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Transverse Subtrochanteric Shortening Osteotomy During Cementless Total Hip Arthroplasty in Crowe Type-III or IV Developmental Dysplasia

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ABSTRACT

The purpose of this study was to review the outcomes of transverse subtrochanteric shortening osteotomy during cementless total hip arthroplasty in Crowe Type-III or IV developmental dysplasia. Seventy-three osteotomies were included in our study. Mean follow-up was 61 months. Harris hip score, leg length discrepancy, neurological status, union status of the osteotomy, and femoral component stability were the criteria for evaluation. All complications were noted. The mean Harris hip score improved from 38.6 points to 83.7 points. The mean leg length discrepancy decreased from 56.5 mm to 10.7 at the latest follow-up. The mean union time was 5.2 months. We observed 4 non-unions. Transverse subtrochanteric shortening osteotomy is an effective and reliable method in restoration of a more normal limb.

Total hip arthroplasty (THA) in patients with Crowe Type-III or IV developmental dysplasia of the hip (DDH) is technically much more demanding procedure than reconstruction surgery in primary coxarthrosis due to hypoplastic acetabulum, femoral deformities, adaptive soft tissue contractures and biomechanical alterations [1]. Restoration of the anatomical hip rotation center has been reported as critically important to obtain durable clinical results of THA in such patients [2–5]. However, placement of the acetabular component in the true acetabulum generally leads to a hip that is difficult to reduce because of severe soft tissue contractures, and a limb which is relatively lengthened [6]. Femoral shortening osteotomy is required in most cases to facilitate reduction, equalize limb lengths, and avoid overstretching of neurovascular structures [5,7–9]. Furthermore, it will also allow correction of the femoral malrotation. Various techniques using different anatomic levels and cutting shapes have been described. Anatomic levels are greater trochanter, subtrochanteric region of the proximal femoral metaphysis, and distal femur [10–12]. Subtrochanteric osteotomies can be performed as transverse, oblique, Z-shaped, or double Chevron [7,8,13–16]. Fixation of the osteotomy can be obtained by using cables or a plate system. Regardless of the technique preferred the major concern is nonunion [1].

The purpose of the present study was to review the clinical and radiographic outcomes of transverse subtrochanteric shortening osteotomy applied during reconstruction surgery using cementless THA in a group of hips with Crowe Type-III or IV developmental dysplasia.

Materials and Methods

Between January 2004 and January 2010, 73 transverse subtrochanteric shortening osteotomies performed during primary cementless total hip arthroplasty in 68 patients who had Type-III or IV developmental dysplasia according to Crowe et al. classification were included in our study. Ten hips (13.7%) were Crowe Type-III whereas the other 63 hips (86.3%) were Crowe Type-IV. The patients included 60 women and 8 men with a mean age of 47 years (range 31–69 years). Sixty-three patients (92.6%) had unilateral dysplasia, whereas 5 patients (7.4%) had bilateral dysplasia operated on bilaterally in a sequential manner. Table 1 summarizes the demographics and preoperative clinical features of our study group. The mean postoperative follow-up time was 61 months (range 36–92 months). A metal-on-polyethylene cementless arthroplasty composite was implanted in all patients. Acetabular and femoral component designs were identical in all hips. A combination of Trident® metal press-fit acetabular shell with screw holes, and Crossfire® 10° polyethylene liner was applied as acetabular reconstruction (Stryker Howmedica Osteonics Corp., Mahwah, NJ). Femoral reconstruction was achieved by implanting Omnifit® femoral stem (Stryker Howmedica Osteonics Corp., Mahwah, NJ). The method of limb length restoration included

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Table 1
Demographics and Preoperative Clinical Features of our Study Group.

	Crowe Type-III	Crowe Type-IV
Number of hips	10	63
Mean age (years)	51	46.5
Gender		
Female	9	51
Male	-	8
Operated side		
Left	1	29
Right	7	26
Bilateral	1	4
Mean pre-op Harris hip score	42	38
Mean pre-op limb length discrepancy of unilateral cases (mm)	38	59.2
Mean amount of shortening (mm)	33.8	46.6

careful pre-operative planning with proper templating on the plane radiographs and intra-operative evaluation. During templating with the cup at the true anatomic hip rotation center and the femoral stem template in its planned position, if reduction of the hip would require more than 35 mm lengthening we planned to perform a subtrochanteric shortening osteotomy. During the surgery, following the fist cut of the osteotomy, the trial femoral stem was inserted into the femoral canal with the trial head inserted into the acetabular component, and then the length of overlapping subtrochanteric bone that would be removed to neutralize the leg length discrepancy was decided. We first implanted the femoral component size that supplied maximum rotational stability in the diaphysis, and then plate and cable fixation added. Stabilization of the osteotomy line was achieved by plate-cable system in all hips. Clinical data of our patients were evaluated retrospectively after having approval from the local ethical research committee. None of our patients was lost to follow-up.

Surgical Technique

All patients were operated in lateral decubitus position. Following posterolateral surgical approach the joint capsule was incised. Resection of the femoral head and capsular remnants were performed. True acetabulum was reached and exposed. Percutaneous release of the adductor tendons and routine iliopsoas tenotomy were applied in all hips. The acetabular cavity was prepared and the suitable component decided according to trial size was implanted as the standard procedure of cementless THA. The femoral canal was prepared by reamers and rasps. The femur was marked on both proximal and distal side of the predicted osteotomy line. The first cut distal to the lesser trochanter was approximately 10 cm below the tip of the greater trochanter. The trial femoral stem was inserted into the femoral canal with the trial head inserted into the acetabular component as well. The length of overlapping subtrochanteric bone that would be removed to neutralize the leg length discrepancy was decided. The second osteotomy was performed also transversely. Rotational alignment of the osteotomy line was established according to the marks on the proximal and distal side of the osteotomy line. Following the rotational alignment the femoral component was implanted and the osteotomy was stabilized by internal fixation with a plate and cable system in all hips (Figs. 1 and 2). We did not use any strut allografts in osteotomy line.

Mobilization with crutches but without weight-bearing was routinely achieved at the first postoperative day. Passive and active rehabilitation exercises were also administered immediately after the operation. Antibiotic prophylaxis, starting from half an hour before surgery, was continued for two days post-operatively. First generation cephalosporin was the preferred agent. Administration of low molecular weight heparin and the use of elastic stockings were routine protocol as thromboembolic prophylaxis in all patients. Low molecular weight heparin was continued for 28 days totally. Weight bearing was not allowed during the first 8 weeks postoperatively. Then, progressive weight bearing according to clinical and radiographic follow-up was allowed.

Data Collection

Post-operative follow-up visits including a detailed physical examination and radiographic evaluation were undertaken at four weeks, eight weeks, three months, one year post-operatively, and then annually thereafter. Harris hip score was calculated, patients were observed for any limp, leg length discrepancy was measured from the anterior superior iliac spine to the medial malleolus as the patient lying supine, and the neurologic examination was performed preoperatively and at the latest follow-up post-operatively. All evaluations regarding limp status of the patients were achieved by the same author in pre and post-operative periods. The categorization of limp status was achieved according to the 'Limp' section of the Harris Hip Scoring system. Radiographic data included union status of the osteotomy site, and presence of any osteolysis or heterotopic ossification. Radiographic criteria to evaluate the union status were the presence of callus, cortical continuity of the proximal and distal fragments, and no progressive gapping at the osteotomy site on serial radiographs. Femoral component stability was defined according to Engh et al. as fixation by bony ingrowth, stable fibrous ingrowth and unstable implant [17,18]. All complications were noted.

Statistical Analysis

The Wilcoxon signed rank-sum test was used to compare preoperative and postoperative data. P values of <0.05 were considered as significant. Kaplan-Meier survival analysis was used to construct the cumulative survival rate of the osteotomies and the femoral implants

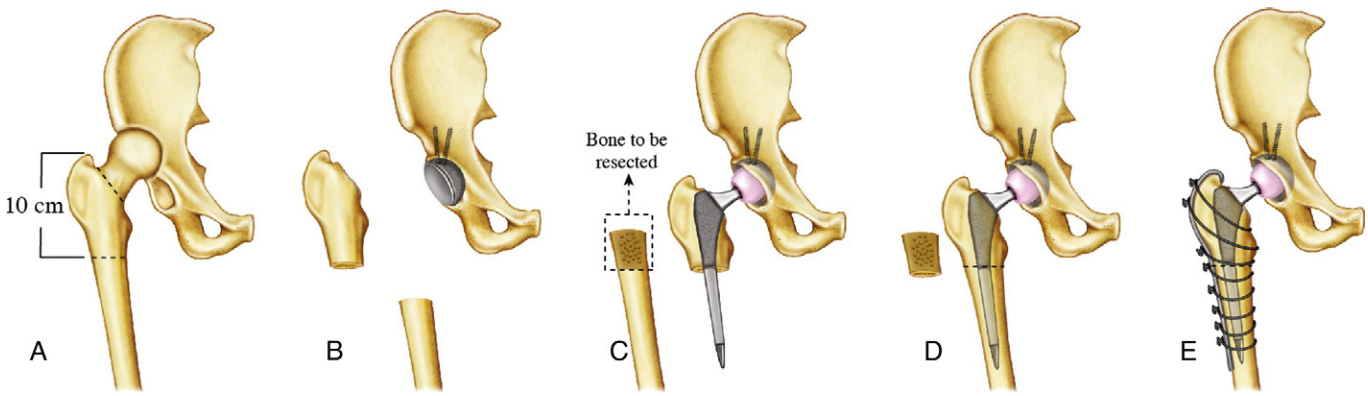

Fig. 1. Surgical technique used for subtrochanteric femoral shortening osteotomy during cementless total hip arthroplasty.