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Analyzing acetabular deficiency by computed tomography in osteoarthritis after Crowe type 2 developmental dysplasia of the hip

Crowe tip 2 gelişimsel kalça çıkığında asetabuler yetmezliğin bilgisayarlı tomografi kullanılarak incelenmesi

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Objectives: Images of acetabular deficiency in Crowe type 2 developmental dislocated hips were evaluated by computed tomography (CT) and acetabular component was placed surgically.

Patients and methods: Twenty-nine hips of 18 patients (2 males, 16 females; mean age 46 years; range 37 to 56 years) have been reviewed through CT imaging. The roof edge angle, the acetabular index of depth to width and bone mass of the anterior and posterior acetabular rim have been measured over the cross sections obtained from the CT.

Results: Acetabular structure was normal in four hips, and there was no posterior rim deficiency in any hips. However, there was anterior rim deficiency in 21 hips, and there was both posterior and anterior deficiency in four hips. The acetabular anteversion was the most common finding.

Conclusion: In this study, increased acetabular anteversion and anterior rim deficiency were frequently observed in patients with Crowe type 2 hip dislocation. An orthopaedist should consider anteversion and this deficiency when fitting acetabular component.

Key words: Acetabular dyspasia; anteversion; computed tomography; deficiency; developmental dislocation of the hip; total hip arthroplasty.

Amaç: Crowe tip 2 gelişimsel kalça çıkıklı hastalardaki asetabuler yetmezlik bilgisayarlı tomografi ile incelendi ve ameliyatla asetabuler komponent yerleştirildi.

Hastalar ve yöntemler: On sekiz hastanın 29 kalçası (2 erkek, 16 kadın; ort. yaş 46 yıl; dağılım 37-56 yıl) bilgisayarlı tomografi ile incelendi. Çatı köşe açısı, asetabuler derinlik/genişlik indeksi, anterior ve posterior asetabulum dudağındaki kemik kalınlığı bilgisayarlı tomografi kesitlerinde ölçüldü.

Bulgular: Dört kalçada asetabuler yapı normaldi ve hiçbir kalçada posterior dudak yetmezliği yoktu. Anterior dudak yetmezliği 21 kalçada; hem anterior hem posterior dudak yetmezliği dört kalçada ölçüldü. Asetabuler anteversiyon en yaygın bulguydu.

Sonuç: Bu çalışmada, artmış asetabuler anteversiyon ve anteriyor dudak yetmezliği Crowe tip 2 kalça çıkıklı hastalarda sık olarak ölçüldü. Ortopedist bu hastalara asetabuler komponenti yerleştirirken yetmezliği ve anteversiyonu göz önünde bulundurmalıdır.

Anahtar sözcükler: Asetabuler displazi; anteversiyon; bilgisayarlı tomografi; eksiklik; gelişimsel kalça çıkığı; total kalça artroplastisi.

Acetabular morphology is important in developmental dysplasia of the hip (DDH) when total hip replacement is planned. Recently, classification systems have been presented in assisting preoperative evaluation and providing treatment protocols.[1,2] Hartofilakidis et al.,[1] classified acetabular deficiency by using tri-dimensional computed tomography (CT). Superior, anterior and posterior segmental deficiencies, inadequate depth and narrow opening in low dislocated hip are presented. Furthermore, segmental deficiencies of the entire acetabular rim, narrow opening, inadequate depth,

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excessive anteversion and abnormal distribution of bone stock was described mainly in superoposteriorly high dislocated hips. Deficiency was not clearly described and the need for pathoanatomical classification was underlined in that study.[1] In this study, the deficiencies were described and classified. The purpose of this study was to standardize CT images to determine acetabular deficiency that should be corrected during surgery.

PATIENTS AND METHODS

We retrospectively reviewed the records and CT images of 23 patients treated for DDH (Crowe type 2[2] characterized by 50 to 75 per cent subluxation of the femoral head and a deficient acetabular roof) between 1996 and 2004. Of these 23 patients, five patients were excluded from study. Computed tomography scans of three patients were of low quality and acetabular osteotomy had been performed in two patients previously. Twenty-nine hips of 18 patients (2 males, 16 females; mean age 46 years; range 37 to 56 years) were reviewed. Institutional Review Board approval was obtained.

The CT scans (Brilliance CT 40-channel, Philips Medical Systems, Cleveland, OH) were obtained in the prone position.[3] All CT scans were analyzed by the same investigator (AG). The deepest acetabular sections, in which the anterior and posterior edges of the acetabulum were clearly identified, were selected for measurement. The following acetabular angles were measured and recorded (Figure 1). The roof-edge angle was defined by a line drawn between the anterior and posterior edges. The acetabular index of depth to width[4] gave an indication of the depth of the acetabulum. The bone mass of the anterior and posterior acetabular rim was determined (Figure 2). Intraoperative findings of the bone graft, position of the acetabular component and surgical technical difficulties due to the acetabular rim morphology were recorded.

All acetabular components used at surgery were cementless and placed with at least 60% of bone coverage in the frontal plane at the true acetabulum. The initial reaming was performed with a small acetabular reamer that was directed to the posterior rim in patients with anterior rim deficiency and acetabular component was placed in 10 degrees anteversion. A posteriorly supported liner was used to prevent postoperative dislocation. In patients with both anterior and posterior rim deficiency, the acetabular component was medialized (cotyloplasty) to increase coverage. Bone grafts obtained from the femoral head was placed superolaterally in three hips.

RESULTS

The average follow-up time was 4.2 years (range, 2.8 to 8.2 years). We found all the acetabulums anteverted. The average roof edge angle was 22 degrees (range, 5-50 degrees). The average acetabular index

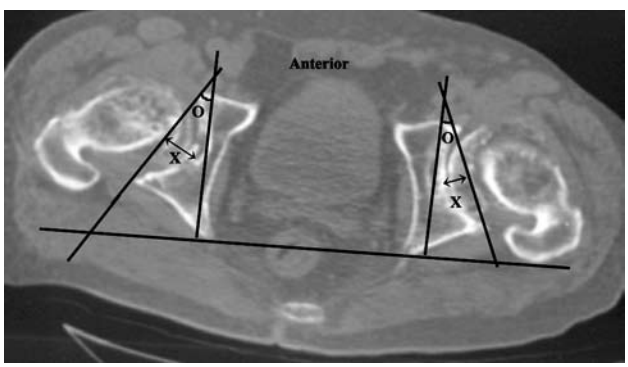

Figure 1. The computed tomography scan shows the roof edge angle, where (O) is defined by a line drawn between the anterior and the posterior edges of the acetabulum. Then a second line is drawn through the transverse plan of the posterior cortex of the acetabulum. The acetabular index of depth to width is presented as " X".

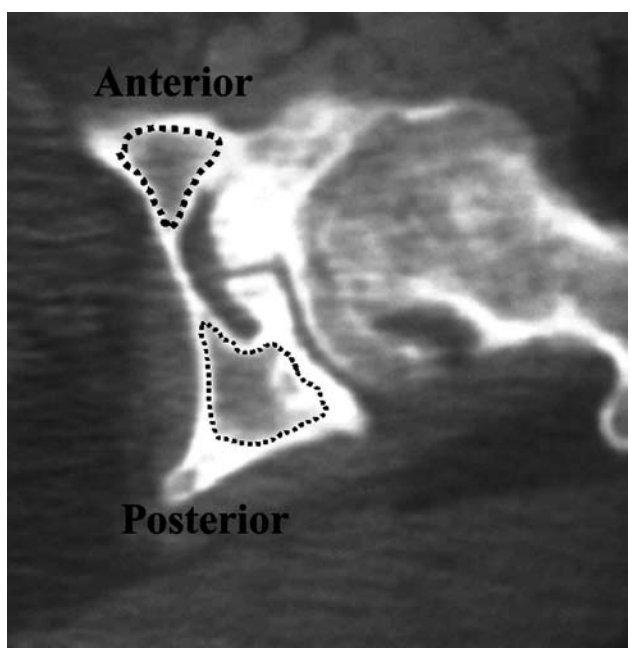

Figure 2. The computed tomography scan shows measurement of the anterior and the posterior rim using the mapping method.

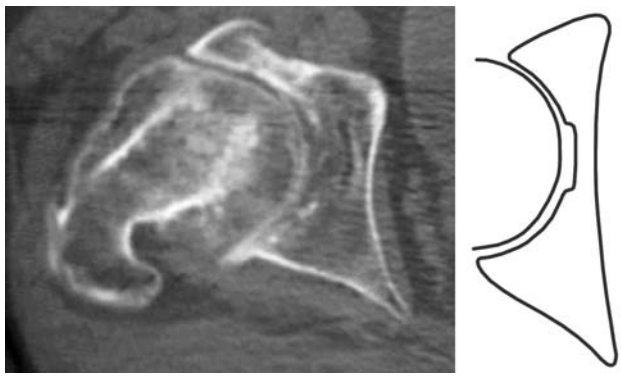

Figure 3. Radiographs and drawing presents anterior rim deficiency.

of depth to width was 14.7 mm (range 4.5-33.3) and the average bone mass of the anterior and posterior acetabular rim were 285 mm (range 52-747) and 517 (range, 370-727), respectively.

There was no rim deficiency in four hips (Figure 3). Anterior rim deficiency was determined in 21 hips (Figure 4). Both posterior and anterior deficiency were measured in four hips (Figure 5). Posterior bone deficiency was not observed.

No patients had a postoperative dislocation and needed revision dueto loosening of the acetabular component at final control.

DISCUSSION

A thorough understanding of the anatomy of the dysplastic hip is crucial in order to plan and perform a total hip arthroplasty. Mendes et al.,[5] evaluated the anatomy of the acetabulum and proximal femur and proposed a classification of adult DDH for the planning of total hip arthroplasty. Primary considerations in this study were the bone reserve and the inclination of the acetabulum. Xenakis et al.,[6] evaluated the available bone stock and the morphology, dimension and orientation of both the acetabulum and the femur. According to those authors, the acetabular component should be chosen on the basis of the deficiency of the acetabulum and the degree of anteversion when total hip replacement is performed. This study showed that acetabular deficiency was mainly at the anterior rim in the Crowe type 2 hip dislocation and the posterior acetabular mass should be used to place acetabular component properly.

It is commonly thought that dysplasia of the hip is associated with increased acetabular anteversion.[1,6-10] This current study supported this idea as various degrees of increased acetabular anteversion was found in all patients.

The CT provides valuable information regarding acetabular morphology. To date, several CT studies showed parallel descriptions of the acetabulum in patients with DDH; these were anterior and posterior segmental deficiency, inadequate depth and increased anteversion.[7,11-16] In addition, we focused on Crowe type 2 dislocated hips and the current study showed that anterior rim deficiency was the general finding in these hips. Anterior deficiency tolerated positional changes of the acetabular component. In cases with either anterior or posterior rim deficiency, the acetabular component can be placed in about 10 degrees of antevertion. This maneuver may, however, increase the risk of postoperative dislocation and this can be minimized using a specially designed liner. Authors[8,10,17,18]

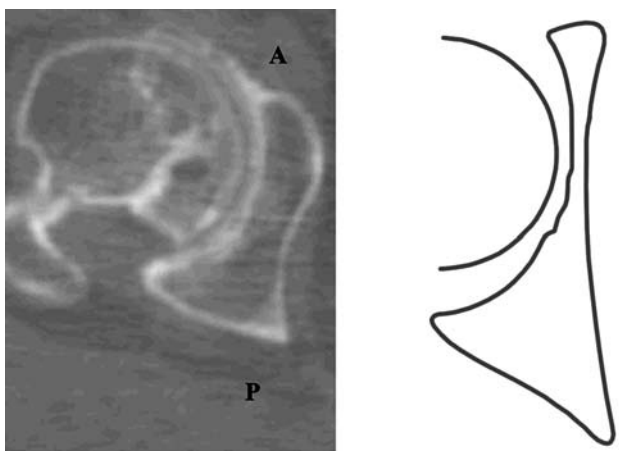

Figure 4. Radiographs and drawing present the posterior rim deficiency.

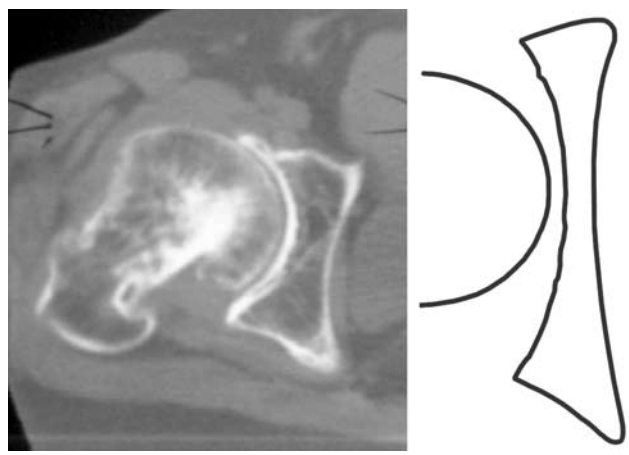

Figure 5. Radiographs and drawing presents both anterior and posterior rim deficiency.

usually recommend that the acetabular component should be placed at the level of the true acetabulum. Our experience was similar in this current study.

The main limitations of the present study were related to the relatively short follow-up period and small patient number. We need more patients in order to show clearly where the acetabular deficiency in Crowe type 2 hips is.

This study showed that acetabular anteversion was the most common finding in Crowe type 2 hips. By using CT preoperatively, the mass of acetabular rim can be determined and the acetabular component can be placed in the anteverted position to increase bone coverage without postoperative hip dislocation complication.

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