Orthopaedics & Traumatology: Surgery & Research 105 (2019) 35–39

Contents lists available at ScienceDirect

Orthopaedics & Traumatology: Surgery & Research

journal homepage: www.elsevier.com

Original article

Cementless distal fixation modular stem without reconstruction of femoral calcar for unstable intertrochanteric fracture in patients aged 75 years or more

Guo-Chun Zha[a,*], Jia Liu[b], Yong Wang[c], Shuo Feng[a], Xiang-Yang Chen[a], Kai-Jin Guo[a], Jun-Ying Sun[d]

[a] Department of Orthopedic Surgery, The Affiliated Hospital of Xuzhou Medical University, No. 99, Huaihai West Road, Xuzhou, 221002 Jiangsu, PR China
[b] Department of Operating Room, The Affiliated Hospital of Xuzhou Medical University, No. 99, Huaihai West Road, Xuzhou, 221002 Jiangsu, PR China
[c] Department of Orthopedic Surgery, Yixing People's Hospital, 75, Tong zhen Road, Yi Xing, 214200 Jiangsu, PR China
[d] Orthopaedic Department, The First Affiliated Hospital of Soochow University, 188, Shizi Street, Suzhou, 215006 Jiangsu, PR China

ARTICLE INFO

Article history:
Received 23 September 2017
Accepted 14 November 2018

Keywords:
Cementless modular stem
Intertrochanteric fracture
Old age

ABSTRACT

Introduction: Hemiarthroplasty (HA) using standard-length femoral stem with reconstruction of femoral calcar or using calcar replacing prosthesis for unstable intertrochanteric fractures in elderly patients is a viable option. However, both of the techniques increase the complexity of procedure, operative trauma and complication. This study evaluated the clinico-radiological results of the MP-Link cementless distal fixation modular prosthesis without reconstruction of femoral calcar for unstable intertrochanteric fracture in patients aged 75 years or more.
Hypothesis: Bipolar HA using the MP-Link cementless distal fixation modular prosthesis for unstable intertrochanteric fractures in patients aged 75 years or more, do not need to reconstruct the femoral calcar.
Materials and methods: Forty-two patients (42 hips) underwent bipolar HA using the MP-Link cementless distal fixation modular prosthesis for unstable intertrochanteric fractures from January 2008 to January 2012. Five (11.9%) patients were lost to follow-up. The 37 remaining patients (37 hips) were available for evaluation. The mean age was 83.9 ± 5.2 years. Their clinico-radiological data were prospectively gathered.
Results: All of 37 patients, 4 patients (10.8%) died within 1 year postoperatively. At the final follow-up, 31 (83.8%) out of 37 patients were regained preoperative ambulatory status; the mean Harris hip score (HHS) of the 15 patients who died during the follow-up period of 7–59 months, was 84.5 ± 2.4 points; the 22 healthy patients were followed for 68.6 ± 14.7 months, with mean HHS of 84.6 ± 2.8 points. Radiologically, none of stems had evidence of loosening; 16 stems had subsidence of 2–3 mm without clinical significance; the bone in-growth fixation was achieved in 24 patients and stable fibrous fixation in 13 patients.
Discussion: Bipolar HA using the MP-Link cementless distal fixation modular prosthesis for unstable intertrochanteric fractures in patients aged 75 years or more, without reconstruction of the femoral calcar, may achieve a satisfactory clinico-radiological outcome, and could regain preoperative ambulatory status in most patients (83.3%).
Level of Evidence: IV, Retrospective study.

1. Introduction

For unstable intertrochanteric fracture in the elderly, the majority of patients could achieve satisfactory clinical outcomes with internal fixation, however, there have been poor outcomes in patients with osteoporosis and femoral calcar fractures, which could result in excessive weight loading of implant and resultant

* Corresponding author.
E-mail address: 41049015@qq.com (G.-C. Zha).

https://doi.org/10.1016/j.otsr.2018.11.015
1877-0568/

complications, such as cut-out of femoral head, "cut-through" phenomenon, the "Z" and "reverse Z" effects, and femoral head collapse [1–3]. Additionally, due to fear of loss of fixation and the risk of implant failure, these patients need to restrict early weight bearing and prolonged bed rest, which would lead to subsequent morbidity and mortality [2,4–6].

Therefore, hemiarthroplasty (HA) is an alternative solution for unstable intertrochanteric fracture in these patients, as it avoids complications in the fracture site, and allow for immediate postoperative weight bearing. When using HA, some authors suggest reconstruction of femoral calcar simultaneously, which may maintain the initial prosthesis stability and avoid subsidence of the femoral stem [7,8]. Other authors advocate using calcar, replacing prosthesis instead of reconstruction of femoral calcar [9–13]. However, both may increase the complexity of procedure, operative trauma and complications [4,10,13].

We are not aware of any study evaluating the results of treatment with HA without reconstruction of femoral calcar or treatment without calcar-replacement HA. We report the mid-term results of the MP-Link cementless distal fixation modular prosthesis without reconstruction of femoral calcar for unstable intertrochanteric fracture in patients aged 75 years or more. Our primary hypothesis was that bipolar HA using the MP-Link cementless distal fixation modular prosthesis for unstable intertrochanteric fractures in patients aged 75 years or more, do not need to reconstruct the femoral calcar.

2. Patients and Methods

Institutional review board approval was obtained for this prospective cohort study. The criteria for inclusion: patients who have sustained an unstable intertrochanteric fracture (A2.2–A2.3 according to the AO/OTA classification) treated with HA and who are at the age of 75 years or older at the time of injury, were able to ambulate independently with or without crutches, were assigned ASA class I–III status, have follow-up information (completed information for a minimum of 60 months or death). The criteria for exclusion: patients who have contraindication of anesthesia, associated fractures, head injury or polytrauma, bilateral intertrochanteric fractures and pathological fractures.

Between January 2008 and January 2012, a total of 346 patients were admitted to our hospital with an unstable intertrochanteric fracture over the four-year study period. Of which, 149 (43.1%) were at the age of 75 years or older, 42 patients (42 hips) underwent bipolar HA using the MP-Link cementless distal fixation modular prosthesis. Of the 42 patients, 5 (11.9%) patients were lost to follow-up at an average of 7.2 months (range 3 to 11 months) after surgery. The 37 remaining patients (37 hips) were available for evaluation (Fig. 1). Detailed distribution of patient demographics and characteristics, fracture types, mechanism of injury, Singh index and ASA class were shown in Table 1.

Table 1
Preoperative data of the patients.

Demographic	
Gender	
Male	10
Female	27
Average age (years)	83.9 ± 5.2 (range, 76–106)
Body weight (kg)	65.8 ± 8.7 (range, 51–86)
Height (cm)	160.3 ± 5.8 (range, 152–175)
Body Mass Index (kg/m^2)	25.6 ± 3.1 (range, 20.2–33.2)
Albumin (g/L)	36.1 ± 3.2 (range, 27.3–42.4)
Hgb (g/L)	111.9 ± 10.4 (range, 98–137)
Comorbidity (*n*)	
Hypertension	21
Diabetes mellitus	4
Cerebrovascular accident	1
Mechanism of injury	
Pedestrian	19
Fall at home	12
Bike accident	6
AO/OTA classification	
A2.2	22
A2.3	15
ASA class	
I	2
II	14
III	21
Singh index	2.9 ± 0.8 (range, 2–4)
Time to surgery (days)	2.7 ± 0.8 (range, 2–4)

2.1. Surgical technique

All surgeries were performed by the senior author at an average of 2.7 ± 0.8 days (range, 2–4 days) from the initial injury. The medical conditions of the patients were optimized through a preoperative multidisciplinary approach.

All patients were operated under general anesthesia and performed through posterior approach to the hip. The fracture fragments including the femoral head, neck, calcar (posteromedial fragment) and lesser trochanter were removed from the wound. The femoral canal was identified and prepared using a broach in the usual fashion, and then insertion of a MP-Link cementless distal fixation modular femoral stem (Waldemar Link, Hamburg, Germany) was done. A trial reduction was performed and then the appropriate neck length and bipolar head diameter were selected. All of the displaced greater trochanter fracture fragments were reduced and fixed by locking plate and screws. The capsule and the short external rotators were reattached to the posterior border of the gluteus medius muscle. The wound was closed in layers and a closed suction drain was placed.

2.2. Postoperative protocol

Patients received cefazolin or vancomycin antibiotic prophylaxis within 30–60 min before incision and within the first 48 h postoperatively. Low-molecular-weight heparin was used by subcutaneous injection daily and was continued for three weeks. The drain was removed after 48 h. The patients were permitted weight-bear on the day after surgery, and encouraged to use a walker until the patients had adequate muscle strength and balance. Excessive hip flexion and adduction were not allowed within six weeks following surgery.

The patients were followed up at 6 weeks, 6 months, 1 year, and annually thereafter for clinical and radiological examinations. If the patient was too far from the hospital or not willing to come, the clinical outcomes were evaluated by telephone, and the radiological outcomes were evaluated by X-ray films which were obtained at their local hospital.

2.3. Clinical and radiographic assessment

The patients were clinically evaluated on the basis of operation time, intraoperative blood loss, postoperative drainage, total blood loss (intraoperative blood loss + postoperative drainage), postoperative hemoglobin values at postoperative first day, the length of hospital stay, blood transfusion, hip function using Harris hip score (HHS), number of deaths, one year mortality, and postoperative complications (pressure sores, cardiac, pulmonary, deep venous thrombosis, dislocations, hip pain, infection, limb length discrepancy, and peri-prosthetic fracture). The hip pain was assessed using visual analog scale (VAS) that was grade as no pain (0–2 points), mild (3–5 points), moderate (6–8 points), and severe (> 8 points).

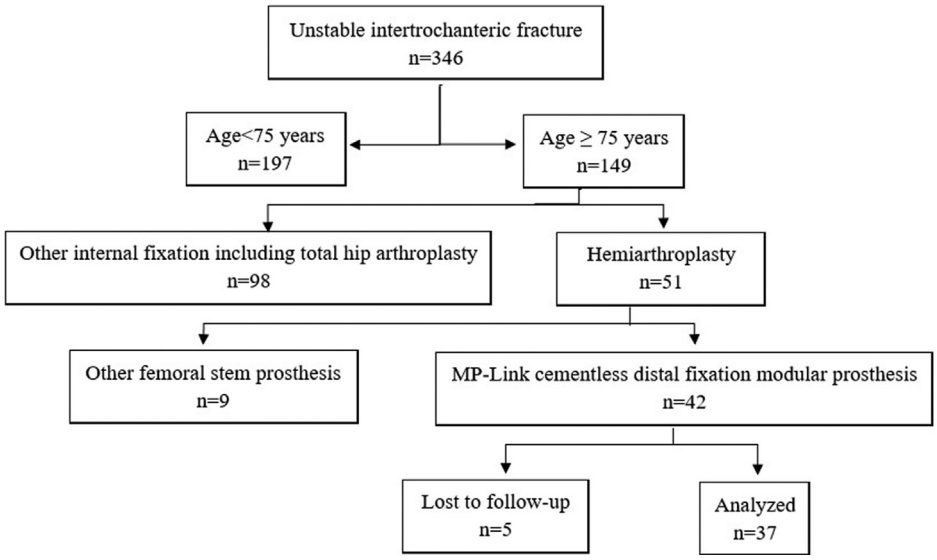

Fig. 1. A flow chart of inclusions.

The patients were radiographically evaluated in terms of the osteolysis [14], bone in-growth [15], subsidence of the femoral components, and heterotopic ossification [16].

3. Results

The mean operative time was 90.9 ± 9.1 min (range, 76–120 min). The mean intraoperative blood loss, postoperative drainage, total blood loss was 428.4 ± 91.7 mL (range, 300–650 mL), 213.2 ± 47.4 mL (range, 150–350 mL), 641.6 ± 86.1 mL (range, 470–850 mL), respectively (Table 2). The mean Hgb of the first postoperative day was 83.9 ± 9.9 g/L (range, 72–111 g/L). The mean length of stay was 8.2 ± 1.5 days (range, 6–12 days). Of the 37 patients, 13 (35.1%) required transfusion with the average transfusion of 0.86 ± 1.2 units (range, 0–3 units).

All of patients could ambulate independently with a walker at hospital discharge. At the final follow-up, 31 (83.8%) out of 37 patients were regained preoperative ambulatory status. 6 patients ambulated independently without crutches before injury, while they require a walker for ambulation after surgery. 4 (10.8%) out of 37 patients had the limb length discrepancy with a range of 3–7 mm, without discomfort.

Table 2
Intraoperative and postoperative results.

Demographic	
Intraoperative blood loss (mL)	428.4 ± 91.7 (range, 300–650)
Postoperative drainage (mL)	213.2 ± 47.4 (range, 150–350)
Total blood loss (mL)	641.6 ± 86.1 (range, 470–850)
Hgb of the first postoperative day (g/L)	83.9 ± 9.9 (range, 72–111)
Length of stay (days)	8.2 ± 1.5 (range, 6–12)
Transfusion	
Number (%)	13 (35.1%)
Volume (units)	0.86 ± 1.2 (range, 0–3)
Number of death (%)	15(40.5%)
Between 7–12 months postoperatively	4 (10.8%)
Between 13–24 months postoperatively	3
Between 25–36 months postoperatively	2
Between 37–48 months postoperatively	2
Between 49–60 months postoperatively	4
One-year mortality	10.8%
The follow-up time of death patients (months)	32.3 ± 19.7 (range, 7–59)
HHS in the death of patients (points)	84.5 ± 2.4 (range, 80–89)
The follow-up time of healthy patients (months)	70.8 ± 12.2 (range, 60–96)
HHS in the healthy patients (points)	84.6 ± 2.8 (range, 80–89)

No patient died within 6 months after surgery. Of all 37 patients, 15 (40.5%) died during a 7–59 months follow-up period. Of the 15 patients, 4 patients died within 1 year postoperatively (Table 2). One-year mortality was 10.8%. The mean HHS of the 15 patients was 84.5 ± 2.4 points (range, 80–89 points). The remaining 22 patients alive were followed for 70.8 ± 12.2 months (range, 60–96 months), with a mean HHS of 84.6 ± 2.8 points (range, 80–89 points).

All of the 37-femoral stem achieved press-fit at the isthmus; bony union of the greater trochanter were observed in all patients at a mean follow-up of 4.3 ± 1.7 months (range, 3–6 months); the bony in-growth fixation of stem was achieved in 24 patients (24/37, 64.9%) and stable fibrous fixation were achieved in other patients (13/37, 35.1%) (Figs. 2 and 3). None of these patients had evidence of osteolysis, loosening or subsidence of femoral stem ≥ 5 mm (2 mm subsidence in 11, and 3 mm in 5 patients). There was no subsidence of femoral stem after 6 months postoperatively.

Two patients (5.4%) experienced mild groin pain on ambulation. There were no pressure sores, cardiac, pulmonary, deep venous thrombosis, dislocations, hip pain, infection, and peri-prosthetic fracture. 6 hips (16.2%) demonstrated heterotopic ossification, including 5 hips in Grade I and 1 hip in Grade II.

4. Discussion

The most important finding of the present study was that bipolar HA using the MP-Link cementless distal fixation modular prosthesis without reconstruction of femoral calcar for unstable intertrochanteric fracture in patients aged 75 years or more: (1) could achieve satisfactory clinical outcomes with 83.8% of patients recovery of preoperative ambulatory status and a low one-year mortality rate (10.8%); (2) may achieve stable initial fixation of the femoral stem, and could be early weight bearing ambulation of the patients.

The goals of treatment of unstable intertrochanteric fracture in the elderly are to regain preoperative ambulatory status with the lowest possible rate of surgical and medical complications, permitting immediate mobilization is important to achieve these [2,6]. For elder patients with fracture instability, comminution, and osteoporosis, the high failure or re-operation rate of internal fixation, which was reported 6% to 32%, has been a hassling problem [9,17,18]. In order to prevent loss of reduction, failure of fixation or both, these patients usually require prolonged bed rest or limited ambulation, which would lead to a high rate of general

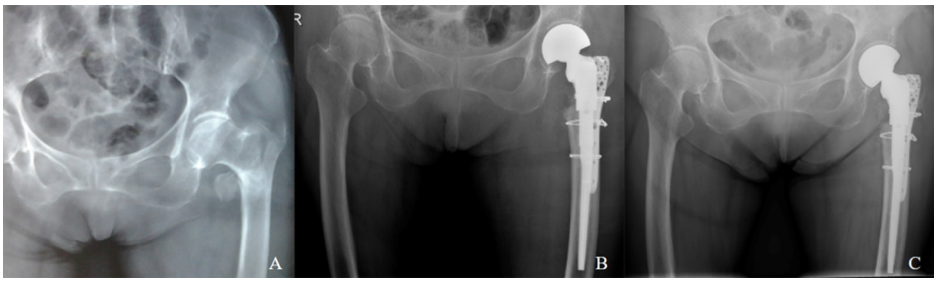

Fig. 2. Radiographs of an 87-year-old female patient with AO/OTA A2.2 fracture. A. Pre-operatively. B. Immediately after HA, showing the femoral stem achieved press-fit at the isthmus. C. The radiograph respectively taken at 48 months postoperatively, showing no osteolysis and subsidence of femoral stem.

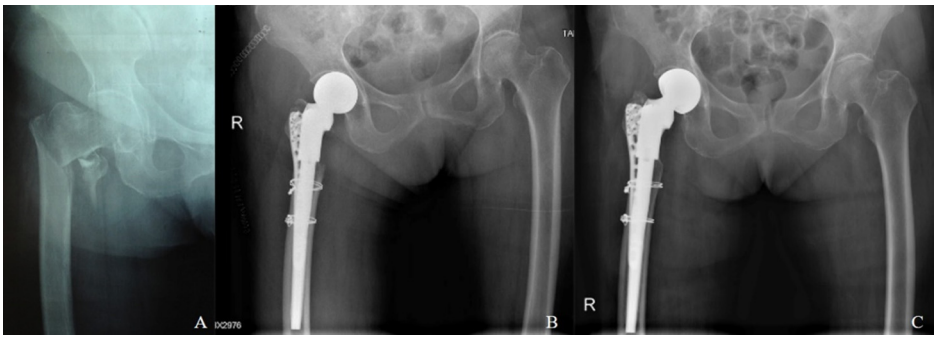

Fig. 3. Radiographs of an 80-year-old female patient with AO/OTA A2.3 fracture. A. Pre-operatively. B. Immediately after HA, showing the femoral stem achieved press-fit at the isthmus. C. The radiograph respectively taken at 96 months postoperatively, showing no osteolysis and subsidence of femoral stem.

complications [4]. In our study, all of patients achieve a good clinical function (HHS of 84.6 ± 2.8 points), with low one-year mortality rate (10.8%) and some minor complication (two patients with mild groin pain, 6 patients with heterotopic ossification, and 4 patients with limb length discrepancy) that did not lead to discomfort. It may be attributed to the permitted immediate weight-bear mobilization. Haentjens et al. [13] found a higher incidence of pneumonia and pressure sores with internal fixation compared to HA, due to restricting early weight-bear mobilization in patients with internal fixation. Meanwhile many authors believed that early ambulation after surgery is important for preventing complications and reducing mortality [2,5,6]. Our patients were permitted weight-bear mobilization on the day after surgery using a walker, so the patients could achieve satisfactory clinical results.

Considering the limited immediate weight-bear mobilization and the higher risk of complication of internal fixation for unstable intertrochanteric fracture in elderly patients, many authors [13,18,19] believe that the HA is suitable for these patients, especially in osteopenic individuals. Bonnevialle et al. [19] reported that better clinical results and lower rates of mechanical complications with arthroplasty than with nailing in unstable trochanteric fracture in patients aged 75 years or more. In order to achieve initial implant stability and immediate weight-bear mobilization, some authors suggest HA for unstable intertrochanteric fracture with reconstruction of the femoral calcar, regardless of using cemented or uncemented femoral stem [4,7,8,17,19–22], other authors suggest to use calcar, replacing prosthesis to augment the deficient proximal medial femur, if there is failure to reconstruct femoral calcar [9–13]. To reconstruct the femoral calcar, it would need extra expose and cerclage wire for reduction and fixation of the fracture fragment, which is associated with significant soft tissue stripping and the reconstruction technique may be more likely to require longer operative time and increased blood loss, which, obviously, increase the overall risk in fragile patients. Abdelkhalek et al. [4] reported that the average operative time was 140 min and the mean hospital stay was 16 days, using cemented HA with reconstruction of femoral calcar for unstable intertrochanteric fracture in elderly patients. Comparing with their patients, our patients have less operative time (90.9 min) and hospital stay (8.2 days). Though the calcar replacing HA could achieve satisfactory outcomes, they are also associated with complications of trochanteric non-union and leg length inequality [10,13], and it may increase the complexity of procedure, requiring a surgeon with a wealth of surgical experience and extreme surgical skills, and the stems were not readily available in many hospitals [1,7–9].

In this study, none of patients had evidence of loosening or subsidence of femoral stem ≥ 5 mm (2 mm subsidence in 11, and 3 mm in 5 patients). It may be primarily attributed to the MP-Link cementless distal fixation modular prosthesis, which can achieve stable initial fixation. The initial press-fit stability was achieved in all patients at the isthmus, and bony in-growth fixation or stable fibrous fixations were observed in all patients. This indicates that initial stability is fundamental for reducing the subsidence and survival of cementless femoral stems, and maximizing initial stem stability and successful osseo-integration of the femoral stem, which could offset the adverse effect of poor bone quality and incomplete bone contact secondary to the presence of the deficient proximal medial femur.

Reconstruction of femoral calcar in HA has always been emphasized as an important factor for reducing the subsidence of the femoral stem [8], limb length discrepancy [4,17], inappropriate anteversion of femoral head [23]. In this study, the patients were treated by HA using MP-Link cementless distal fixation modular prosthesis without reconstruction of femoral calcar. There was minor subsidence of the femoral stem in 16 patients with 2–3 mm; this is of no clinical significance. Only 4 patients had the limb length discrepancy with a range of 3–7 mm. There were no patients with dislocation. It may be attributed to the advantages of the MP-Link cementless distal fixation modular prosthesis: (1) the stem is a fluted, tapered biocompatible porous-coated cementless prosthesis, a cortical grip through the 8–10 fins that allow rotational and axial control of the implant in the isthmus of the diaphysis; (2)

the stem can effectively adjust leg length and femoral anteversion through the proximal components, and spacers.

Our study has some certain limitations. First, it is a prospective non-comparative study that did not compare HA with internal fixation, or reconstructed femoral calcar with non- reconstructed, or non- reconstructed femoral calcar with calcar replacing prosthesis. Considering the high risk of internal fixation related complications and restriction of immediate weight-bear mobilization, internal fixation was not performed in the senior author for the unstable intertrochanteric fractures in patients aged 75 years or more. Additionally, giving an increasing complexity of surgical procedure of reconstructed femoral calcar and the calcar replacing prosthesis, only the MP-Link cementless distal fixation modular prosthesis was performed in the senior author. Therefore, it was difficult to recruit a comparison group. Secondly, the follow-up period is short. However, a long-term follow-up is barely possible in typically very senile patients (mean age was 83.9 years in our study) and has little clinical relevance considering the remaining life expectancy.

In conclusion, bipolar HA using the MP-Link cementless distal fixation modular prosthesis for unstable intertrochanteric fractures in patients aged 75 years or more, without reconstruction of the femoral calcar, may achieve a satisfactory mid-term clinical and radiographic outcome, and could regain preoperative ambulatory status in most patients (83.3%).

Disclosure of interest

The authors declare that they have no competing interest.

Funding

This study was funded by the Jiangsu Provincial Medical Youth Talent (QNRC2016800), The Science and Technology Planning Project of Xuzhou (KC16SL111), and The Foundation of Jiangsu Province commission of Health and Family Planning (H2017081).

Authors' contributions

Guo-Chun Zha did the study, analyzed the data, and wrote the manuscript. Guo-Chun Zha, Jun-Ying Sun, Yong Wang, Jia Liu, Shuo Feng, Xiang-Yang Chen, Kai-Jin Guo was involved in the design, data management of the study. Guo-Chun Zha, Jia Liu, Yong Wang, Shuo Feng, Xiang-Yang Chen, Kai-Jin Guo, Jun-Ying Sun contributed to the study analysis. All authors read and approved the final manuscript.

References

[1] Mäkinen TJ, Gunton M, Fichman SG, et al. Arthroplasty for pertrochanteric hip fractures. Orthop Clin North Am 2015;46:433–44.
[2] Socci AR, Casemyr NE, Leslie MP, et al. Implant options for the treatment of intertrochanteric fractures of the hip: rationale, evidence, and recommendations. J Bone Joint 2017;99:128–33.
[3] Lozano-Alvarez C, Alier A, Pelfort X, et al. Cervicocephalic medial screw migration after intertrochanteric fracture fixation OTA/AO 31-A2, using intramedullary nail Gamma 3: Report of 2 cases and literature review. J Orthop Trauma 2013;27:e264–7.
[4] Abdelkhalek M, Ali AM, Abdelwahab M. Cemented bipolar hemiarthroplasty with a cerclage cable technique for unstable intertrochanteric hip fractures in elderly patients. Eur J Orthop Surg Traumatol 2013;23:443–4.
[5] Yoo JH, Kim TY, Chang JD, et al. Factors influencing functional outcomes in united intertrochanteric hip fractures: a negative effect of lag screw sliding. Orthopedics 2014;37:e1101–7.
[6] Choy WS, Ahn JH, Ko JH, et al. Cementless bipolar hemiarthroplasty for unstable intertrochanteric fractures in elderly patients. Clin Orthop Surg 2010;2:221–6.
[7] Göçer H, Coşkun S, Karaismailoğlu N. Comparison of treatment of unstable intertrochanteric fracture with different arthroplasty methods. Niger Med J 2016;57:81–5.
[8] Kim Y, Moon JK, Hwang KT, et al. Cementless bipolar hemiarthroplasty for unstable intertrochanteric fractures in octogenarians. Acta Orthop Traumatol Turc 2014;48:424–30.
[9] Wada K, Mikami H, Oba K, et al. Cementless calcar-replacement stem with integrated greater trochanter plate for unstable intertrochanteric fracture in very elderly patients. J Orthop Surg (Hong Kong) 2017;25 [2309499016684749].
[10] Green S, Moore T, Proano F. Bipolar prosthetic replacement for the management of unstable intertrochanteric hip fractures in the elderly. Clin Orthop Relat Res 1987;224:169–77.
[11] Harwin SF, Stern RE, Kulick RG. Primary Bateman-Leinbach bipolar prosthetic replacement of the hip in the treatment of unstable intertrochanteric fractures in the elderly. Orthopedics 1990;13:1131–6.
[12] Stern MB, Angerman A. Comminuted intertrochanteric fractures treated with a Leinbach prosthesis. Clin Orthop Relat Res 1987;218:75–80.
[13] Haentjens P, Casteleyn PP, De Boeck H, et al. Treatment of unstable intertrochanteric and subtrochanteric fractures in elderly patients. Primary bipolar arthroplasty compared with internal fixation. J Bone Joint Surg Am 1989;71:1214–25.
[14] Kim YL, Nam KW, Yoo JJ, et al. Cotyloplasty in cementless total hip arthroplasty for an insufficient acetabulum. Clin Orthop Surg 2010;2:148–53.
[15] Engh CA, Bobyn JD, Glassman AH. Porous-coated hip replacement. The factors governing bone in-growth, stress shielding, and clinical results. J Bone Joint Surg Br 1987;69:45–55.
[16] Brooker AF, Bowerman JW, Robinson RA, et al. Ectopic ossification following total hip replacement: incidence and a method of classification. J Bone Joint Surg 1973;55:1629–32.
[17] Grimsrud C, Monzon RJ, Richman J, et al. Cemented hip arthroplasty with a novel cerclage cable technique for unstable intertrochanteric hip fractures. J Arthroplasty 2005;20:337–43.
[18] Fichman SG, Mäkinen TJ, Safir O, et al. Arthroplasty for unstable pertrochanteric hip fractures may offer a lower re-operation rate as compared to cephalomedullary nailing. Int Orthop 2016;40:15–20.
[19] Bonnevialle P, Saragaglia D, Ehlinger M, et al. Trochanteric locking nail versus arthroplasty in unstable intertrochanteric fracture in patients aged over 75 years. Orthop Traumatol Surg Res 2011;97:S95–100.
[20] Chan KC, Gill GS. Cemented hemiarthroplasties for elderly patients with intertrochanteric fractures. Clin Orthop Relat Res 2000;371:206–15.
[21] Lee YK, Ha YC, Chang BK, et al. Cementless bipolar hemiarthroplasty using a hydroxyapatite-coated long stem for osteoporotic unstable intertrochanteric fractures. J Arthroplasty 2011;26:626–32.
[22] Wang JS, Pei FX, Shen B, et al. Coincidence of avascular necrosis of the femoral head and unstable intertrochanteric fracture: Is an extensively coated cementless revision stem a reasonable choice? J Trauma 2011;71:E137–9.
[23] Gu GS, Li YH, Yang C. Bipolar hemiarthroplasty with a two-step osteotomy technique for unstable intertrochanteric fracture in senile patients. Chin J Traumatol 2013;16:103–6.