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Original Article

Long-Term Results of Cementless Total Hip Arthroplasty With Subtrochanteric Shortening Osteotomy in Crowe Type IV Developmental Dysplasia

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ABSTRACT

Background: When surgeons reconstruct hips with a high dislocation related to severe developmental dysplasia of the hip (DDH) in total hip arthroplasty (THA), archiving long-term stable implant fixation and improving patient function and satisfaction remain challenging. The purpose of this study was to evaluate the 10-year outcomes of transverse subtrochanteric shortening osteotomy in cementless, modular THA in Crowe type IV-Hartofilakidis type III DDH.

Methods: We reviewed 62 patients (76 hips) who underwent cementless THA with transverse subtrochanteric shortening osteotomy from 2002-2010. There were 49 women and 13 men with a mean age of 38.8 years, all of whom had Crowe type IV DDH. Mean follow-up period was 10 years. The acetabular cup was implanted in placement of the anatomical hip center in all hips.

Results: The mean Harris Hip Score significantly improved from 38.8 points to 86.1 points. Similarly, modified Merle d'Aubigne and Postel Hip Score, Hip dysfunction and Osteoarthritis Outcome Score, and SF-12 also significantly improved. The mean limb length discrepancy was reduced from 4.3 cm to 1.0 cm. At mean follow-up of 10 years, there were 3 cases of postoperative dislocation, 2 cases of transient nerve palsy, 1 case of nonunion, and 4 cases of intraoperative fracture. Revision surgery was performed in 2 patients due to isolated loosening of acetabular component and femoral stem, respectively.

Conclusion: Our data demonstrated that the cementless, modular THA combined with transverse subtrochanteric shortening osteotomy was an effective and reliable technique with high rates of successful fixation of the implants and satisfactory clinical outcomes.

Total hip arthroplasty (THA) for the treatment of Crowe type IV-Hartofilakidis type III developmental dysplasia of the hip (DDH) is a technically demanding procedure due to triangular-shaped and hypoplastic acetabulum filled with fibrous tissue and fat [1,2]; femoral deformities with straight and narrow medullary canal [3,4]; soft tissue abnormalities including hypertrophic capsule and shortened abductor muscle [5,6]; and biomechanical alterations [7]. In Crowe type IV dysplasia, the true acetabulum is the best region to place a cup with sufficient bone stock and good biomechanics. Compared with nonanatomic hip center, the placement of acetabular components in an anatomic position promotes long-term durability with lower loosening and aseptic revision rates [8]. In addition, the reduction of the femoral head into the true acetabulum has been reported to yield the durable results in patients with Crowe type IV DDH [9-11].

However, restoration of the anatomical hip rotation center can generally lead to a hip that is difficult to reduce due to soft tissue contracture, and a limb that is excessively lengthened due to excessive soft tissue tension, abductor impairment, and nerve palsy [6,12]. Therefore, femoral shortening is a useful or sometimes necessary technique to facilitate reduction without stretching the sciatic nerve, equalize limb lengths, and overcome the contractures [10,13,14]. Various subtrochanteric osteotomy techniques with different cutting shape, such as transverse, oblique chevron, or

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Z-shaped, have been previous described with good clinical results [11,15-18]. The risk of fracture and nonunion remains the major concern in the procedure. Compared with a monoblock stem, a modular stem could be desirable to fit and fill in the straight and small femoral canal of a severely dysplasia hip and to stabilize the metaphyseal and diaphyseal fragments with good torsional stability at the osteotomy site [9]. And, a modular stem is also beneficial as these patients may have excessive anteversion and thus the ability to place the proximal segment separate from the diaphyseal piece [14,19]. We utilized a modular stem with simultaneous transverse subtrochanteric shortening osteotomy for Crowe IV DDH in our center.

Several recent series have documented short-term or mid-term results of a modest number of cementless THAs with use of a modular stem for Crowe IV DDH [9-11,17,20-22]. However, some prior reports have included cemented and cementless acetabular and femoral components [4,9-11], while others have included hips that were treated with no femoral osteotomy [21,22] and that were treated with mixed groups of different anatomic levels and cutting shapes [17,20]. In addition, reliable long-term clinical and radiographic outcomes have not been previously described with large sample size.

The purpose of this study was to evaluate 10-year functional and radiographic results of cementless and modular THAs combined with transverse subtrochanteric shortening osteotomy in a group of consecutive hips with Crowe type IV-Hartofilakidis type III DDH.

Patients and Methods

The retrospective study protocol was approved by the Institutional Review Board, and informed consent was obtained from all patients. From September 2002 to December 2010, a total of 65 consecutive patients (81 hips) with Crowe IV-Hartofilakidis type III developmental dysplasia were treated with cementless THA at our institution. One patient (2 hips) was lost to follow-up after surgery and could not been contacted via E-mail and telephone. Two patients (3 hips) were dead due to causes unrelated to the THA at 3 years after surgery. The left 76 hips in 62 patients (48 with unilateral and 14 with bilateral THA) who were treated with THA combined with simultaneous shortening subtrochanteric osteotomy were eligible in this study. Preoperative clinical evaluations, surgical data, and postoperative clinical and radiographic examinations were available. These data in total joint registry were collected for all patients.

Clinical Data

The indications for THA were severe pain unresponsive to nonsurgical management, resulting in stiffness, limping, and low quality of life. The eligible patients included 13 men and 49 women with a mean age of 46.5 years (range 19-73) at the time of surgery. The average weight was 61.9 kg (range 34-92). The average height was 155.6 cm (range 143-178), and the average body mass index was 25.4 kg/m^2 (range 21-29.8). In our cases, the mean operative time was 122 min (range 89-149), and the average blood loss was 1.05 L (range 0.7-1.6).

At clinical evaluation, clinical follow-up was conducted at 3 weeks, 6 weeks, 12 weeks, and 6 months after surgery and annually thereafter until the last follow-up. Clinical evaluation protocol was utilized for all patients with the use of Harris Hip Score, the Merle d'Aubigne and Postel Hip Score (including pain, range of motion, and gait function), Hip dysfunction and Osteoarthritis Outcome Score (covering pain, symptoms, daily living, sports, and quality of life), and SF-12 scale. The preoperative or postoperative limb length discrepancy (LLD) and the severity of limp were also recorded. The distance between the anterior superior iliac spine and the medial malleolus represented the LLD, suggesting the length discrepancy of lower extremities. In addition, abduction strength was evaluated by the Trendelenburg test. All complications were reviewed.

Surgical Technique

For preoperative templating, an acetabular template was placed at the true anatomic hip center and a femoral template was placed for the femoral component. When the templating indicated that the maximum amount of lengthening was >3-4 cm, the length of subtrochanteric shortening bone was planned to equalize the leg lengths and lengthen the limb by <3-4 cm. In addition, 3-dimensional computed tomography (CT) scans were utilized on a routine basis to evaluate the acetabular bone defects.

All procedures were performed via a posterolateral approach with the patient in the lateral decubitus position. After total capsulotomy, we resected femoral head and removed the osteophytes and fibrous scar tissue to recognize the true acetabulum before reaming. The acetabulum was gradually reamed with hemispherical reamers to reach the medial wall of the true acetabulum, with bleeding cancellous bone. The porous-coated acetabular component (DePuy, Pinnacle, Warsaw, IN) was inserted in the anatomic acetabular position with the use of press-fit technique and fixed with dome screws in all hips. If the acetabular bone was deficient, bulk bone autografts with the resected femoral head were utilized to provide adequate coverage of acetabular cup. The median diameter of the acetabular cup was 42 mm (range 40-46). The median femoral head size was 28 mm in 34 hips, 32 mm in 30 hips, and 36 mm in 12 hips. Ceramic-on-ceramic wear bearing material was used in 60 hips, and metal-on-poly in 16 hips.

After insertion of acetabular cup, attention was then redirected to the femoral preparation. The sequentially proximal femur was reamed with straight reamers to archive appropriate stem size. A transverse subtrochanteric osteotomy was carried out, usually at 1-2 cm beneath the lesser trochanter, to shorten the femur by the planned amount and decrease the risk of excessively stretching sciatic nerve. A mean amount of femoral bone resected was 2.68 cm (range 2.0-4.6). If hip reduction with a femoral trial stem was impossible, additional bone was gradually resected at the osteotomy site to archive satisfactory hip reduction and avoid excessive tension on the sciatic nerve. The 2 osteotomy fragments were held with autogenous cortical bone plate affixed with 2 cables or wires to prevent intraoperative splitting of the femur and enhance biologic healing. In addition, autogenous cancellous bone cut from the resected femoral bone fragment was used to fill any gap at the osteotomy site. After osteotomy had been completed, the distal part of the femur was prepared for implantation of a cementless modular femoral stem (S-ROM, DePuy). When the rotational alignment of the 2 fragments was adjusted to allow approximately 15°-20° of anteversion of trial stem, the femoral components were inserted into the femur in all cases.

All patients were encouraged to conduct early mobilization and limb exercise on a bed immediately after surgery. The mean hospital stay was 7.5 days (range 6-14). The patients walked with partial weight bearing for approximately 2 weeks, and then gradually progressive full weight bearing was allowed at 4-6 weeks after surgery depending on the stability of femoral stem and positively osseous healing at osteotomy site.

Radiographic Analysis

Anteroposterior and lateral radiographs of the hip, full-length view of the lower extremities, and 3-dimensional computed tomography of the hip were taken and reviewed at each follow-up