Acetabular Considerations During Total Hip Arthroplasty for Hip Dysplasia

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KEYWORDS

• Developmental dysplasia of the hip (DDH) • Total hip arthroplasty (THA) • Femoral head autograft • Acetabular reconstruction • Uncemented acetabulum

KEY POINTS

- The wide spectrum of anatomic abnormalities that characterize hip dysplasia dictate the need for different reconstructive techniques when hip replacement is required.
- When standard techniques of reconstruction leave a significant portion of the component uncovered, the alternatives include acetabular augmentation with bone autograft, intentional high placement of the component, or medialization of the component with or without medial wall osteotomy.
- Uncemented sockets have provided promising midterm results with supplemental bone augmentation and are our preferred method of treatment for hips with moderate dysplasia and anterolateral acetabular bone deficiency.

INTRODUCTION

Developmental dysplasia of the hip (DDH) is the most prevalent developmental childhood hip disorder.[1] Formerly known as congenital dysplasia of the hip, this condition encompasses abnormalities involving the growing hip, from minimal dysplasia to dislocation of the hip joint. Dysplastic hips share a common pathophysiology in which anatomic abnormalities subject the hip to increased contact stress leading to abnormal hip biomechanics, hip instability, impingement, associated labral pathologic condition, and eventually degenerative arthritis.[2–4] Despite the availability of several nonarthroplastic alternatives, many patients with advanced hip dysplasia eventually require hip replacement surgery. Because of the unique characteristics of these patients, including young age and anatomic abnormalities of the hip, the failure rate after total hip arthroplasty (THA) in patients with DDH is higher than those in the general population.[5] The specific alterations observed in the acetabulum usually include a shallow socket with bone deficiency anteriorly, laterally, and superiorly. Reconstruction during THA, particularly the location of the placement of the acetabular component defines the new center of hip rotation, which in turn influences hip biomechanics, leg length, and femoral reconstruction. This article reviews the different alternatives for the reconstruction of acetabulum during THA in patients with DDH.

CLASSIFICATION

Dysplastic hips can be characterized by the severity of anatomic abnormalities. Classification systems are useful for the assessment of patients and comparison of results using different treatments. The classification by Crowe and colleagues[6] is the most common method to categorize the degree of dysplasia. In the original

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description, dysplastic hips were categorized radiographically into 4 groups based on the extent of proximal migration of the femoral head. The migration is calculated on an anteroposterior radiograph of the pelvis by measuring the vertical distance between the interteardrop line and the inferior head-neck junction. The amount of subluxation is the ratio between this distance and the vertical diameter of the undeformed femoral head. Thus, if the distance between the head-neck junction and the teardrop is half the vertical diameter of the femoral head, the hip is subluxated 50%. When the femoral head is deformed, the predicted vertical diameter of the femoral head was 20% of the height of the pelvis, as measured from the highest point on the iliac crest to the inferior margin of the ischial tuberosity (**Table 1**). Because this system is based on the degree of displacement of the femoral head and does not define the acetabular abnormality, other classification systems, such as the Hartofilakidis classification,[7] which divides congenital hip disease in adults into 3 categories: dysplasia, low dislocation, and high dislocation (**Table 2**), have been proposed. The authors prefer using this classification system because it simply describes the acetabular deformity and is useful in determining the type of acetabular reconstruction that is required. In this system, each category is based on the relationship between the femoral head and the true or false acetabulum. With dysplasia, the femoral head, despite some degree of subluxation, is still contained within the original acetabulum. With low dislocation, the femoral head articulates with a false acetabulum that partially covers the true acetabulum and radiographically appears to be 2 overlapping acetabula; the inferior part of the false acetabulum is an osteophyte that begins at the level of the superior rim of the true acetabulum. With high dislocation, the femoral head migrates superiorly and posteriorly. The true acetabulum is inferior and anterior to the hollow in the iliac wing, with which the femoral head articulates, and may have the appearance of a false acetabulum.

Table 1
Crowe classification for DDH in adults

Group	Description
I	Subluxation <50% or proximal dislocation <0.1% of the pelvic height <10%
II	Subluxation 50%–75% or proximal dislocation of 0.1%–0.15% of pelvic height 10%–15%
III	Subluxation 75%–100% or proximal dislocation of 0.15%–0.20% of pelvic height 15%–20%
IV	Subluxation >100% or proximal dislocation of >0.20% of pelvic height >20%

ANATOMIC POSITION OF THE ACETABULAR COMPONENT

To reconstruct the acetabulum successfully during THA in patients with DDH, certain information such as the position of the true acetabulum is of capital importance. Today, the aim of the acetabular reconstruction is to place the acetabular component in the area of the true acetabulum for purely mechanical reasons. A method to locate the correct anatomic position of the acetabulum in deformed hips and to assess any variation of position of the acetabular component after THA based on radiographs was developed by Ranawat and colleagues.[8] Parallel horizontal lines are drawn at the level of the iliac crest and the ischial tuberosities and are connected by a perpendicular passing through a point (A) located 5 mm lateral to the intersection of Kohler and Shenton lines. The length of the perpendicular between the parallels lines is equal to the height of the pelvis and one-fifth of this equals the height of the acetabulum. A second point (B) is located on the perpendicular superior to the point A, at a distance equal to one-fifth of the perpendicular line. From B a perpendicular is erected laterally to point C, so that the distance BC equals the distance AB. Joining point A and C completes the isosceles triangle, indicating the correct position of the acetabulum to be reconstructed. In a normal hip, the superior border of the triangle will pass through the superior aspect of the subchondral bone of the acetabulum (**Fig. 1**). Although this system is useful, in the majority of deformed hips, the location of the radiographic teardrop is visible and can be used as a simple radiographic marker to the position of the acetabular component.

TREATMENT OPTIONS

When choosing a treatment option for acetabular reconstruction, risk and benefits of the technique as well as the type of bony deformity should be considered preoperatively. The practical and biomechanical advantages of hip reconstruction at a normal anatomic location must be balanced with the need to provide sufficient acetabular implant coverage. When possible, acetabular reconstruction should seek normalization of the

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