FRACTURES OF THE ACETABULUM

Essay

For Partial Fulfillment of the Requirement of Master Degree in Orthopaedic Surgery

by

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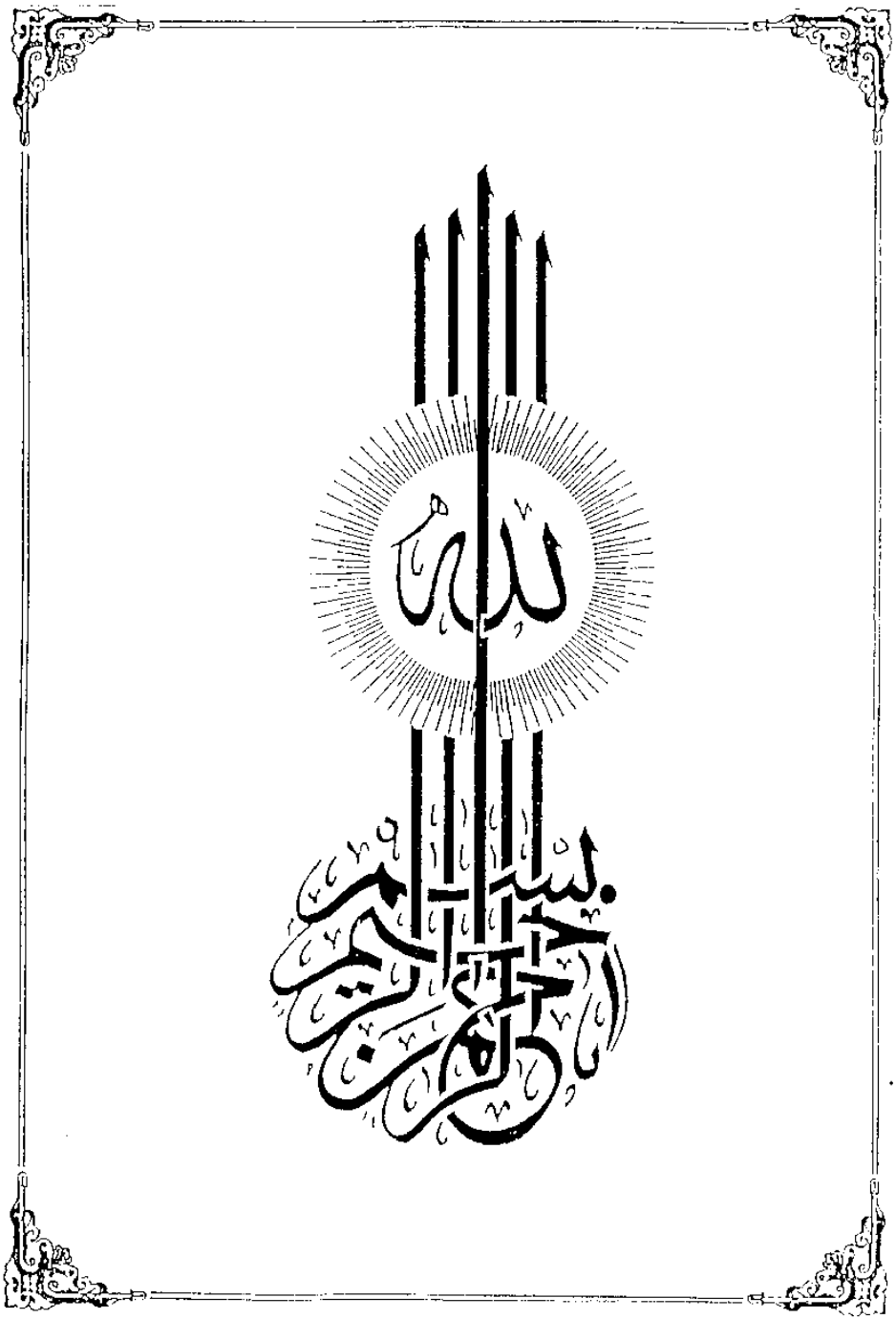

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DEDICATION

TO MY PARENTS

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INTRODUCTION AND AIM OF THE WORK

Fractures of the Acetabulum remain a major challenge to the orthopaedic surgeon.

In the past, owing to many reasons, the outcome of management of acetabular fractures has not been favorable.

The major problems in the acetabulum is that the orthopaedic surgeon is mostly confronted with are: the complex anatomy making exposure of the fracture so difficult, comminution of the fracture rendering reduction and internal fixation a tedious task. Besides fracture acetabulum frequently occurs as one entity of a polytraumatised patient.

Should treatment be operative or non-operative has been and still is a matter of controversy through the past decades.

Decision tasking is largely dependent on two factors. The fracture factor that is the morphology of the fracture and other injuries of the limb, the patient factor including age, medical state, other injuries, state of bone and proficiency of health care team. Recent evolution in Diagnostic imaging of acetabular trauma include C.T. scanning 3 D.C.T. scanning and M.R.I have made management and decision taking a subject to major reassessment.

The aim of the work is to provide the current concepts of Fractures of the Acetabulum as regards surgical approaches, techniques of open reduction, internal fixation and newly evolving radiological tools used in assessment and classification of acetabular trauma.

ANATOMICAL CONSIDERATIONS

Hip Joint: Bones and Ligaments

Movements of the hip joint are flexion-extension, abduction - adduction, and medial and lateral rotation. Circumduction is also allowed. The hip joint, a synovial ball-and-socket joint, consists of the articulation of the globular head of the femur in the cup-like acetabulum of the innominate bone. Compared to the shoulder joint, it has greater stability and some decrease in freedom of movement.

The head forms about two-thirds of a sphere and is covered by articular cartilage, thickest above and thinning to an irregular line of termination at the junction of the head and neck. The acetabulum exhibits a horse-shoe-shaped articular surface (lunate surface) arching around the acetabular fossa. The articular fossa lodges a mass of fat covered by synovial membrane; the transverse ligament of the acetabulum encloses the fossa below. An acetabular labrum attaches to the bony rim and to the ligament. Its thin, free edge cups around the head of the femur and holds it firmly.

The articular capsule of the joint is strong. It is attached to the bony rim of the acetabulum above and to the transverse ligament of the acetabulum inferiorly. On the femur it is attached anteriorly to the intertrochanteric line and to the junction of the neck of the femur and its trochanters. Behind, the capsule has an arched free border covering only two thirds of the neck of the femur distally. Most of the fibres of the capsule are longitudinal running from the coxal bone to the femur, but some deeper fibres run circularly. These fibres are named Zona

orbicularis and are most marked in the posterior part of the capsule; they help to hold the head of the femur in the acetabulum.

Three ligaments, as thickenings of the capsule add strength. The very strong *iliofemoral* ligament lies on the anterior surface of the capsule, in the form of an inverted Y. Its stem is attached to the lower part of the anterior inferior iliac spine, with the diverging bands attaching below to the whole length of the intertrochanteric line. The ilio-femoral ligament becomes taut in full extension of the hip and thus helps to maintain erect posture. The *pubofemoral* ligament is applied to the medial and inferior part of the capsule. Arising from the pubic part of the acetabulum and the obturator crest of the superior pubic ramus, it reaches the under side of the neck of the femur and the iliofemoral ligament. The ligament becomes tight in extension and also limits abduction.

The articular capsule is thinnest between the iliofemoral and pubofemoral ligaments but is crossed by the iliopsoas tendon. The iliopectineal bursa lies between this tendon and the capsule. The *ischiofemoral* ligament forms the posterior margin of the capsule. It arises from the ischial portion of the acetabulum and spirals lateralward and upward, ending in the superior part of the femoral neck. The *capitis femoris* ligament, about 3.5 cm long, is intracapsular arising from the two margins of the acetabular notch and the lower border of the transverse acetabular ligament and ending in the fossa of the head of the femur.

The Synovial membrane of the hip joint lines the articular capsule, covers the acetabular labrum, and is extended, sleeve-like, over the ligament of the head of the femur. The membrane covers the fat of the acetabular notch and is reflected back along the femoral neck till attachment of the capsule. Blood vessels to the head and neck of the femur course under these synovial reflections.

The arteries of the hip joint are branches of the Medial and lateral circumflex femoral arteries, the deep branch of the superior gluteal artery and the inferior gluteal artery. The posterior branch of the obturator artery provides a singificant portion of the blood supply of the femoral head.

The nerve supply to the hip joint is derived from the nerves supplying the quadratus femoris and rectus femoris muscles, the anterior division of the obturator nerve (rarely from the accessory obturator nerve), and the superior gluteal nerve *(Netter F.H., 1987)*.

Relations of the Hip Joint:

• Anteriorly the iliac bursa lies over the capsule and extends upwards into the iliac fossa beneath the iliacus. The psoas Major tendon separates the capsule from the femoral artery and the iliacus muscle separates it from the femoral nerve, while more medially pectineus intervenes between the capsule and the femoral vein.

• Superiorly there is a loose connective tissue space between the capsule and the over-hanging minimus.

• Inferiorly obturator externus spirals backward around the femoral neck.

• Posteriorly lies piriformis and below it the tricipital obturator internus and gemelli, separate the sciatic nerve from the capsule.

• Medially the acetabular fossa is thin and translucent; this forms part of the lateral wall of the pelvis and in the female the ovary lies adjacent, separated only by the obturator internus, the obturator nerve and vessels and the peritoneum *(Last, 1984)*.

The Acetabulum

One must be adept at three-dimensional vision to master the complex anatomy of the acetabulum. Inspection of the lateral aspect of the acetabulum without the femoral head will clearly outline the anatomical features (Fig.1A to C). From its lateral aspect the acetabulum is cradled by the arms of an inverted Y.

The posterior column is strong and triangular and is most suitable for internal fixation. Beginning at the dense bone of the greater sciatic notch, it extends distally through the center of the acetabulum to include the ischial tuberosity. Its inner surface forms the posterior aspect of the quadrilateral area, its posterior surface the non-articular area of the posterior wall of the acetabulum, and its anterior surface the posterior articular surface of the acetabulum.

The anterior column extends from the iliac crest to the symphysis pubis and includes the anterior wall of the acetabulum. Commonly, fractures involving the anterior column exit below the anterior inferior iliac spine, thereby not extending to the iliac crest. Rotation of the hemipelvis to expose the inner surface, as shown in (fig. 1B,) will facilitate the three-dimensional picture of the acetabulum.

Also, inspection of the lateral aspect of the acetabulum will reveal the important features of its articular surface, especially the superior or weight-bearing surface often referred to as the dome (Fig.1C). This dome, which has great clinical significance, extends from the strong bone just posterior to the anterior inferior iliac spine to the posterior columns (Tile, 1984).

Blood Supply of the Acetabulum:

The blood vessels which pass to the three pelvic bones that comprise the acetabulum arise from three different circulatory regions. The obturator artery sends the preacetabular artery to the inferior acetabular rim. The superior gluteal artery sends the supra acetabular artery forward above the acetabular roof and supplies the ilium. The posterior acetabulum and the ischium are supplied chiefly by the inferior gluteal artery, whose terminal branch is the retroacetabular artery. The acetabular floor is additionally supplied by the acetabular artery, a branch of the obturator artery *(Tonnis, 1987)*. Letournel and Judet (1981) mentioned that these arteries are frequently torn in acetabular fractures and become thrombotic. Considerable bleeding from these vessels also occur after detachment of soft tissues. Hence their preservation during surgery is important. They also mentioned that inspite of such an abundant blood supply, avascular necrosis may occur from extensive periosteal stripping, which should therefore be kept to a minimum during surgery.

Fig.1 (A,B,C): **(A)** The lateral aspect of the hemipelvis and acetabulum. The posterior column is characterized by the dense bone at the greater sciatic notch and follows the dotted line distally through the center of the acetabulum, the obturator foramen, and the inferior pubic ramus. The anterior column extends from the iliac crest to the symphysis pubis and includes the entire anterior wall of the acetabulum. Fractures involving the anterior column commonly exit below the anterior inferior iliac spine as shown by the heavy dotted line **(B)** the hemipelvis from its medial aspect.**(C)**The area between the posterior column and the heavy line, representing a fracture through the ant column, is often considered the superior dome fragment, represented by the middle portion *(Tile, 1984)*.

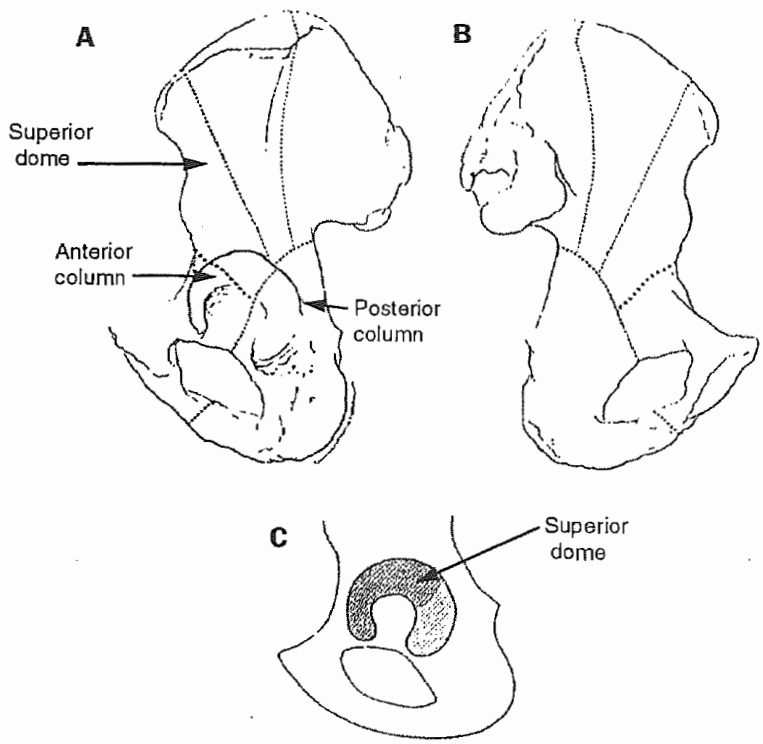

Fig. 2
Hip bone viewed from the outer aspect

Fig. 3
Hip bone viewed from the inner aspect

MECHANISM OF INJURY

The pathoanatomy of any acetabular fracture depends on the position of the femoral head at the moment of impact. The femoral head acts like a hammer, shattering the acetabulum on impact, *(Rockwood, Jr et al.,1991)*. For this reason damage to the articular surface of the femoral head must always be suspected in any acetabular fracture *(Tile, 1984)*. Fractures of the posterior column are produced when the femoral head is rotated internally and those of the anterior column are produced when the head is rotated externally. If the femoral head is adducted, the superior aspect of the dome is involved, and if abducted, the inferior aspect is involved *(Rockwood, Jr et al, 1991)*.

Fig.4

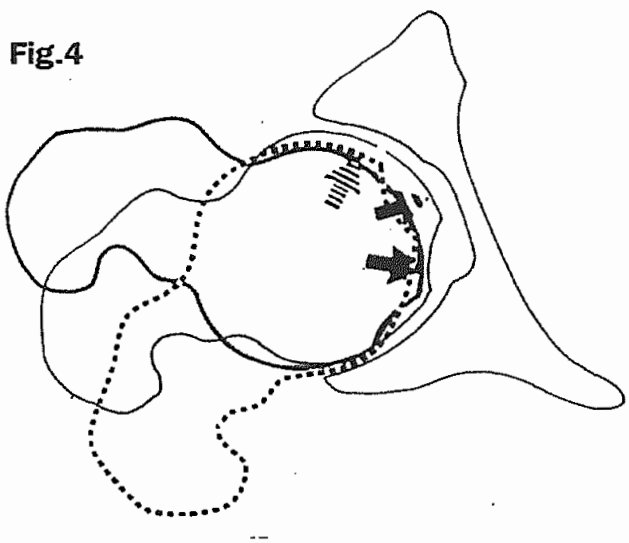

Fig. 4 The type of acetabular fracture will depend upon the position of the femoral head at the moment of impact. If externally rotated (striped arrow) the anterior column will be involved; if internally rotated (solid arrow) the posterior column will be involved *(Tile,M. 1984)*.

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