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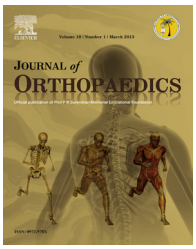

Review Article

Clinical evaluation and surgical options in acetabular reconstruction: A literature review

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ABSTRACT

The purpose of this paper is to review the clinical indications for acetabular reconstruction in patients with underlying peri-prosthetic segmental and cavitary defects, evaluate steps in pre-operative planning, and present the American Academy of Orthopaedic Surgeons (AAOS) and Paprosky classification systems to categorize acetabular defects. We also present a review of the current surgical techniques to reconstruct the acetabular socket which includes a cementless acetabular component with morselized bone, structural allograft, jumbo and oblong cups, reinforcement rings, bone cages, custom triflange acetabular constructs, and trabecular metal components.

1. Introduction

Total hip arthroplasty (THA) is perhaps the most recognized operation in the field of orthopedic surgery and regarded as a benchmark treatment of end-stage hip joint disease. The aging population and growing incidence in obesity will continue to increase the number of hip replacements. Despite excellent clinical results, many patients outlive the typical lifespan of implants with approximately 17% of all primary hips eventually failing and requiring revision.[1] Acetabular revision in the context of poor bone stock is a technically challenging procedure; therefore, it is imperative for the arthroplasty surgeon to understand the advantages and disadvantages of the available acetabular component systems. In this paper, we review clinical indications for acetabular revision, radiographic classification systems, and pre-operative planning. We also include a summary of available acetabular component systems and highlight unique features.

2. Clinical evaluation

Clinical presentation depends on the fundamental etiology for acetabular implant failure, which include aseptic loosening, infection, instability, wear, trauma, and osteolysis.[2] Groin or buttock pain is a characteristic patient complaint associated with acetabular implant failure while thigh pain is often associated with femoral implant failure.[2,3] A comprehensive medical history and focused physical exam should be performed on all patients regardless of clinical presentation. Laboratory studies including complete blood count (CBC),

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erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), nuclear scans, and aspiration arthrogram with culture and sensitivity are recommended when underlying infection is suspected.[4] Pre-operative templating requires an upright weight-bearing anteroposterior (AP) pelvis, femoral lateral, and full-length views to evaluate the extent of disease. Judet views can help detect acetabular column disease. Furthermore, 3D pelvis CT scans provide ancillary evidence of osteolytic lesions as plain films often underestimate the degree of bone loss. Multiple studies report that CT scan is better than plain film at identifying peri-acetabular osteolytic lesions.[5–8] Frail cortical bone is often difficult to distinguish from bone cement in poor quality films. Finally, CT angiogram of pelvis vasculature and possible vascular surgery consultation may be necessary when Kohler's (ilio-ischial) line is interrupted and the acetabular component is markedly displaced.

3. Classification of acetabular defects

An ideal radiological classification system provides accurate and standardized algorithm to evaluate the extent of bone loss, assist in pre-operative planning and clinical management. Acetabular defects are routinely described using the American Academy of Orthopaedic Surgeons (AAOS) and Paprosky classification system.

The AAOS classification system categorizes lesions into cavitary, segmental, combined cavitary and segmental, pelvic discontinuities, and arthrodesis.[9] Cavitary defects are localized within the acetabular cavity and do not involve the anterior, superior, and posterior rim. Cavitary defects include any kind of dome lesion. Segmental defects occur along the acetabular rim and include the medial wall. Segmental defects are subdivided into anterior or posterior. Pelvic discontinuity occurs when anterior and posterior columns separate and disrupt the rostral hemipelvis from the distal aspect.[10] It constitutes less than 5% of all acetabular revisions and requires careful planning.[10]

The Paprosky classification system uses pre-operative imaging and intraoperative assessment to describe acetabular defects.[11,12] Using this classification system, acetabular defects are graded from Type I to Type III based on location and extent of bone loss (Fig. 1).

Technical goals in acetabular revision are to reconstitute bone stock, restore anatomic hip center of rotation, limb-length, offset, and secure the prosthesis to the native acetabular socket.[13] These steps are necessary to reduce risk of post-operative dislocations, increase wear time, and avoid particle-induced osteolysis that may permanently alter hip biomechanics.[13] A number of options are available to help the arthroplasty surgeon achieve sufficient acetabular bony contact and return hip center to normal anatomic position, including the use of bone cages, allografts, jumbo and oblong cups, triflange implants, and porous acetabular metal augments. The decision to proceed depends on the localization and extent of disease, patient anatomy, and experience of the arthroplasty surgeon.

4. Cavitary defects

Cementless hemispheric acetabular components are generally used for patients with cavitary defects. Small cavitary defects can be reamed with a larger size reamer to increase contact area between native bone and implant. The acetabular shell is then impacted into the socket and transacetabular screws are placed in the posterior quadrants to provide ancillary fixation to the ileum and ischium. Anterosuperior and anteroinferior placements of screws increase the risk of injury to external iliac and obturator vessels respectively and should be done with care.

4.1. *Morselized bone grafts with a cementless acetabular cup*

Over-reaming large cavitary defects may cause further damage to pre-existing bone along the acetabular rim and should be supplemented with morselized bone grafts.

Cementless hemispheric acetabular components with morselized cancellous bone allografts are generally used in the setting of type 1 Paprosky contained defects with an intact rim, columns, and dome.[14,15] The literature recommends that at least 50% host bone contact is needed to prevent mechanical loosening between the prosthesis and native bone.[1,2,14] Femoral head, distal femur, and acetabular allografts can be used to fill in the gaps. The operating surgeon may consider autogenic graft as they are less immunogenic, but difficult to harvest in some patients with pathological bone disease.[14,15] Intraoperatively, the arthroplasty surgeon uses a bone mill or rangeur to generate small chunks of bone that are impacted with a smooth acetabular impaction domes. Reverse reaming technique can be used alternatively to impact bone into the acetabular socket.[15] Subsequently, the cup is pressfit and

Type	Defect
I	Acetabular rim, anterior and posterior column intact and supportive.
IIA	Teardrop intact. No ischial lysis and > 50% host bone contact
IIB	Moderate superolateral migration > 50% host bone contact
IIC	Medial migration with preserved peripheral rim
IIIA	Substantial superolateral migration, < 50% host bone contact
IIIB	Significant superomedial migration, < 50% host bone contact, substantial ischial lysis and full obliteration of teardrop
IIIC	Pelvic discontinuity

Fig. 1 – Paprosky classification of acetabular defects.[12,13]