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Total Hip Arthroplasty With a Non-Modular Conical Stem and Transverse Subtrochanteric Osteotomy in Treatment of High Dislocated Hips

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ABSTRACT

Conventional stems may be unsuitable for hypoplastic femurs associated with severe dysplasia, meanwhile, custom-made or modular stems in total hip arthroplasty are often complex and expensive. This series included 21 Crowe type IV dysplastic hips in which a non-modular cementless conical stem was implanted with transverse subtrochanteric femoral osteotomy. Follow up averaged 40 months. Twenty hips survived with mean Harris hip score improved from 52 to 90. One hip failed for stem loosening. The average leg lengthening was 3.8 cm with transient sciatic nerve palsy occurring in three hips. Femoral offset averaged 3.3 cm postoperatively. The non-modular conical stem not only obviated the complexities, high medical cost and potential risk at the neck-stem interface associated with stem modularity, but also simplified surgical technique.

Total hip arthroplasty (THA) in high dislocated hips presents specific difficulties including restoration of the normal hip center, correction of excessive femoral anteversion and fitting the prosthesis in a narrow and straight medullary canal [1,2]. The use of a conventional stem may be impossible in hypoplastic femurs because the proximal femoral anatomy often progressively worsens in line with the grade of dysplasia [1]. For easier control of neck anteversion, custom-made components, tapered prostheses as well as dual modular stems have been recommended in some studies [3,4]. Either custom-made or modular stems are technically challenging and expensive [3–5]. Although additional junctions of modular stems offer many advantages, they have potential risks for neck-body complications and increasing amounts of metal debris from neck-stem or sleeve-stem interface [5]. From our perspective, cementless tapered prostheses are preferred over cemented stems because of the relatively young age of patients and concurrent subtrochanteric osteotomy. However, few studies have reported on non-modular conical stems for high dislocated hip treatment even though the results of this prostheses in moderate hip dysplasia have been encouraging [6,7]. The Wagner Cone Prosthesis Hip Stem (Zimmer) is a non-modular conical stem with eight longitudinal sharp ribs. For better rotational stability and easier correction of neck antevertion, the cementless Wagner stem has been established as an appropriate and inexpensive solution for Crowe type I and II dysplastic hips [6–9]. However, few cases of Crowe type IV or Crowe type III dysplastic hips were reported in these studies. The increased soft tissue contracture and bone deformity in severely dislocated hips presents additional technical challenges including femoral osteotomy, stem fixation and soft tissue balancing. The clinical results of Wagner stem in high dysplastic hips (Crowe type IV) remain unclear since the rates of failure and complications increased with the grades of dysplasia [10,11]. The aim of this study is to define the short-term radiographic and clinical outcomes, and complications of Crowe type IV dysplastic hips treated with the non-modular cementless conical stem.

Patients and Methods

A consecutive series of 21 hips in 20 patients who were diagnosed as hip dysplasia of Crowe type IV [12] was retrospectively identified out of a total THA cohort of 1226(1271 hips) patients at our institution. Eighteen female (19 hips) and two male patients were identified and investigated based on the ethical standards of the committee on human experimentation of our institution. The patients' age ranged from 21 to 77 years (mean 36 years) at the time of surgery between March 2009 and March 2012. The average body-mass index was 21.8 (range, 18.2–26.6). The operative time ranged from 2 to 3.5 hours (mean 2.5 hours). Four hips (19%) had a total of five surgical procedures prior to the index THA including open reduction (four hips) and varus-producing proximal femoral osteotomy (one hip).

Surgical Technique

A distally extended posterolateral approach was performed by one senior surgeon (X. Chen) to expose the hip joint and proximal femur in all cases. After capsulotomy, the true acetabulum was identified by removing the soft tissue within it. A Trilogy Acetabular System

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(Zimmer, Warsaw, IN, USA) was placed at the level of original acetabulum or a slightly elevated position without lateralization. Moderate medialization of the cementless cup without perforating the inner cortex was performed in some cases. If the original acetabulum bone stock was deficient, bulk autografts from the resected femoral head were fixed with screws to provide acetabular component coverage. The acetabular component was fixed with screws in all cases. After the implantation of the acetabular component, the femur was prepared as previously described [13]. The medullary cavity was gradually widened with a tapered reamer. The extension was complete when the reamer received powerful frictional resistance. A subtrochanteric shortening osteotomy [14] was performed beneath the lesser trochanter to avoid excessive stretching of the sciatic nerve. After hip reduction with a femoral trial stem only seated in the proximal fragment, the length of bone resection was decided according to the overlapping of the femoral segments. After the shortening osteotomy, two femoral fragments were held face to face by two bone holding forceps and reamed again. For the proper restoration of femoral offset, the scheduled conical stem was implanted distally and connected to a longer femoral head if necessary. Prophylactic cable fixation was used before the insertion of the uncemented Wagner Cone Prosthesis Hip Stem (Zimmer, Warsaw, IN, USA) to prevent iatrogenic splitting of the femur. Rotation of the trial stem was initially estimated in 15°–20° of anteversion relative to the lower leg bent at a right-angle. The anteversion of implanted cone stems could be slightly increased or decreased based on the hip stability after reduction. The wear bearing materials of this cohort consisted of ceramic-on-ceramic in 19 hips and metal-on-poly in 2 hips. The osteotomy site was grafted with cancellous bone from the femoral head. Patients were hospitalized in an average of 7.7 days (range, 6–11 days). Partial weight bearing was encouraged at 3–6 weeks postoperatively. Twelve weeks later, full weight bearing was usually allowed if osseous healing was positive at the osteotomy sites.

Clinical and Radiographic Evaluation

Clinical results were evaluated with Harris Hip Score (HHS) and leg length discrepancy (LLD) preoperatively, at 6 months and 1 year postoperatively, and then yearly until the last follow-up. LLD indicated the length discrepancy of lower extremities which was measured with a tape by measuring the distance between the anterior superior iliac spine and the medial malleolus [15]. Clinical failure was defined as the need for revision surgery. Anteroposterior and false profile lateral radiographs were made at each follow-up visit. Radiographic evaluation was performed by one surgeon (J. Zhu) including femoral off-set, leg lengthening, loosening signs and bone union of femoral osteotomy. The femoral off-set was defined by measuring the distance on radiographs between the femoral axis and the femoral head center. The amount of radiographic leg lengthening was measured by subtracting the amount of intraoperative femoral resection from the distance between the top of the greater trochanter preoperatively and postoperatively on radiographs [16]. The stability of the femoral components was assessed radiographically as previously described [17]. Stable fixation by bone ingrowth was defined as no subsidence or radiolucent lines around the prosthesis. Provided consolidation presented across the osteotomy sites, osseous healing was determined.

Statistical Analysis

Preoperative and postoperative HHS scores, LLD and radiographic evidences were compared using t test. Significance was determined at a P value of <0.05.

Results

The average follow-up of total 21 hips lasted 40 months (range, 24–60 months). The average HHS score, LLD and radiographic evaluation of these patients postoperatively improved (Fig. 1 and Table 1). Femoral shortening subtrochanteric osteotomy was performed with an average femoral resection of 1.5 cm (range 1.0–2.5 cm). Limp that characterized by excessive lateral trunk movement over the affected hip, was postoperatively corrected or improved in 20 hips, based on a function of the lateral head motion [18]. Twenty hips survived at the last follow-up without observed subsidence. One hip was dislocated in a 77 years old lady and manipulated with closed reduction at first postoperative month (Fig. 2). The same hip was revised at 6 months follow-up due to early stem loosening between the stem and distal femoral fragment.

No infection was found following the surgery in this cohort. Postoperative sciatic nerve palsy occurred in three hips with leg lengthening of 4.5 cm, 5.5 cm and 6.8 cm. Two cases of nerve palsy (3/5) disappeared in 3 months. The other case which had the maximal leg lengthening of 6.8 cm in this series improved from 2/5 to 4/5 after one year. All acetabular implants survived at last follow up without any complication. Nonunion of the femoral osteotomy site was recorded in the previous hip which was revised at 6 months follow up due to early stem loosening. The average time to bone union for the other 20 hips was 5 months (range 3–9 months). One case of delayed union at the femoral osteotomy site was found and healed at 9-month follow-up.

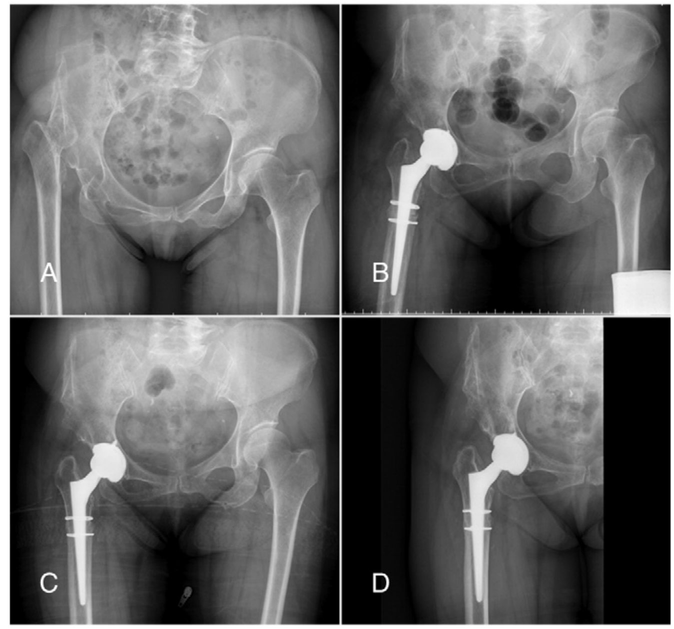

Fig. 1. Radiographs are shown of a 59-year-old woman with Crowe type IV dysplastic right hip. (A) The preoperative femoral off-set was 2.3 cm. The preoperative leg length discrepancy (LLD) was 5.2 cm and the preoperative Harris hip score was 58. (B) At 3-month follow up, bone union was detected on the lateral half of the osteotomy site. The postoperative femoral off-set was 3.4 cm and leg lengthening was 3.7 cm. The postoperative LLD was 14 mm. (C) At 1-year follow up, the osteotomy site was completely healed. The postoperative Harris hip score was 97. (D) No subsidence or radiolucent lines around the prosthesis was found at 4-year follow up. The amount of radiographic leg lengthening was measured by subtracting the amount of intraoperative femoral resection from the distance between the top of the greater trochanter preoperatively and postoperatively on radiographs [16]. LLD indicated the length discrepancy of lower extremities which was measured with a tape by measuring the distance between the anterior superior iliac spine and the medial malleolus [15].

Table 1
Preoperative and Postoperative Radiographic and Clinical Results.

	n	Preoperative Value	Postoperative Value	P Value
Harris hip score	21	52.4 ± 6.8(35–63)	90.5 ± 15.1 (26–97)	<0.001
Leg discrepancy (cm)	20	4.7 ± 1.1 (2–7)	1.2 ± 0.4 (0–2)	<0.001
Femoral off-set (cm)	21	1.9 ± 0.5 (1–2.6)	3.3 ± 0.4 (2.8–4)	<0.001
Leg lengthening (cm)	21		3.8 ± 0.9 (3–6.8)	

Values are expressed as mean ± standard deviation with range in parentheses.