Injury 50 (2019) 2277–2281

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Mid-term survivals of cemented calcar-replacement bipolar hemiarthroplasty for unstable intertrochanteric fractures in elderly patients

Adem Cobden[a,*], Yalkin Camurcu[b], Serda Duman[c], Ahmet Kocabiyik[d], Mehmet Kıs[e], Nuh Saklavcı[e]

[a] Kayseri City Hospital, Department of Orthopaedics and Traumatology, 38080, Kayseri, Turkey
[b] Erzincan University Faculty of Medicine, Department of Orthopaedics and Traumatology, 24030, Erzincan, Turkey
[c] Diyarbakır Selahaddin Eyyubi State Hospital, Department of Orthopaedics and Traumatology, 21080, Diyarbakır, Turkey
[d] Fatih Sultan Mehmet Training and Research Hospital, Department of Orthopaedics and Traumatology, 34752, Istanbul, Turkey
[e] Sivas Numune Hospital, Department of Orthopaedics and Traumatology, 58000, Sivas, Turkey

ARTICLE INFO

Article history:
Accepted 11 October 2019

Keywords:
Intertrochanteric fracture
Bipolar hemiarthroplasty
Cemented
Mortality
Survival

ABSTRACT

Background: The literature has limited evidence regarding the mid-term survivals of cemented calcar-replacement bipolar hemiarthroplasty (HA) in elderly patients with unstable intertrochanteric (IT) fracture. The purpose of the present study was to evaluate clinical and radiological outcomes of cemented calcar-replacement bipolar HA for unstable IT fractures in elderly patients.

Methods: One hundred and twenty-two patients with the mean age of 80.6 years were enrolled in this retrospective study after they met the selection criteria. Demographics, main clinical characteristics, and operative data were recorded for all patients. Functional outcomes were assessed according to Koval's categories. Clinical and radiological evaluations were performed. Kaplan–Meier survival analysis was used to construct the cumulative survival rate. The mean follow-up time was 25.7 ± 2.9 months (ranges 0–72 months).

Results: Based on Koval's categories, 3 or 4-level decrease was detected in 21 patients (17%). Three patients (2 periprosthetic infections, 1 periprosthetic fracture) underwent reoperation during follow-up. No patient underwent revision of bipolar HA prosthesis. Femoral stem loosening and stem subsidence was the most common complication, observed in 22 patients (18%), followed by acetabular erosion that was seen in 12 patients (9.8%). The mean cumulative survival rate of prosthesis was 56.5% (95% confidence interval: 51.3–61.6).

Conclusion: Based on the results of our study, cemented calcar-replacement HA is an appropriate treatment option in elderly patients with unstable IT fractures owing to the advantages of satisfactory functional outcomes and lower reoperation rates. However, orthopedic surgeons should consider the low survival rates of cemented calcar-replacement HA prosthesis because of the increased femoral loosening in osteoporotic elderly patients.

Introduction

The elderly population has increased considerably in developed countries [1]. Hip fracture, consisted of femoral neck and intertrochanteric femur fracture, is one of the most common fracture types among older people [2]. Intertrochanteric (IT) fractures are common in the elderly people, and surgical management of these fractures remains challenging because of the patients' medical comorbidity, poor bone quality owing to severe osteoporosis, and fracture instability [3,4]. In addition, the choice of surgical treatment for displaced IT fractures in older people remains controversial. Currently, most patients are treated with internal fixation, cemented or cementless bipolar hemiarthroplasty (HA).

Nevertheless, nonunion, implant failure, and screw perforation of the femoral head can occur in elderly patients treated using internal devices because of severe osteoporosis [5,6]. Therefore, primary bipolar HA is proposed for the treatment of unstable IT fractures in elderly patients considering its advantages of early mobilization, acceptable functional results, and lower failure rates [7–9]. The increased risk of periprosthetic fracture with the use of

* Corresponding author.
E-mail address: dradem33k@gmail.com (A. Cobden).

https://doi.org/10.1016/j.injury.2019.10.023
0020-1383/

cementless components is a well-known fact, and recent data from Rogmark showed a higher risk of reoperations with cementless HA in patients with hip fractures [10–12].

On the other hand, cemented fixation is advantageous for enhancing the initial fixation strength in elderly patients with poor bone quality. In addition, cemented bipolar HA is typically preferred in low-demand patients with high mortality risk. However, the literature reveals limited evidence regarding mid-term survivals of cemented calcar-replacement bipolar HA for unstable IT fractures in the elderly population. Therefore, the primary aim of the present study was to evaluate the clinical and radiological outcomes of cemented calcar-replacement bipolar HA after unstable IT fractures in elderly patients. Additionally, we aimed to determine the mid-term survivals of cemented calcar-replacement bipolar HA prosthesis.

Materials and methods

This retrospective study was performed with the approval of our institution's ethical review board. Overall, 133 patients (133 hips) with unstable IT fracture were surgically treated using a primary cemented calcar-replacement bipolar HA between 2010 and 2014. The primary indications for cemented calcar-replacement bipolar HA were unstable (Muller type A2.2 or A2.3) IT fracture with the loss of posteromedial cortex support, ≥65 years of age, and severe osteoporosis (Singh index ≤4). The exclusion criteria included being wheelchair-bound or bedridden before the fracture, incomplete medical records, or incomplete follow-up. Patients' demographics (gender, age), body mass index (BMI), American Society of Anesthesiologists (ASA) score [13], and systemic diseases were reviewed from our medical records.

Two types of cemented calcar-replacement bipolar HA prosthesis were used, either tapered design (Calcar Replacement Stem, Zimed Medikal, Gaziantep, Turkey) or non-tapered design (CFS stem, Sistem Ortopedi, Konya, Turkey). Both designs had a rectangular collar in different sizes (15 mm, 25 mm, 35 mm, 45 mm, or 55 mm) for the bone deficiencies of the proximal medial femur. The total length of the stems ranged from 160 to 190 mm and the diameter of the stems ranged from 9 to 21 mm in 2 mm increments (Fig. 1). All operations were performed under spinal anesthesia by using the standard posterolateral hip approach. Rasps were used to prepare the intramedullary cavity of the femur,

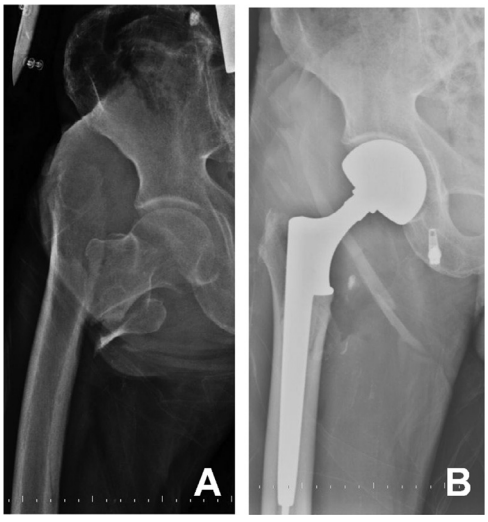

Fig. 1. (A) A 75 years old female patient with an unstable Muller 31.A2 intertrochanteric fracture. (B) Anteroposterior radiograph showing cemented calcar-replacement bipolar hemiarthroplasty prosthesis with a rectangular shaped collar.

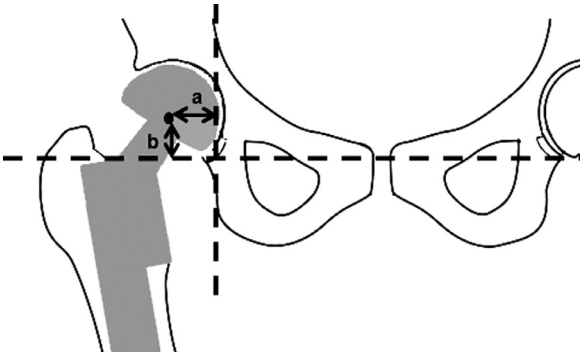

Fig. 2. Evaluation of the acetabular migration: "a" is the horizontal distance from the center of the bipolar head to the ipsilateral teardrop and "b" is the vertical distance from the center of the cup to the interteardrop line.

and then an appropriate size femoral stem was placed after a standard first-generation cementing technique. Proper placement of the femoral stem was performed under the guidance of intact greater trochanter and the initial position of the fractured lesser trochanter. The fixation of the greater trochanter was performed by Ethibond Excel (*Ethicon, Johnson & Johnson*, New Jersey, USA) sutures. Both two prostheses have suture holes to fix the greater trochanter and gluteus medius to the prosthesis. The hip joint was reduced following stability assessment by performing a femoral head trial and placing an appropriate size femoral head. No complications related to anesthesia or orthopedic procedure occurred during the surgery. All patients received prophylactic first-generation cephalosporin 30 min before the procedure. Postoperative intravenous antibiotics were continued for 24 h. All patients received low-molecular-weight heparin for thromboembolic prophylaxis until the end of the postoperative fourth week. Patients were mobilized with the help of a walker and were allowed full weight-bearing. We did not follow a posterior hip protocol to prevent dislocation of bipolar hemiarthroplasty prosthesis. However, we used abduction pillow for patients with cognitive impairment due to dementia or Alzheimer disease. Clinical follow-up visits were conducted postoperatively at second and sixth weeks; third, sixth, ninth, and twelfth months, and then annually. The preoperative and postoperative follow-up ambulatory status of the patients was evaluated using the Koval's categories [14]. The decrease in the ambulatory ability was recorded for all patients. Leg length discrepancy, detected either clinically or from x-Rays, was noted during follow-up examinations. All complications were recorded.

Radiographic evaluation was performed by an independent observer who did not perform the operations. Second postoperative week standard anteroposterior and lateral radiographs were defined as the baseline and compared with the latest follow-up radiographs. Patients who were lost to follow-up because of death were recorded, and their latest control radiographs were evaluated as the final follow-up control. The radiographic evaluation of femoral stem was performed using the zonal system of Gruen et al. [15]. Stem loosening was diagnosed when radiolucent zone at the stem-cement interface, radiolucent zone at the cement-bone interface, or fractured cement was observed in all zones in the radiographs. Stem subsidence was defined as vertical migration of the femoral stem by more than 5 mm. Acetabular migration was assessed by measuring the vertical distance from the center of the bipolar head to the inter-teardrop line and the horizontal distance from the center of the cup to the ipsilateral teardrop (Fig. 2). Acetabular migration was confirmed if vertical or horizontal migration was more than 3 mm [16,17]. Heterotrophic ossification, if present, was recorded and graded according to the classification of Brooker et al. [18] (Fig. 3).

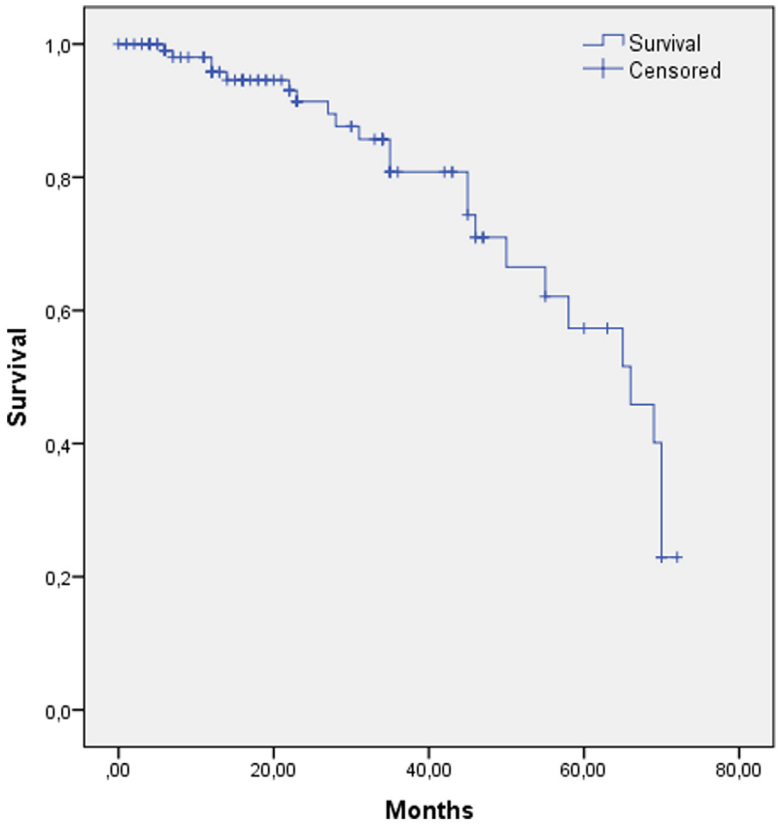

Fig. 3. Kaplan–Meier survival line chart of the patients.

Statistical analysis was performed using SPSS 20.0. Kaplan–Meier survival analysis was performed to determine mid-term survivals of the cemented calcar-replacement HA prosthesis. Femoral loosening, femoral stem subsidence, acetabular erosion, or revision surgery were defined as endpoints.

Results

One hundred and twenty-two patients (65 females, 57 males) with the mean age of 80.6 ± 6.8 years (ranges, 66–102 years) were evaluated in the current study. Demographics, main clinical characteristics, and operative data of the patients are shown in Table 1. The mean follow-up time was 25.7 ± 2.9 months (ranges, 0–72 months). Of the 122 patients, 41 (33.6%) died within 1 year postoperatively. Forty-nine patients (40.1%) survived over 2 years, 29 (23.7%) survived over 3 years, 16 (13.1%) survived over 4 years, and 12 (9.8%) survived over 5 years postoperatively.

Table 1
Demographics and clinical characteristics of the patients.

Age* (years)	80.6 ± 6.8 (66–102)
Gender** (Female /Male)	65/57
Body mass index* (kg/m2)	26.2 ± 3.7 (19–33)
Total hospitalization time* (day)	9.4 ± 4.7 (3–25)
Time from injury to surgery* (day)	2.5 ± 1.9 (1–10)
Number of systemic comorbid diseases** (<3/≥3)	110/12
ASA score** (<3/≥3)	70/52
Operation time* (minute)	81.9 ± 30.6 (25–280)
Estimated blood loss* (mL)	413.4 ± 164.9 (180–800)
Postoperative immobilization** (1 day/≥2 days)	75/47
Decrease level in Koval's categories** (<3/≥3)	101/21

* Mean ± Standard deviation (range).
** Ratio of the patients.

Based on Koval's categories, 84 of 122 patients (68.8%) were independent community ambulators and 38 patients were community ambulators with a cane, preoperatively. At postoperative last follow-up, 28 patients (22.9%) returned to their pre-fracture ambulatory status, 39 (31.9%) dropped 1 level, 34 (27.8%) dropped 2 levels, and 21 (17.2%) dropped 3 or more levels.

Three patients underwent reoperation during follow-up. Two patients underwent debridement because of prolonged postoperative wound drainage and suspected infection, and 1 patient underwent plate fixation for periprosthetic femoral fracture. No patient underwent prosthesis revision. Femoral stem loosening and stem subsidence was the most common complication, observed in 22 patients (18%), followed by acetabular erosion that was seen in 12 patients (9.8%). Heterotrophic ossification was encountered in 8 patients (6.5%). Leg length discrepancy was detected in 17 patients (13.9%).

Kaplan–Meier survival analysis was based on 122 patients at risk during follow-up. The cumulative survival rate was 56.5% (95% confidence interval: 51.3–61.6).

Discussion

IT fractures account for 45% to 50% of all hip fractures. Notably, more than half of these are unstable, with comminution of the posteromedial support, displaced lesser trochanteric fragment, or those with the subtrochanteric extension [19]. The best treatment option for unstable IT fractures is still controversial. Currently, the treatment options for IT are internal fixation and bipolar HA with a cemented stem or cementless femoral fixation [20]. Bipolar HA is proposed for the treatment of unstable IT fractures owing to its advantages of early mobilization, acceptable functional results, and lower failure rates. Our study demonstrated that in elderly patients with unstable IT fractures cemented calcar-replacement bipolar HA

for unstable IT fractures had successful clinical results. However, the survival analysis based on our radiological outcomes showed that cemented calcar-replacement bipolar HA had moderate survival rates.

When the clinical data of our patients were reviewed, 28 of 122 patients (23%) were able to walk independently, and 73 of 122 patients (60%) could walk independently with the help of a cane or walker. Overall, 21 patients (17%) were found to have 3- or 4-level decrease per Koval's categories, which means that the patients needed someone's help for walking. Lee et al. reported that 21 of 60 patients (35%) in their study dropped 3 or 4 levels and 21.7% of patients were bedridden after cementless total or HA for failed internal fixation of IT fractures [6]. Chan et al. reported that 20% of the patients in their study (8 of 40 patients) regained their pre-fracture walking ability after cemented HA [7]. Kim et al. showed that 20 of 56 (36%) of their patients returned to their pre-fracture ambulatory level after cementless HA for unstable IT fracture [20]. Wada et al. reported that 20 of 44 (50%) of their patients were ambulatory after cementless calcar-replacement HA for unstable IT fracture [21]. Suh et al. compared the outcomes, according to Koval's categories, between HA and internal fixation and found no intergroup difference [22].

According to our radiographic outcomes, femoral stem loosening, and stem subsidence were the most common radiographic problems at the latest follow-up. Femoral stem subsidence over 5 mm, which was defined as a definite diagnosis of femoral loosening, was detected in 22 patients (18%). In their study, Celiktas et al. reported no femoral loosening or femoral stem subsidence over 5 mm after cemented HA in 64 patients with a mean follow-up of 31 months [23]. Cankaya et al. compared cementless and cemented hemiarthroplasty for IT fractures with 32- and 38-month follow-ups, respectively, and they observed no femoral loosening in both groups [24]. The rate of acetabular erosion in our study was consistent with the literature. However, a higher rate of femoral stem loosening was detected than that reported by Celiktas et al. [23] and Cankaya et al. [24]. This difference may have occurred because of the relatively lower bone density of our patients, represented by the Singh index of $\leq$4.

Among 122 patients, 3 patients underwent reoperation owing to postoperative complications (2.4%). Infection was the most common complication in 2 patients (1.6%), and we observed periprosthetic femur fracture in 1 patient (0.8%). Dislocation of the prosthetic hip joint and periprosthetic fracture were not detected during the follow-up. Lee et al. reported 3.3% dislocation and 3.3% infection rate after cementless calcar replacement HA in 60 patients of their study [6]. Rodop et al. noted 1 patient with deep infection after HA [9]. In these 2 studies, the infection was treated by performing implant removal and debridement. In our study, we performed early debridement combined with intravenous antibiotic administration and eradicated the infection successfully. Langslet et al. encountered 1 femoral fracture postoperatively in their cemented group and 7 femoral fractures in their cementless group [25]. In their 12-month follow-up prospective study, Figved et al. reported that 7 patients in the cemented group and 8 in the cementless group needed one or more operations [26]. Taylor et al. reported that none of the patients with cemented HA experienced periprosthetic fractures or prosthetic infection postoperatively in their 2-year follow-up study [27]. In our study, the reoperation rate was lower despite moderate radiographic outcomes. We encountered radiological problems that would generally need a revision of bipolar HA. However, no patient in our study group needed to undergo revision of the bipolar HA prosthesis. This issue may be explained by the high mortality rate of the elderly patient population.

There is limited knowledge regarding the mid-term survival of cemented calcar-replacement bipolar HA. In the present study, acetabular erosion was observed in 12 patients (10%) and femoral stem subsidence over 5 mm, which was defined as a definite diagnosis of femoral loosening, was detected in 22 patients (18%) during 5-year follow-up. There were no cases of calcar resorption. Grimsrud et al. reported no femoral loosening or femoral stem subsidence over 5 mm after cemented HA in 39 patients with a mean follow-up of 12 months [28]. As mentioned above, Cankaya et al. compared cementless and cemented HA for IT fractures, and they observed no femoral loosening in both groups [24]. Abdelkhalek et al. reported no femoral loosening or femoral stem subsidence over 5 mm after cemented HA in 20 hips during a mean follow-up of 24 months [8]. Like our study, Kim et al. evaluated mid-term survivals of cementless bipolar HA prosthesis for unstable IT fractures in elderly patients [20]. However, the authors had higher survival rates (97.3% and 99.1% for reoperation and femoral stem revision, respectively) than our study [20]. We did not revise any prosthesis during follow-up. Nevertheless, we decided to define the endpoints as femoral stem loosening and acetabular erosion for assessing the survival of the prosthesis to evaluate the actual survival of the cemented bipolar HA prosthesis because unstable IT fractures mostly occur in extremely old patients who do not have a chance to undergo revision of the prosthesis owing to their health status. Moreover, we believe that these patients, with an inadequate functional status, probably do not demand revision of their prosthesis.

Nonetheless, this study had several limitations. First, it was a retrospective evaluation of prospectively followed patient group. Second, only a small number of patients were able to complete the follow-up over 5 years (12 patients). However, our study group consisted of extremely old patients, and this study population is the largest in the literature which reported mid-term survival of cemented calcar-replacement bipolar HA prosthesis. On the other hand, we reported clinical and radiological outcomes of a relatively homogeneous patient population who were operated in a single center by the same surgical team. However, further studies are needed to procure valid evidence regarding survivals of cemented calcar-replacement HA prosthesis.

Conclusion

Based on our study results, cemented calcar-replacement HA is an appropriate treatment option in elderly patients with unstable IT fractures considering the advantages of satisfactory functional outcomes and lower reoperation rates. However, orthopedic surgeons should consider the low survival rates of cemented calcar-replacement HA prosthesis owing to increased femoral loosening in elderly patients with osteoporosis.

Declaration of Competing Interest

None.

References

[1] Clement ND, MacDonald D, Howie CR, Biant LC. The outcome of primary total hip and knee arthroplasty in patients aged 80 years or more. J Bone Joint Surg Br 2011;93(9):1265–70.
[2] Turesson E, Ivarsson K, Thorngren KG, Hommel A. Hip fractures - Treatment and functional outcome. The development over 25 years. Injury 2018;49(12):2209–15. doi:10.1016/j.injury.2018.10.010.
[3] Haidukewych GJ, Berry DJ. Hip arthroplasty for salvage of failed treatment of intertrochanteric hip fractures. J Bone Joint Surg Am 2003;85-A:899e904.
[4] Palm H, Jacobsen S, Sonne-Holm S, Gebuhr PHip Fracture Study Group. Integrity of the lateral femoral wall in intertrochanteric hip fractures: an important predictor of a reoperation. J Bone Joint Surg Am 2007;89:470e5.
[5] Thakur RR, Deshmukh AJ, Goyal A, Ranawat AS, Rasquinha VJ, Rodriguez JA. Management of failed trochanteric fracture fixation with cementless modular hip arthroplasty using a distally fixing stem. J Arthroplasty 2011;26(3):398–403. doi:10.1016/j.arth.2010.01.103.

[6] Lee YK, Kim JT, Alkitaini AA, Kim KC, Ha YC, Koo KH. Conversion hip arthroplasty in failed fixation of intertrochanteric fracture: a propensity score matching study. J Arthroplasty 2017;32(5):1593–8. doi:10.1016/j.arth.2016.12.018.
[7] Chan KC, Gill GS. Cemented hemiarthroplasties for elderly patients with intertrochanteric fractures. Clin Orthop Relat Res 2000(371):206–15.
[8] 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(4):443–8. doi:10.1007/s00590-012-1006-z.
[9] Rodop O, Kiral A, Kaplan H, Akmaz I. Primary bipolar hemiprosthesis for unstable intertrochanteric fractures. Int Orthop 2002;26(4):233–7.
[10] Rogmark C, Fenstad AM, Leonardsson O, et al. Posterior approach and uncemented stems increases the risk of reoperation after hemiarthroplasties in elderly hip fracture patients. Acta Orthop 2014;85:18–25.
[11] Choy WS, Ahn JH, Ko JH, Kam BS, Lee DH. Cementless bipolar hemiarthroplasty for unstable intertrochanteric fractures in elderly patients. Clin Orthop Surg 2010;2(4):221–6. doi:10.4055/cios.2010.2.4.221.
[12] Lin FF, Chen YF, Chen B, Lin CH, Zheng K. Cemented versus uncemented hemiarthroplasty for displaced femoral neck fractures: a meta-analysis of randomized controlled trails. Medicine (Baltimore) 2019;98(8):e14634.
[13] White BL, Fisher WD, Laurin CA. Rate of mortality for elderly patients after fracture of the hip in the 1980′s. J Bone Joint Surg Am 1987;69:1335e40.
[14] Koval KJ, Aharonoff GB, Rosenberg AD, Bernstein RL, Zuckerman JD. Functional outcome after hip fracture. Effect of general versus regional anesthesia. Clin Orthop Relat Res 1998(348):37–41.
[15] Gruen TA, McNeice GM, Amstutz HC. "Modes of failure" of cemented stem–type femoral components: a radiographic analysis of loosening. Clin Orthop Relat Res 1979(141):17–27.
[16] Wachtl SW, Jakob RP, Gautier E. Ten-year patient and prosthesis survival after unipolar hip hemiarthroplasty in female patients over 70 years old. J Arthroplasty 2003;18(5):587–91.
[17] Nunn D, Freeman MA, Hill PF, Evans SJ. The measurement of migration of the acetabular component of hip prostheses. J Bone Joint Surg Br 1989;71(4):629–31.
[18] Brooker AF, Bowerman JW, Robinson RA, Riley LH Jr. Ectopic ossification following total hip replacement. Incidence and a method of classification. J Bone Joint Surg Am 1973;55(8):1629–32.
[19] Yoo JI, Cha YH, Kim KJ, Kim HY, Choy WS, Hwang SC. Comparison between cementless and cemented bipolar hemiarthroplasty for treatment of unstable intertrochanteric fractures: systematic review and meta-analysis. Hip Pelvis. Dec 2018;30(4):241–53.
[20] Kim JT, Kim HH, Kim JH, Kwak YH, Chang EC, Ha YC. Mid-term survivals after cementless bipolar hemiarthroplasty for unstable intertrochanteric fractures in elderly patients. J Arthroplasty 2018;33(3):777–82.
[21] Wada K, Mikami H, Oba K, Yonezu H, Sairyo K. Cementless calcar-replacement stem with integrated greater trochanter plate for unstable intertrochanteric fracture in very elderly patients. J Orthop Surg (Hong Kong) 2017;25(1):2309499016684749. doi:10.1177/2309499016684749.
[22] Suh YS, Nho JH, Kim SM, Hong S, Choi HS, Park JS. Clinical and radiologic outcomes among bipolar hemiarthroplasty, compression hip screw and proximal femur nail antirotation in treating comminuted intertrochanteric fractures. Hip Pelvis 2015;27(1):30–5. doi:10.5371/hp.2015.27.1.30.
[23] Celiktas M, Togrul E, Kose O. Calcar preservation arthroplasty for unstable intertrochanteric femoral fractures in elderly. Clin Orthop Surg 2015;7(4):436–42. doi:10.4055/cios.2015.7.4.436.
[24] Cankaya D, Ozkurt B, Tabak AY. Cemented calcar replacement versus cementless hemiarthroplasty for unstable intertrochanteric femur fractures in the elderly. Ulus Travma Acil Cerrahi Derg 2013;19(6):548–53. doi:10.5505/tjtes.2013.57615.
[25] Langslet E, Frihagen F, Opland V, Madsen JE, Nordsletten L, Figved W. Cemented versus uncemented hemiarthroplasty for displaced femoral neck fractures: 5-year followup of a randomized trial. Clin Orthop Relat Res 2014;472(4):1291–9.
[26] Figved W, Opland V, Frihagen F, Jervidalo T, Madsen JE, Nordsletten L. Cemented versus uncemented hemiarthroplasty for displaced femoral neck fractures. Clin Orthop Relat Res 2009;467(9):2426–35.
[27] Taylor F, Wright M, Zhu M. Hemiarthroplasty of the hip with and without cement: a randomized clinical trial. J Bone Joint Surg Am 2012;94(7):577–83.
[28] Grimsrud C, Monzon RJ, Richman J, Ries MD. Cemented hip arthroplasty with a novel cerclage cable technique for unstable intertrochanteric hip fractures. J Arthroplasty 2005;20:337e43.