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Comparative study between the dynamic hip screw
and the other methods used in internal fixation
of femoral neck fractures

Thesis

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Presented by :

OSAMA YOUSSEF AHMED RABIE

Supervised by :

Prof. Dr. MOHAMED HAMED ELGHAWABY

Professor of Orthopaedic Surgery

Faculty of Medicine, Ain Shams University

and

Dr. RAFIK AHMED SADEK

Lecturer of Orthopaedic Surgery

Faculty of Medicine Ain Shams University

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OSAMA YOUSSEF AHMED



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INTRODUCTION

INTRODUCTION

Fractures of the neck of the femur have always presented great challenges to orthopaedic surgeons and remain in many ways today the unsolved fractures as far as treatment and end results are concerned. With life expectancy increasing with each decade, our society is becoming more and more a geriatric society with significant numbers of hospitalized and nursing home patients suffering from femoral neck fractures, and their sequelae. Results following this injury apparently depend on the extent of the injury, such as the amount of displacement, the amount of comminution, and thus whether the circulation has been disrupted. The adequacy of reduction and fixation will greatly affect the end results of femoral neck injury. The history of the development of treatment rationale for femoral neck fractures parallels the historical development of orthopaedic surgery itself. Specific milestones have included the principle of reduction by dynamic traction, the importance of anatomical reduction and its maintenance in plaster, the development of stable internal fixation devices and finally the development of implant arthroplasty that led to the era of total joint replacement. A follow up for the different techniques used for treatment of femoral neck fractures will show that these techniques have been greatly changed, advanced and improved. Phillips, in 1867, introduced a technique for longitudinal and lateral traction to be used in the treatment of femoral neck fractures to eliminate "shortening or

other deformity" Maxwell, in 1976., reported the successful use of this technique. Ruth, in 1921, advocated closed reduction and maintenance of the reduction in a "phillips splint" for 8 weeks and non-weight bearing for 6 to 12 months post-traction. Whitman in 1904, after introduction of roentgenograms suggested careful closed reduction followed by hip spica immobilization. This produced a few satisfactory unions but also extremely high morbidity and mortality rates. (Quoted from Campbell's operative orth, 1980).

However, the first report of attempts at internal fixation of femoral neck fractures was by Von Langenbeck in 1850. Koenig in 1875, Nicolaysen in 1897; and Hey-Groves in 1916 used various internal fixation material, but because of metal incompatibility or material failures these were less than optimal.

This was the start to treat femoral neck fractures by internal fixation. However, the revival in the treatment of fractures of the neck of the femur by internal fixation was made practical by the development of efficient apparatus for internal fixation, by the development of relatively nonelectrolytic metals and by the perfection of more efficient roentgenographic control. (Quoted from campbell op. orth, 1980).

Early in the development of the method of fixation the fracture was exposed and reduction and internal fixation were done under direct vision. Now with good roentgenographic control exposure of the femoral neck in fresh fractures is not

indicated unless the reduction is unsatisfactory. Internal fixation using roentgenographic control may be done with minimal surgery and with minimal injury to the blood supply of the femoral head and neck.

In spite of all modern concepts in treating femoral neck fracture, it is still the unsolved fracture and still great effort & work is needed to solve it.

ANATOMY & BLOOD SUPPLY

Anatomy of the upper end of the femur

The upper end of the femur comprises a head, neck, a Greater and a lesser trochanters. (Fig. 1)

The head:

It is not a perfect sphere. It is directed upwards, medially and slightly forward to articulate with the acetabulum. The surface of the femoral head is smooth, capped with hyaline cartilage. This covering articular cartilage is about 4 mm in thickness over the superior portion and 3 mm at the equator (Hoaglund et al, 1980).

The medial convexity of the head is marked a little below and behind its centre by a small rough pit, the fovea, to which the ligament of the head of the femur is attached.

The femoral head is entirely intracapsular and is encircled by a fibro-cartilagenous rim, the acetabular labrum.

The neck:

It is an upward extension of the shaft. It has two rounded borders. The upper border is nearly horizontal and is gently concave upwards. The lower border is straight but oblique and is directed downwards laterally & backwards to meet the shaft near the lesser trochanter. The neck of the femur has two surfaces, an anterior surface which is flattened and its junction

with the shaft is marked by a prominent rough ridge, termed the intertrochanteric line, and a posterior surface which is convex backwards & upwards in its transverse axis and concave in its long axis and its junction with the shaft is marked by a rounded ridge (termed the intertrochanteric crest)

The neck is marked by numerous vascular foramina especially on its anterior surface and on the upper part of its posterior surface (Gray's Anatomy; 1976). Synovial membrane covers the neck entirely anteriorly but posteriorly it covers only the upper portion of the neck.

It arises at the border of the margin of the articular cartilage of the femoral head and is reflected on the under surface of the capsule of the hip joint. The capsule is attached at the intertrochanteric line anteriorly and approximately 1.5 cm proximal to the intertrochanteric crest posteriorly, in other word, the capsule is attached halfway along the femoral neck posteriorly. Beneath the synovial membrane, periosteum covers the proximal femur

(Quoted from Hoaglund et al , 1980). Hoaglund, 1980

has shown that the periosteum does not have a cambium layer on the femoral neck. This accounts for the lack of peripheral callus formation in the healing process after fractures in this region. therefore, healing in femoral neck area depends on endosteal union alone.

The neck inclines upon the shaft at an angle of about 125° , ranging nearly between 113° & 136° (Fig 2). This angle is more obtuse in infants, decreases with maturity notably in the first 5 years of life. The angle is known as the angle of inclination or the vertical neck-shaft angle (Saunders, 1977).

The neck of the femur also does not lie in the same plane as the shaft, but it sets upon the shaft at an angle of about 15° anteriorly. This is known as the angle of femoral torsion (Fig 3) (Gray's Anatomy; 1976).

The femoral neck is about 5 cm long. Its diameter is three quarters the diameter of the femoral head, allowing a greater range of motion before impinging on the acetabular labrum (Harty, 1982). Figure 4, shows the different values of superior-inferior diameters and antero-posterior diameter of the neck as well as the subtrochanteric -apical distance (Saunders', 1977).

The head of the femur overlaps the neck cortex but projects most prominently posteriorly as does the greater trochanter and its crest. This combination increases the curved outline of the neck. The neck possesses a thick cortex anteriorly and laterally, posteriorly the calcar reinforces the neck, A thin fragile angulated cortex is left at the lesser trochanter and subcapital junction (Harty, 1982).

Acetabulum

It is a deep cup shaped cavity on the lateral aspect of the hip bone. It is about 3.5 cm in diameter (Saunders's ~~surgical~~ anatomy 1977). The ilium, ischium and pubis share in the formation of the acetabulum.

The articular surface is a c-shaped concavity covered with hyaline cartilage. It is deficient posteriorly forming a gap known as the acetabular notch.

The acetabulum is deepened by a fibrous rim enclosing the head known as the labrum acetabulare which continues across the acetabular notch, plugging it and producing the transverse ligament which in turn gives attachment to the ligament of the head of the femur.

The central non-articular part of the acetabulum is known as the acetabular fossa. It contains a pad of fat known as the Haversian pad (Last in Anatomy; 1977)

Capsule of the hip Joint :

It attaches around the labrum acetabulare and transverse ligament. In front it is attached to the intertrochanteric line, posteriorly it is attached half way along the femoral neck. From these attachments the fibres of the capsule are reflected back along the neck constituting the retinacular fibres which bind down the nutrient arteries that pass along the femoral neck to supply the ~~major~~ part of the head (Last in Anatomy; 1977).

The fibrous capsule consists of two sets of fibres, circular & longitudinal. The circular are the deeper (zona orbicularis) and forms an inelastic collar around the mid neck of the femur.

Reinforcing capsular ligaments:

a) The ilio-femoral ligament (Y-shaped ligament of Bigelow):

The stem of the (Y) arises from the lower half of the anterior inferior iliac spine and the acetabular rim. The divergent limbs are attached to the upper and lower ends of the intertrochanteric line (Fig 5).

b) The pubo-femoral ligament:

Passes from the ilio-pubic eminence and obturator crest to the capsule on the inferior part of the neck.

c) The ischio-femoral ligament:

Arises from the postero-inferior margin of the acetabulum and continues into a band of fibres running in the capsule around the femoral neck (Last in Anatomy, 977).

The ligament of the head of the femur (the ligamentum teres):

A triangular ligament attached by its apex to the antero-superior part of the fovea and its base is attached by 2 bands one on each side of the acetabular notch.

It is ensheathed by synovial membrane. It becomes tense with semiflexion of the hip then adduction and relaxes with limb abduction (Grays Anatomy 1976).

Dee et al, in 1969 said that it had little mechanical value and does not contribute significantly to the blood supply of the femoral head. It is supplied by a branch of the obturator nerve and it contains large corpuscular mechano-receptor nerve endings which when stimulated by strong compression the musculature of the hip joint is inhibited.

Internal structure of the upper end of the femur

Ward in 1838 had first described the distribution of the cancellous trabeculae of the upper end of the femur (Quoted from Rockwood & Green 1984).

Ward described these trabeculae to be arranged into five groups:

1- Principal compressive group:

Extend from the medial cortex of the femoral shaft to end at the upper portion of the head.

2- Principal tensile group:

Extend from the lateral cortex immediately below the greater trochanter group & curve to join the thick cortex of the superior neck and end in the inferior portion of the femoral head.

3- Secondary compressive group:

Arise from the medial cortex below the principal compressive group at the level of the lesser trochanter & curve to decussate with the principal tensile group towards the greater trochanter.