RECENT ADVANCES IN ACETABULAR RECONSTRUCTION IN TOTAL HIP ARTHOPLASTY

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٢٠١٣

List of contents

	Page No.
List of tables .	II
List of abbreviation**.**	III
Introduction and aim of the work	IV
Chapter one: Applied surgical anatomy of the acetabulum.	1 – 18
Chapter two: Pathological anatomy and classifications.	19 – 34
Chapter three: Preoperative and intraoperative assessment	35 – 50
Chaoter four : Methods of acetabular reconstruction in totalhip replacement .	51-91
Summary .	92-93
References .	94-112
Arabic summary.	١-٢

List of tables

	Page No.
Table. 1:D'Antonio Classification.	25
Table. 2: D'Antonio grading system of severity of acetabular bone loss .	25
Table. 3 : Paprosky Classification of Acetabular Bone Loss .	29
Table. 4: Cross-walks Among Classification Systems .	33

List of abbreviations.

THA	Total hip arthroplasty
AP	Ateroposterior
3D	Three dimension
HHC	High hip center
TAN	Transverse acetabular notch
AAN	Anterior acetabular notch
DDH	Developmental hip dysplasia
AAOS	American Academy of Orthopaedic Surgeons
CT	Computed tomography
LLD	Leg Length Discrepancy
DMB	Demineralized bone matrix
HA	Calcium hydroxyapatite
ZPCTM	Zeta Potential Control
β-TCP	β-Tri-Calcium Phosphate
KT	kerboull plat
TM	Trabecular metal
MAPC	Modular antiprotrusion component
CTAC	Custom triflanged acetabular component

Introduction

Total hip arthroplasty (THA) is highly successful at improving pain and function in patients experiencing arthrosis of the hip joint. Although the longevity of these implants has improved over the years, their life spans are still finite, and all implants will fail with time. Furthermore, because the number of younger patients undergoing THA continues to increase, the number of revision hip arthroplasty cases is also expected to rise [(1)].

Classification systems seek to place the varying amounts and directions of bone stock loss into differing categories, to help guide which method is to be used, and for comparing the literature results of differing methods and implants. Most widely used are the AAOSIII and PaproskyIV grading systems. In the assessment of bony defects, a key issue is containment. If a defect is well contained by surrounding bone, it is readily amenable to bone grafting. If not, then containment can become a major factor in achieving primary stability [(2)] .

Bone defects encountered in primary hip surgery can arise from numerous causes including trauma, developmental dysplasia, and those etiologies of acetabular protrusion, understanding of acetabular bone defects will aid in determining the best approach to the hip, whether bone graft might be required, and the appropriate equipment to be available[(3)].

The main goals are to provide a stable, lasting fixation, and where possible to improve the bone stock [(2)].

Complicated primary acetabular reconstruction can present many of the challenges that are present in revision hip surgery, in addition to features that are unique to primary reconstruction. Primary reconstruction is distinguished from revision situations in that many of the deformities and bone loss patterns in primary reconstruction are of long standing, accompanied by secondary extremity shortening, soft tissue contracture, and other compensatory changes in the pelvic anatomy [(3)].

Primary indications for acetabular revision include aseptic mechanical loosening, hip instability due to component malposition, and periprosthetic osteolysis associated with wear debris. An additional indication for revision total hip arthroplasty, albeit in a staged manner, is deep periprosthetic infection necessitating removal and reimplantation of components[(4)].

Bone stock deficiency presents the major challenge in acetabular reconstruction during revision hip arthroplasty. The preoperative assessment of acetabular bone stock before revision surgery is critical because the amount and location of pelvic osteolysis can determine the type and success of revision surgery. Traditionally, plain radiographs with AP and lateral views have been used for this purpose;V however, Judet views can provide additional information about the integrity of the anterior and posterior columns. CT and MRI scans are indicated in selected patients[(5)].

Massive acetabular bone loss is defined as bone loss affecting more than 50% of the acetabular cup, with distortion of acetabular geometry, column damage, and pelvic discontinuity. Surgical options include massive structural grafts, oblong revision cups, custom triflanged cages, noncustom reconstruction rings, cages with modular porous metal

augments, and impaction grafting techniques [6].

Acetabular reconstruction in revision total hip arthroplasty can successfully be achieved with hemispherical components featuring a porous or roughened ingrowth surface and options for placement of multiple screws. Most defects can be reconstructed with large hemispherical or "jumbo" cups. Defects with greater bony loss or compromised columns require either the use of modular augments combined with a hemispherical shell, reconstruction cages, structural allografts or custom triflange acetabular components[8].

Aim of the work

The purpose of this study is to review the different methods of acetabular reconstruction in both primary and revision total hip arthroplasty with special reference to the recent advances .

Introduction

The basic anatomy around the hip consists of the superficial surface anatomy and deep bony, muscular, and neurovascular anatomy. The clinically relevant surface anatomy of the hip consists of several superficial palpable bony prominences [(8)].

The anterior landmarks consists of the prominent anterior superior iliac spine and anterior inferior iliac spine , which serves as insertion points for the Sartorius and direct head of the rectus femoris, respectively. The greater trochanter and posterior superior iliac spine also are easily identifiable on the posterior-lateral aspect of the hip (Fig.1). They are important landmarks for incision planning. Understanding the relationship of these structures to the deeper anatomy is a critical surgical anatomic principle. Accurate identification and palpation of these structures are vital to all surgical hip planning [(8)].

Fig.(1): Superficial anatomy of the hip seen with patient in traction before hip arthroscopy. Palpation of the hip allows for easy identification of the greater trochanter (lateral) and anterior superior iliac spine (anterior) in most patients[(8)]..

The hip is a diarthrodial joint and is defined by the constrained bony articulation of the proximal femur and acetabulum.The acetabulum, which consists of the 3 bones of the pelvis, the illium, ischium, and pubis, form the

Y-shaped triradiate cartilage (Fig.2), which usually fuses by 15 to 16 years of age[9].

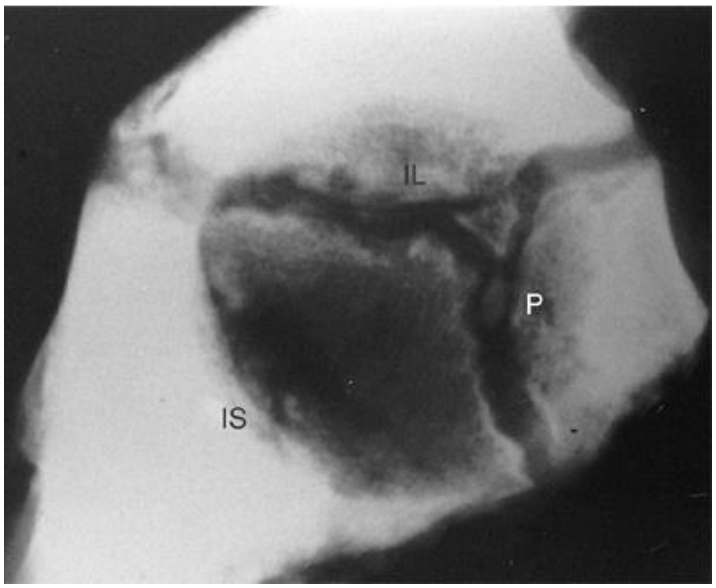

Fig.(2): The triradiate cartilage in the floor of the acetabulum[9].

The acetabulum is made up of three walls and a floor to form a spherical receptacle for the femoral head. The ischium, which makes up the posterior column, is the most substantial wall. The ilium contributes to the superior wall or dome, and a thin contribution from the pubis completes the anterior column. Medially, the floor of the acetabulum receives contributions from all three bones. Screws placed through cementless acetabular cups to aid fixation should be placed between the 10 and 2 o'clock positions when the acetabulum is viewed from the side, to avoid damage to the internal iliac vessels anteriorly, and the sciatic nerve posteriorly. Revision surgery of the acetabulum often involves bony defects in one or more of the columns, putting neurovascular structures even more at risk[10].

A medial defect will often be covered by a pseudomembrane, which overlies the iliacus muscle. Directly medial to this lies the obturator nerve and artery, the ureter, and the bladder. Great care should be taken when preparing the acetabulum to avoid damage to any of these structures, which may have catastrophic consequences [(10)].

The anterior column includes the anterior iliac crest, anterior acetabulum and superior pubic ramus. The posterior column extends from the sciatic notch to the ischial tuberosity and includes the posterior wall of the acetabulum. Fractures involving the anterior and posterior columns characteristically pass through relatively weak areas. The columns are attached to the sacrum through a strut of dense bone called the sciatic buttress (Fig.3).This transmits load between the torso (via the sacrum) and the lower extremity (via the columns). The main weight bearing surface of the acetabulum is cradled between the anterior and posterior columns and is referred to as the dome or roof [(11)].

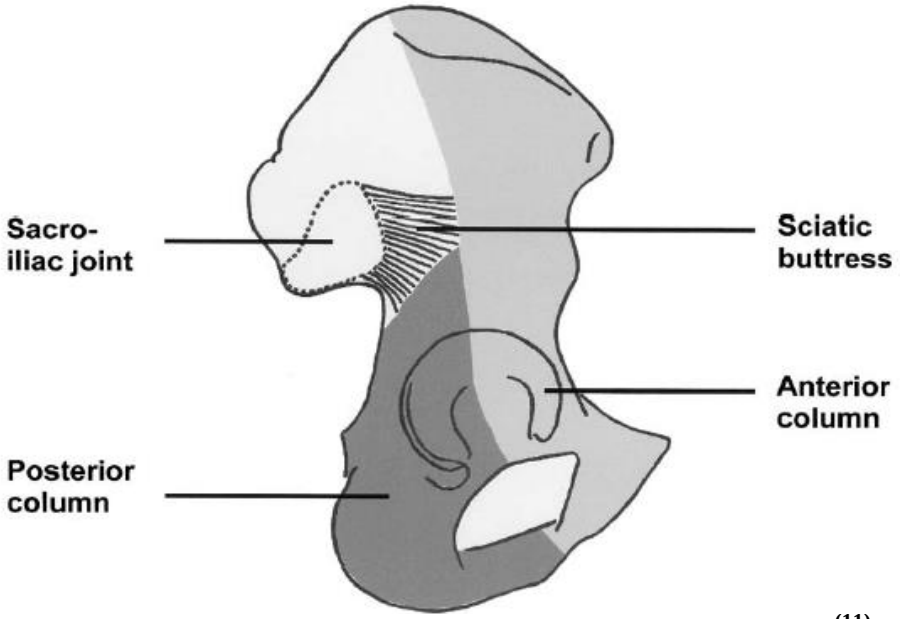

Fig.(3): The Descriptive anatomy of acetabulum [(11)].

THE COLUMN CONCEPT OF THE ACETABULUM

At first sight the acetabulum appears to be contained within an arch.The limbs of the arch are posterior (or ilio-ischial), and anterior (or ilio-pubic). It is better to regard the acetabulum as being contained within the open arms of an inverted Y [12] .

The three elements of the hip bone contribute to the acetabulum formation in human; meeting at a Y shaped Cartilage forming their epiphyseal junction. This epiphysis closes after puberty. The united upper limbs of the Y epiphysis are represented on the hip bone by heaping up of bone at the iliopubic eminence anteriorly and at the point of meeting of ilium and ischium posteriorly **.** The posterior mark reaches approximately to one third of the way down to greater sciatic notch. The stem of the Y is vertical and passes through the acetabular notch to the obturator foramen (Fig.4&5) [13].

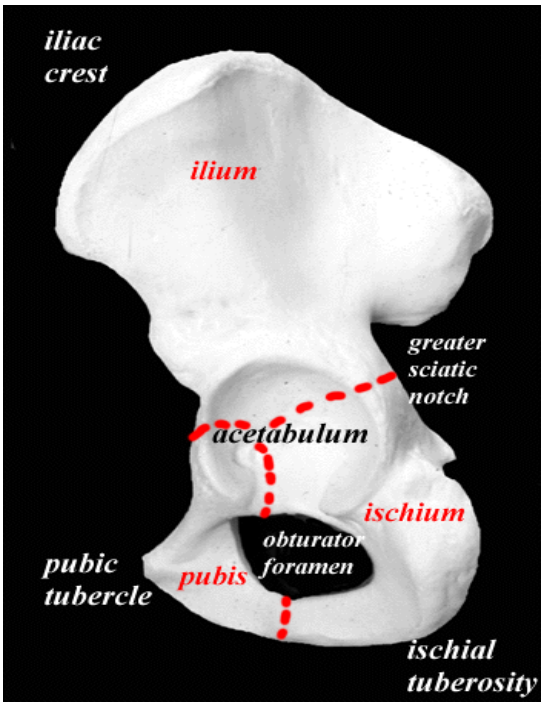

Fig.(4): Column concept of the acetabulum [13].