and iliacus. The hamstring muscles share in producing movement, also the ischial part of the adductor magnus, when strong resistance is encountered [(23)].

- Internal rotators:

The internal rotators are the anterior fibers of gluteus medius and minmus. The movement is limited by the tension in the external rotators, the ischiofemoral ligament and the posterior part of the fibrous capsule. Internal rotation is weak in full extension, more effective in flexion [(23)].

- External rotators:

They are obturators, the gemilli and quadratus femoris assisted by the piriformis, the gluteus maximus and to slight extent by the sartorius. The movement is limited by tension in the medial roators and the lateral band of the iliofemoral ligament. The external rotators are three times more powerful than the internal rotators, but internal rotation is reinforced by hip flexion [23].

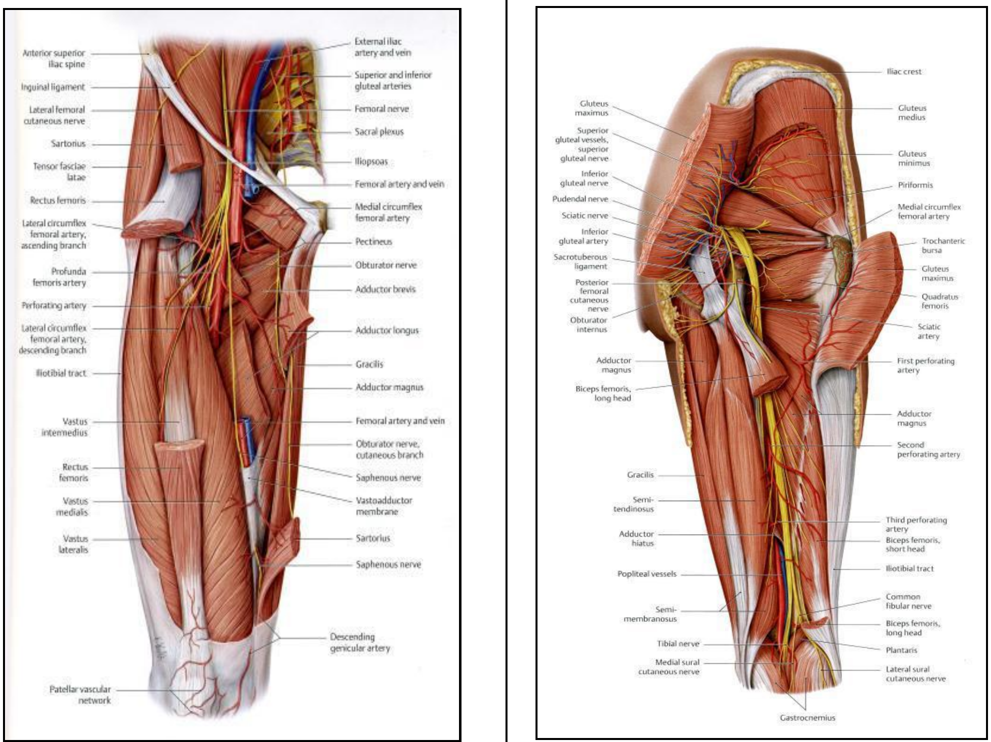

Figure 6: Hip muscles, anterior view & posterior view.

In addition to the direct forces acting on the hip to produce the trochanteric fracture pattern, indirect muscle forces also contribute. The magnitude of force applied, the direction of force, and the degree of osteoporosis all contribute to the variations in fracture pattern [26].

Simple biomechanical forces lead to the shortened and externally rotated lower extremity seen with most displaced trochanteric fractures. Gravity externally rotates the lower limb until the foot rests on its lateral aspect [27].

Arterial supply of the proximal end of the femur:

The numerous muscular origins and insertions within the trochanteric area bring with them a rich blood supply to the trochanteric fracture, making an environment very conducive to fracture healing. This is in sharp contrast to the limited vascularity of the intracapsular femoral neck, where healing complications are common [27].

The arterial supply to the proximal end of the femur has been studied extensively. The description by Crock seems the most appropriate because it is based on the three plane analysis and provides a standardization of anatomic nomenclature. Crock described the arteries of the proximal end o the femur in three groups (Figure 7):

a) An extracapsular arterial ring located at the base of the neck;
b) Ascending cervical branches of the extracapsular cervical ring on the surface of the femoral neck; and
c) The arteries of the round ligament.