Total Hip Arthroplasty in Patients with Developmental Dysplasia of the Hip

Camilo Restrepo, MD, Frank Grisafi, BS, and Richard H. Rothman, MD

Total hip arthroplasty (THA) of a developmental dysplasia of the hip (DDH) is a challenging reconstructive procedure. 50% of all THA may be due to DDH. An adequate classification like Crowe's is necessary so surgical planning can be established. In order to evaluate possible surgical approaches, keep in mind the anatomical disruption (pelvic and femoral) present in a patient with DDH. The acetabular and femoral considerations based on Crowe's classification should be overviewed to maximize outcome. The most important complication is lengthening of the sciatic nerve, and artery injury.
Semin Arthro 16:80-85 © 2005 Elsevier Inc. All rights reserved.

KEYWORDS THA, DDH, Crowe, acetabular, femoral

Total hip arthroplasty (THA) for ostheoarthrosis (OA) is now performed frequently in the United States.[1,2] The level of difficulty in performing this procedure, for the surgeon, hence may be decreasing. However, this statement is not true when it comes to performing THA for developmental dysplasia of the hip (DDH). The anatomy of a patient with DDH is always different from one who has OA from other etiologies.[3-7] Some of those changes are present even if it is a previously treated patient, by means of closed and/or open reduction, osteotomy at the acetabulum, and/or the proximal femur. On nonneglected DDH patients who underwent osteotomy, it is always necessary to evaluate the need for removal of hardware prior to the implantation of the prosthesis components. There is also a partial loss of reference points in patients with DDH, and, of course, fibrosis and scar tissue on previously treated patients increase this loss of reference. The leg length discrepancy is always a major concern, since it is not always achievable nor desirable in some cases. The early development of OA in some of the patients with DDH is also a concern in terms of longevity for the prosthesis. Patients with severe DDH may develop OA late in life, and even if they have been limping all their life, they may show no or little pain, which gives the surgeon second thoughts about whether to perform a surgical procedure of this magnitude or not.

Rothman Institute, Philadelphia, PA.
Address reprint requests to Camilo Restrepo, MD, Rothman Institute, 925 Chestnut Street, Philadelphia, PA 19107.

Natural History

DDH is present in 1% of all births in the United States, and even if it is treated early in life to prevent squeals, it is believed to be the etiology for 50% of all the patients that undergo THA for OA.[8] On a neglected setting, patients with mild DDH will eventually develop symptoms in their fifth to sixth decades; those with moderate and severe DDH become symptomatic early in life, soon developing OA, and on the contrary, patients with very severe DDH may live painless but will limp from their toddler ages. There are numerous different types of surgical treatments for DDH in childhood or young adults[9-13]; all seem to establish that good head coverage (center edge (CE) angle >20° and acetabular inclination (AI) angle <43°) leads to a good function of the affected hip. Those patients treated in which the goal was not met will eventually and much sooner develop AO.[9-13]
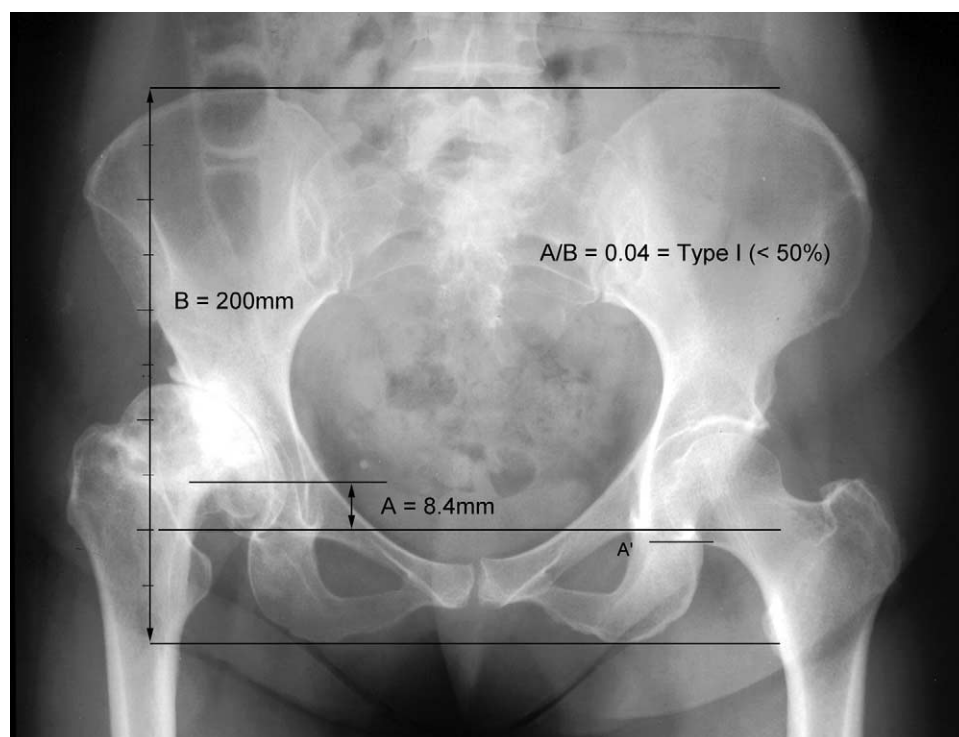
Classification

There are several classifications posted for identifying DDH in adults; basically they describe the localization of the head compared with the pelvis and or acetabulum. Hartofilakidis and coworkers describe three types: first, a dysplastic hip contained in the true acetabulum; second, a subluxated hip with a neo-acetabulum that partially covers the true acetabulum, called low dislocation; and third, a neo-acetabulum located above and posterior from the true acetabulum without overlapping it, called high dislocation.[3] Eftekhar shares more or less the same classification but adds a fourth one in which the femoral head on a

Figure 1 The distance from the ischial tuberosity to the iliac crest defines the pelvis height (B). The distance from the teardrop reference line to the inferior confluent point of the femoral neck and head identifies the vertical displacement (A). The ratio (A/B) determines degree of subluxation in the Crowe's classification. Note that the teardrop line starts at 20% of (B) and the superior border of the normal contralateral hip is located at 40% of (B).

high dislocation does not contact the pelvis.[14] Finally, Crowe and coworkers establish a classification that is somehow objective in terms of a scale given by a ratio between the height of the pelvis and the distance between the inferior border of the teardrop and the union of the neck and head on the medial aspect.[4] Crowe's classification gives rise to four types in which the ratio for type I is <0.10; type II is from 0.10 to 0.15; type III is from 0.15 to 0.20; and type IV is >0.20. Crowe also determined that the subluxation degree was correlated to the type of dysplasia: type I being a displacement of the head in relation to the true acetabulum <50% (Fig. 1), type II from 50 to 75%, type III from 75 to 100%, and type IV, complete dislocation.

This particular classification is most widely used now, since not only is it less subjective than the others, but it can easily be used as a standard method for planning surgery, knowing what to expect to find at surgery, and also helping to determine the possible outcomes and complications depending on the degree or type of dysplasia. A comparison chart between the different classifications is shown in Table 1.

Table 1 Comparative Classification Chart

Comparative Classification Chart			
Hartofilakidis[3]	**Eftekhar[14]**	**Crowe[4]**	
Dysplasia	Type A	Type I	<50%
Low dislocation	Type B	Type II	50–75%
		Type III	75–100%
High dislocation	Type C	Type IV	Dislocation
	Type D		

Anatomy

The anatomical changes associated with DDH occur at the acetabulum, femur, and soft tissues. The location and extent of anatomical distortion dictates the surgical challenges that the surgeon must overcome in an attempt to restore normal anatomy and function. On nonneglected DDH patients, some of the anatomical changes may still be apparent.

The acetabulum is often shallow, with an increased AI angle >43°. Deficiency of bone stock is seen anterolateral and on greater dysplasia is also superolateral; narrowing of the acetabulum in the anteroposterior diameter makes it oval or rhomboid in configuration containing fibrofatty tissue. It also has an increased anteversion; finally, there is a certain degree of osteoporosis even if some sclerosis can be eventually seen on the anterolateral aspect of the acetabulum. In a completely dislocated hip, there is hypoplasia of the true acetabulum with formation of a neo-acetabulum on the thin iliac bone, located superoposterior to the true acetabulum.

The femur changes are as follows: Head: a small nonspherical head that may or not be congruent with the shape of the acetabulum; on Crowe I, II, and III, the head may have a certain degree of sclerosis, as a mirror image to the acetabulum; on Crowe IV, the head is so shrunken it is just a remnant; neck: a short neck, which is also valgus and has a patent anteversion that is not directly related to the degree of dysplasia (the average degree of increased anteversion in all four Crowe's groups is 12°, ranging from 10° to 90°[6,7]; this anteversion may falsely increase the valgus appearance and also falsely increase the length of the neck, when evaluated on X-rays); greater trochanter: located posteriorly; proximal femur: hypoplastic, straight, and having a stenotic endomedullary canal, directly related to the degree of dysplasia.