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Medial Protrusio Technique in Cementless Total Hip Arthroplasty for Developmental Dysplasia of the Hip: A Prospective 6- to 9-Year Follow-Up of 43 Consecutive Patients

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ABSTRACT

Background: The medial protrusio technique may be used during total hip arthroplasty (THA) on patients with developmental dysplasia. However, studies have yet to determine whether a cementless cup can be sufficiently stable to withstand loading forces. This study aimed to assess the clinical and radiographic outcomes of this technique. Furthermore, we sought to determine the relationship between the rate of medial protrusion and the incidence of cup loosening.

Methods: Thirty-nine patients (43 hips) underwent cementless THA between April 2006 and March 2009 by using the medial protrusio technique. These patients participated in a 6- to 9-year follow-up. Their clinical and radiographic data were gathered prospectively.

Results: The average Harris Hip Score improved from 43.1 ± 15.4 points preoperatively to 91.9 ± 12.8 points at the final follow-up ($P < .001$). The mean height of hip center and the distance of hip center medialization were 2.4 ± 0.6 and 2.5 ± 0.9 cm, respectively. The rate of medial protrusion and the rate of cup coverage were 42.1 ± 12.4% and 96.8 ± 5.1%, respectively. The rate of medial protrusion ranged from 18.3% to 58.3% in 38 hips (group A) and from 61.3% to 68.9% in 5 hips (group B). None of the cups in group A loosened or failed, 2 failures occurred in group B (0% vs 40.0%; $P = .011$).

Conclusions: Developmental dysplasia was treated through THA using the medial protrusio technique, which easily achieves a sufficient superolateral host bony coverage of the cup and promotes socket reconstruction at the true acetabulum. The rate of medial protrusion of <60% may be necessary to obtain excellent clinical and radiographic midterm results.

Acetabular bone deficiency is often encountered during total hip arthroplasty (THA) in patients with developmental dysplasia of the hip (DDH); this deficiency can pose major challenges in reconstruction. Achieving sufficient host bone coverage of the acetabular component with socket reconstruction at the normal anatomic location is one of the more challenging aspects of THA for DDH [1,2]. Techniques described to overcome this difficulty include cytoplasty and acetabular bulk bone grafting [1,2]. The cotyloplasty includes a controlled medial wall fracture [3-5], medial wall osteotomy [6-8], and medial wall penetration [9,10].

The use of bulk bone grafting for acetabular reconstruction in THA for DDH has yielded conflicting results, which have been influenced by many factors, including patient age, percent coverage of the acetabular component by the bulk autograft, and fixation strength of bone grafting [11-15]. Bulk bone grafting may also increase the complexity of operation and require highly experienced surgeons in THA [16]. Compared with bulk bone grafting, cotyloplasty provides several advantages, including consistent clinical efficacy, technical simplicity, and straightforward processes [3-10].

The use of cotyloplasty in cement THA can achieve excellent short-term clinical outcomes [5,17,18] but can yield poor midterm to long-term results with high loosening rates (32.6%-52.8%) [3,4].

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Recognizing the high loosening rate of cemented acetabular components when cotyloplasty is applied, investigators recommended a cementless acetabular component in THA for DDH [4,6-10]. However, adequate initial stability of cementless cup and appropriate host bone–prosthesis interface area are essential preconditions to ensure a successful osseointegration and to achieve satisfactory midterm to long-term results. Previous studies demonstrated that insufficient superolateral cup coverage occurs if the area of the cup surface beyond the ilioischial line is very small; as such, the initial stability of the cup is compromised [1,9,10]. In contrast, the host bone–prosthesis interface area may decrease if the area of the cup surface beyond the ilioischial line is very large; this condition may also endanger the initial stability and may even lead to a catastrophic cup migration into the pelvis; as a result, early revision occurs [1,9,10]. To avoid complications resulting from very small or very large areas of the cup surface beyond the ilioischial line, Dorr et al [10] suggested that the rate of medial protrusion of the cup is defined as the percentage of the cup beyond the ilioischial line [9,10] and thus should be less than 45%. Kim et al [9] recommended that a protrusio should be within 50%-60%. However, the optimal rate of medial protrusion has yet to be established [6-10].

We examined the results of medial wall penetration technique for acetabular reconstruction in THA for DDH after at least 6 years of follow-up. This study aimed (1) to explore the midterm clinical and radiographic outcomes and (2) to determine the relationship between the rate of medial protrusion and the incidence of cup loosening.

Patients and Methods

We prospectively followed 44 consecutive DDH patients (49 hips) who were treated with cementless THA applying medial wall penetration between April 2006 and March 2009. Patient data were collected prospectively for a minimum of 6 years. Two patients (2 hips) died of factors unrelated to surgery and 3 patients (4 hips) were lost to follow-up. The 39 remaining patients (43 hips; 33 women and 6 men) were available for review. Table 1 summarizes the patient demographics, including age, height, weight, body mass index, Trendelenburg sign, and DDH classifications based on the Crowe system [19]. All the patients agreed to participate in this study. This study was approved by the institutional review board.

Surgical Procedure

Surgical procedures were performed by the senior surgeon via a modified Hardinge approach. The true acetabulum was identified on the basis of the obturator, ischium, and pubis. Soft tissues and any bone in the acetabular cavity were removed to expose the cotyloid notch. The diameter of the acetabular cup was determined in accordance with preoperative computed tomography measurement results. Acetabular reaming was performed from a small reamer to a large reamer until the diameter of the reamer was similar to that of the preoperative computed tomography measurement. The superolateral reamer was covered by a host bone whether or not the medial wall was perforated. Reaming was performed within 40°-45° of abduction and 10°-20° of anteversion. Reaming was performed in a posterior and superior direction to prevent fractures of hypoplastic anterior walls. The medial wall defect in all the patients was filled with cancellous bone autografts harvested from the resected femoral head. A cementless cup was inserted with a press-fit technique. If the initial press-fit fixation could not be expected to gain sufficient cup stability, additional screw fixation was required.

Table 1
Patients and Operative Data.

Gender	
Male/female	6/33
Average age (y)	55.6 ± 15.2 (range, 19-76)
Mean weight (kg)	53.9 ± 7.2 (range, 41-67)
Mean height (cm)	158.2 ± 5.0 (range, 144-167)
Mean body mass index (kg/m^2)	21.5 ± 2.9 (range, 16.0-27.9)
Trendelenburg sign	
Positive	12
Mildly positive	4
Negative	27
Crowe type	
I	15
II	13
III	3
IV	12
Cup type	
BETA	26
T.O.P	7
Pinnacle	4
SPH	4
Reflection	2
Stem type	
Lcu	20
Rab	12
S-ROM	3
Self-locking	2
Synergy	2
C2	2
F2L	2
Friction couples	
Ceramic-on-ceramic	34
Ceramic-on-polyethylene	6
Metal-on-polyethylene	3
Diameter of cup (mm)	48.7 ± 2.4 (range, 44-58)
Screw fixation in cup	
Yes/no	10/33
Intraoperative subtrochanteric osteotomy or femoral fracture	
Yes/no	7/36

Table 1 shows the acetabular and femoral component types, friction couple, acetabular cup size, number of patients with additional screw fixation, and intraoperative parameters.

Perioperative Regimen

Antibiotic prophylaxis with a first-generation cephalosporin was administered within 30-60 minutes before incision and within the first 24 hours postoperatively. Low-molecular-weight heparin was routinely used for thromboembolic prophylaxis. The beginning of rehabilitation or strengthening of exercise programs depended on the stability of intraoperative cup and the rate of medial protrusion. If the rate of medial protrusion was less than 45% or if the intraoperative cups were satisfactorily stable, the patients were encouraged to mobilize the joint, to exercise their quadriceps, to strengthen their hamstrings, and to ambulate with a walker. Conversely, the patients were instructed to remain in bed for 8-12 weeks and then gradually exposed to a full weight bearing. Patients confined to bed rest were allowed to ambulate to the bathroom with assistance and perform isometric non–weight-bearing lower-extremity exercises.

Clinical and Radiographic Assessment

The patients were requested to complete the clinical and radiologic examinations at 6 weeks, 6 months, 1 year, and annually thereafter. The end point of follow-up was defined as the time when the cup loosened or the patient died. For patients who lived too far from our hospital or who do not want to return to our hospital for