Comparison between Bipolar Hemiarthroplasty and Total Hip Arthroplasty for Unstable Intertrochanteric Fractures in Elderly Osteoporotic Patients

Lihong Fan, Xiaqian Dang, Kunzheng Wang*
Department of Orthopaedic Surgery, Second Affiliated Hospital, Medical School of Xi’an Jiaotong University, Xi’an, Shaanxi Province, People’s Republic of China

Abstract
The present study was conducted to compare bipolar hemiarthroplasty (BA) with total hip arthroplasty (THA) in treatment of unstable intertrochanteric fractures in elderly osteoporotic patients. The THA group included 14 males and 26 females with a mean age of 73.4 years, and the BA group included 27 males and 45 females with a mean age of 76.5 years. Significant difference existed between the two groups in operation time, blood loss, transfusion volume and cost of hospitalization, while no remarkable difference was identified in hospitalization period, general complications, joint function, pain, rate of revision and mortality. No dislocation was observed in BA group while 3 occurred in THA group. The results indicated that for unstable intertrochanteric fractures in elderly osteoporotic patients, BA seems to be a better or more reasonable choice compared with THA for the reason of less blood loss, shorter operation time, lower cost and no dislocation.

Methods
All the patients with intertrochanteric fractures admitted to the hospital between March 2003 and September 2009 were evaluated. This study was a retrospective study of prospectively collected data. We used Singh’s classification of the trabecular bone structure in the proximal femur as a measure of osteoporosis based on the anteroposterior (AP) radiograph of the contralateral hip. The inclusion criteria were: unstable intertrochanteric fractures of the femur often occur in elderly people. Their incidence has increased due to the increased life expectancy and osteoporosis [1]. Rigid internal fixation and early mobilization are the key points of the treatment. Stable intertrochanteric fractures can be easily treated by osteosynthesis with predictable good results [2,3], whereas the management of unstable intertrochanteric fractures is challenging because of poor bone quality, osteoporosis and other underlying diseases [4,5]. Although there are some fixation methods such as fixed nail plate, sliding hip screw and intramedullary interlocking devices, no one guarantees absolute fracture stability and complete bone union in elderly patients [6–8]. Osteoporosis and instability are two of the most important factors leading to unsatisfactory results of treatment [9,10], and in the elderly the coexistence of unstable, comminuted fractures with osteoporosis worsens the prognosis [11].

Due to high failure rate and complications associated with internal fixation, prosthetic replacement has been recommended by some authors as primary treatment for unstable intertrochanteric fractures [12–14]. There have been various reports of successful outcomes after the use of hemiarthroplasty and total hip arthroplasty (THA) [15–17]. Stappaerts et al., in a prospective randomized study, concluded that primary cemented endoprosthesis brought better results than compression hip screw in unstable intertrochanteric fractures in elderly osteoporotic patients who were eligible for early mobilization [16]. Parvjeet found in his study that the patients treated with bipolar prosthesis had earlier rehabilitation than those treated with internal fixation, which decreased the overall morbidity, and he therefore concluded that bipolar prosthesis might be favored in old-aged patients even though there was no major difference in the choice of either implant [17]. After hip arthroplasty, patients can bear weight immediately and are encouraged to move and exercise the involved limbs, and thus reduce the period of bed rest and the rate of complications.

Bipolar hemiarthroplasty (BA) is a less complicated and more expensive surgery compared with THA [18]. However, no study is available that compares the effects and outcomes of the two treatments in intertrochanteric fractures. In order to get a clearer picture about the difference in their performance, we conducted the present study to compare the clinical effects of BA and THA in elderly osteoporotic patients with unstable intertrochanteric fractures, in terms of operation time, blood loss and transfusion, duration and cost of hospitalization, hip joint function, pain relief, general complications, and the rate of dislocation, revision and mortality.

Abstract
The present study was conducted to compare bipolar hemiarthroplasty (BA) with total hip arthroplasty (THA) in treatment of unstable intertrochanteric fractures in elderly osteoporotic patients. The THA group included 14 males and 26 females with a mean age of 73.4 years, and the BA group included 27 males and 45 females with a mean age of 76.5 years. Significant difference existed between the two groups in operation time, blood loss, transfusion volume and cost of hospitalization, while no remarkable difference was identified in hospitalization period, general complications, joint function, pain, rate of revision and mortality. No dislocation was observed in BA group while 3 occurred in THA group. The results indicated that for unstable intertrochanteric fractures in elderly osteoporotic patients, BA seems to be a better or more reasonable choice compared with THA for the reason of less blood loss, shorter operation time, lower cost and no dislocation.

Methods
All the patients with intertrochanteric fractures admitted to the hospital between March 2003 and September 2009 were evaluated. This study was a retrospective study of prospectively collected data. We used Singh’s classification of the trabecular bone structure in the proximal femur as a measure of osteoporosis based on the anteroposterior (AP) radiograph of the contralateral hip. The inclusion criteria were: unstable intertrochanteric

Copyright: © 2012 Fan et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Funding: This study was supported by the National Natural Science Foundation of China (Grant No. 81101363). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing Interests: The authors have declared that no competing interests exist.

* E-mail: drwangkz@eyou.com
fractures (three or more part intertrochanteric fractures with a loss of posterosmedial cortical buttress and reverse obliquity fractures), age over 70 years, severe osteoporosis (Singh index ≤3), no contraindication to anaesthesia, and pre-injury independent walking with or without aids. The exclusion criteria were: suspected pathological fracture, significant senile dementia, and osteoarthritis or rheumatoid arthritis in the fractured hip.

All patients were treated operatively with prosthetic replacement by the same surgery team. Follow-up evaluations were performed at 6 weeks, 3, 6, 9, and 12 months, and every year thereafter. THA was performed on the patients admitted in the hospital before December 31, 2005, but it was substituted by BA later in 2006 after the occurrence of three dislocations and for the sake of reducing dislocation rate and cost. The data of the patients’ hospital courses were collected by chart abstracting.

All the patients underwent surgery with a standard posterior approach in lateral position under spinal or general anesthesia within 48 hours of admission. The fibres of the gluteus maximus were split and then the gluteus medius was retracted to expose the short external rotator muscles of the hip. These were divided close to their insertion and an inverted T-shaped incision was made on the joint capsule. To avoid a further displacement of the fragments, with the limb maintained in traction by the surgical assistant, osteotomy of the femoral neck was performed prior to the dislocation of the hip joint. The femoral head was removed. The fragments of the greater trochanter were repositioned and temporarily fixed by using one or two bone forceps. The femoral canal was carefully detected with a long spoon and then was prepared by graduated reaming using rasps. Anteversion-retroversion of the prosthesis was determined using the lesser trochanter as a guide after the lesser trochanter was temporarily reduced. The height of the prosthesis was determined by temporarily fixing the greater trochanter in its anatomical position. In severely comminuted fractures, it was difficult to determine the prosthesis height properly only by anatomical landmarks of trochanters. Trial stem was used to decide the appropriate length of the extramedullary portion of the femoral component. The trial stem was assembled with a trial cup, and reduction test was performed to determine the exact length of the prosthesis that would achieve equal limb length.

The second-generation cementing technique was utilized. Thorough bony bed cleaning was performed by high speed pulsatile lavage. An intramedullary cement plug was placed, and the cement in a doughy state was delivered using a cement gun in a retrograde fashion. The Centrament® stem (Aesculap, Tuttingen, Germany), with a length of 180 to 220 mm, was inserted inside the femoral canal and positioned at an anteverision angle of 15°. No obvious cardiopulmonary complications were observed. The fractured greater trochanter was attached to the prosthesis with two to four 16-gauge stainless steel wires. Isolated displaced fragments of the lesser trochanter were not reduced and fixed. In the THA group, the acetabulum was prepared and a cementless cobalt-chromium cup (Aesculap) with a UHMWPE liner inside was implanted, and then a 28-mm metal head was attached to the femoral stem. The optimal socket position was 40° to 45° of abduction and 10° to 25° of anteverision. Higher range of anteverision was preferred in order to reduce the risk of posterior instability. In the BA group, the acetabulum was not replaced, and a bipolar cup (Aesculap) was implanted instead. After the femoral head was removed, the diameter of the head was measured to determine the approximate size of the outer head of the chosen prosthesis. Range of motion and stability were checked after reduction. The capsule was repaired followed by reattachment of the short external rotators to the femur. Routine closure was performed and vacuum drainage was placed in both groups.

All patients underwent a routine postoperative physiotherapy protocol. The vacuum drains remained in place for 48 hours and were then removed. A pillow between the thighs was used for the first 2 weeks to prevent excessive adduction when the patients lied on the unoperated side. The patients, according to their conditions, were made to sit or stand with support from the first to the third postoperative day, and ambulated with support within the third to the fifth postoperative day. The rehabilitation progressed based on the toleration of the patients. Prophylaxis against deep venous thrombosis using Low-molecular-weight heparin (Lovenox 40 mg) was started 12 hours prior to the operation and continued for 35 days postoperatively.

At the final follow-up, the functional outcome was evaluated using Harris Hip Score (HHS) and the degree of pain was measured by visual analogue scale (VAS). Anteroposterior radiographs of the hip were taken at each follow-up for the evidence of subsidence of the stem, migration of acetabular component, erosion of acetabulum, and heterotopic ossification. The operation and medical records were reviewed to get the information of operation time, blood loss, blood transfusion volume, duration and cost of hospitalization.

All procedures used for this study were reviewed and approved by the Institutional Review Board of the Second Affiliated Hospital of Xi’an Jiaotong University, China. Written informed consent was obtained from participants after adequate explanation of the procedures of the study. Approval by the Institutional Review Board was documented.

The results were compared between the two groups for statistical significance either by a Student’s t-test or a Mann-Whitney U test. Dichotomous variables, such as rates of revision and displacement, were analysed using a chi-squared test or Fisher’s exact test. The p-value less than 0.05 was considered statistically significant.

**Results**

Between March 1, 2003 and September 30, 2009, a total number of 156 patients were admitted with a diagnosis of intertrochanteric fractures. Among the patients, 20 had severe hip arthritis, 16 had significant dementia, and 8 were excluded for pathological fractures. As a result, 112 patients that met the selection criteria were included. For these patients, 40 received THA and 72 underwent BA. The BA group had a mean follow-up period of 39.7 months (24 to 62 months) and the THA group had 48.8 months (32 to 75 months). The difference in the follow-up period between the two groups was statistically significant (p<0.01).

The demographic characteristics of the 112 patients are summarized in Table 1. The THA group included 14 males and 26 females with a mean age of 73.4 years (range 70–80 years), and the BA group included 27 males and 45 females with a mean age of 76.3 years (range 71–85 years). Most patients had comorbidities that could adversely affect the functional outcomes, such as cardiovascular problems, diabetes mellitus, pulmonary diseases and other associated diseases, but there was no significant difference in the number of comorbidities between the two groups. The data including age, sex, BMI, fracture type and Singh index of patients in the two groups also showed no significant difference.

The detailed surgery information of the patients is given in Table 2. The mean operation time in the THA group was 74.5 min, much longer than 53.4 min in the BA group. The average blood loss of the THA patients was 475.3 ml, two times
of the blood loss of 252.8 ml of the BA patients, and the average blood transfusion volume in the THA group was even more than two times that in the other group. The differences between the two groups in operation time, blood loss and transfusion volume were significant (P < 0.05). It can be also seen that although the patients stayed in hospital for similar length of duration, the costs of hospitalization in the two groups were remarkably different. The THA patients spent a lot more than the BA patients did.

The mean HHS was 76.8 in the THA group and 74.6 in the BA group, and the mean VAS was 1.6 in the former and 1.8 in the latter group. Nine patients in the THA group (22.5%) and 16 patients in the BA group (22.2%) had two or more general complications. No significant difference was found between the two groups in HHS, VAS and general complications. For local complications, three dislocations occurred in the THA group while none was observed in the BA group, and this difference was statistically significant (p < 0.05). One dislocation was treated by revision while the other two were clinically reduced, and no recurrence was observed in the follow-up. During follow-up, two patients (4.4%) in the THA group and three patients (4.2%) in the BA group underwent a revision operation, eleven patients (27.5%) in the THA group and nineteen patients (26.3%) in the BA group died. The difference between the two groups in revision rate and mortality rate was not significant (p > 0.05) (Table 3).

Radiography at the last available follow-up showed that all greater trochanter fractures had healed (Figure 1 and 2). The cerclage wire used for the greater trochanter was found broken in two patients in each group. Only one patient in the BA group developed osteoarthrosis of the acetabulum and required a revision to THA because of pain in the groin. The evidence of loosening of femoral component was seen in two BA patients and one THA patient, and revision was performed. There was no sign of heterotopic bone formation in any of the patients.

Discussion

The incidence of all hip fractures is approximately 80 per 100,000 persons and is expected to double over the next fifty years as the population ages [19]. According to the criteria of the modified Evans-Jensen classification, the two-part fractures are considered stable fractures and the rest of the fractures are unstable. About 35%–40% of all intertrochanteric hip fractures are unstable three- and/or four-part configurations with displacement of the posterior-medial cortex [20]. The failure rate of unstable intertrochanteric fractures with osteoporosis has been reported to be between 4% and 16.5% [21,22].

The dynamic hip screw and proximal femoral nail have been commonly used for internal fixation of intertrochanteric fractures. Elderly osteoporotic patients with unstable intertrochanteric fractures usually have a high prevalence of unsatisfactory outcome, with shortening and external rotation deformity of the limb following the treatment with a sliding screw. The failure rate of the dynamic hip screw in unstable fractures is up to 14% [23,24]. The use of intramedullary nail is associated with complications such as screw migration, femoral shaft fracture and implant failure. The failure rate of the proximal femoral nail is between 7.1% and 12.5% [8,25].

The incidence of general complications such as pulmonary embolism, deep venous thrombosis and pneumonia ranges from 22% to 50% when internal fixation was adopted [26,27]. Complications are also related to postsurgery rehabilitation, such as duration of bed rest and starting time of weight bearing [28]. Communion, osteoporosis and instability often preclude the early resumption of full weight-bearing and worsen the prognosis. Mortality rate in hospital ranges from 0.03 to 10.5% [29], while one-year mortality reaches 22% [30].

The incidence of general complications such as pulmonary embolism, deep venous thrombosis and pneumonia ranges from 22% to 50% when internal fixation was adopted [26,27]. Complications are also related to postsurgery rehabilitation, such as duration of bed rest and starting time of weight bearing [28]. Communion, osteoporosis and instability often preclude the early resumption of full weight-bearing and worsen the prognosis. Mortality rate in hospital ranges from 0.03 to 10.5% [29], while one-year mortality reaches 22% [30].

Primary THA and hemiarthroplasty have been used to treat unstable intertrochanteric fractures in an effort to mobilize the patients more rapidly and avoid complications of hip screw migration [31–34], and they are found to have many merits against other fixation techniques. In a recent study, Faldini et al. reported the use of hemiarthroplasty and THA in 54 patients [15] and the finding that hip replacement permits a more rapid recovery with immediate weight-bearing and facilitates nursing care better than other fixation techniques. Sidhu et al also proved in their study on 53 patients that THA may be a valid treatment in
mentally healthy elderly patients with intertrochanteric hip fractures [12]. Hemiarthroplasty and THA, as two possible treatment options for unstable intertrochanteric fractures, may offer the potential for quick recovery with little risk of mechanical failure, avoid the risks often associated with internal fixation, and enable patients to maintain a good level of function immediately after surgery. Meanwhile, they do not result in nonunion or malunion of the fracture site or complications associated with avascular necrosis of the femoral head.

We have noticed that in treating femoral neck fractures, BA, compared with THA, has the advantages of less complexity, shorter operation time and a lower probability of dislocation. However, it may introduce concerns regarding groin and thigh pain due to acetabular erosion which reduces long-term survival and increases the likelihood of a second operation. For deciding whether BA or THA is a better choice for patients with intertrochanteric fractures, four factors should be taken into consideration: operation wound, surgery outcome, complications associated with procedures such as dislocation and acetabular erosion, and operation cost.

In our study, no significant difference has been identified between the group of patients treated by THA the patients treated by BA in surgery outcome, revision rate, mortality rate and general complications. However, the operation time of THA is evidently longer, and the blood loss and blood transfusion volume in the THA patients are significantly higher. The estimated cost of the components in THA is higher than that in BA, and the additional acetabular component in THA requires extra expense. In addition, the increased blood transfusion and longer operation time also increase the hospital cost. In resource-poor countries like China, cost is one of the major factors in patients’ selection of treatments.

Haentjens [35] et al reviewed the literature and summarized the reports regarding prosthetic replacement for the treatment of intertrochanteric fractures and their complications. They concluded that elderly patients with severe osteoporosis may benefit from

![Figure 1. AP hip radiographs of a 76-year-old man with severe osteoporosis and unstable intertrochanteric fracture treated with cement THA using a long stem. A: Preoperative; B: At 6 months postoperatively, the fractured fragment has healed; C: Four years postoperative, the prosthesis was well fixed and his Harris hip score was excellent. doi:10.1371/journal.pone.0039531.g001](#)

![Figure 2. AP hip radiographs of a 78-year-old woman with severe osteoporosis and unstable intertrochanteric fracture treated with cement bipolar hemiarthroplasty using a long stem. A: Preoperative; B: At 6 months postoperatively, the fractured fragment has healed; C: radiographs obtained three years postoperatively, Femoral component was stable with no protrusion of cup. doi:10.1371/journal.pone.0039531.g002](#)
References

1. Koval KJ, Zuckerman JD (1998) Hip fractures are an increasingly important public health problem. Clin Orthop Relat Res 348:2.
2. Sanchez KH, Sanchez P, Shyam A, Patil S, Dharwal Q, et al (2010) Primary hemiarthroplasty or unstable osteoporotic intertrochanteric fractures in the elderly: A retrospective case series. Indian J Orthop 44(4): 428–434.
3. Lindskog DM, Baumgaertner MR (2004) Unstable intertrochanteric hip fractures in the elderly. J Am Acad Orthop Surg 12(3): 179–190.
4. Marsh JL, Stongo TF, Ager J, Broderick JS, Creevey W, et al. (2007) Fracture and dislocation classification compendium. Orthopaedic Trauma Association classification, database and outcomes committee. J Orthop Trauma 21: S1–S35.
5. Larsson S (2002) Treatment of osteoporotic fractures. Scand J Surg 91: 140–146.
6. Kim SY, Kim YG, Hwang JK (2005) Cementless calcar-replacement hemiarthroplasty compared with intramedullary fixation of unstable intertrochanteric fractures: a prospective, randomized study. J Bone Joint Surg Am 87: 2186–2192.
7. Habener W, Hulnert T, Aschauer E, Schmid L (2000) Comparison of ceder nails, dynamic hip screws, and gamma nails in the treatment of peritrochanteric femoral fractures. Orthopedics 23: 121–127.
8. Papasimos S, Koutsouannis CM, Panagopoulos A, Megas P, Lambiris E (2005) A randomised comparison of AMBI, TGN and PFN for treatment of unstable trochanteric fractures. Arch Orthop Trauma Surg 125(7): 462–468.
9. Kim WY, Han CH, Park JJ, Kim JY (2001) Failure of intertrochanteric fracture fixation with a dynamic hip screw in relation to pre-operative fracture stability and osteoporosis. Int Orthop 25: 360–362.
10. Mariani EM, Rand JA (1987) Nonunion of intertrochanteric fractures of the femur following open reduction and internal fixation. Results of second attempts to gain union. Clin Orthop 218: 81–89.
11. Davis TR, Sher JL, Horsman A, Simpson M, Porter BB, et al (1990) Intertrochanteric femoral fractures: Mechanical failure after internal fixation. J Bone Joint Surg Br 72: 26–31.
12. Sidhu AS, Singh AP, Singh AP, Singh S (2010) Total hip replacement as primary treatment of unstable intertrochanteric fractures in elderly patients. Int Orthop 34(6): 789–792.
13. Rodop O, Kiral A, Kaplan H, Alkama I (2002) Primary bipolar hemiprosthesis for unstable intertrochanteric fractures. Int Orthop 26(4): 233–237.
14. Harwin SF, Stern RE, Kulick RG (1990) Primary Bateman-Leinbach bipolar prosthetic replacement of the hip in the treatment of unstable intertrochanteric fractures in the elderly. Orthopedics 13(10): 1131–1136.
15. C. Faldini G, Grandi M, Romagnosi S, Pagliari V, Digenaro-O., et al (2006) Surgical treatment of unstable intertrochanteric fractures by bipolar hip replacement or total hip replacement in elderly osteoporotic patients. J Orthopaed Traumatol 7: 117–121.
16. Stappert KH, Deldycke J, Broos PL, Staes FF, Rommens PM, et al (1995) Treatment of unstable peritrochanteric fractures in elderly patients with a compression hip screw or with a Vandeputte (VDF) endoprosthesis: a prospective randomised study. Journal of Orthopaedic Trauma 9(4): 292–297.
17. Parvej Singh Gulati, Rakesh Sharma, RPS Boparai, Rajesh Kapila, Aarti Devan (2009) Comparative study of treatment of intertrochanteric fractures of femur with long-stem bipolar prosthetic replacement versus dynamic hip screw fixation. Ph Journal of Orthopaedics Vol XI, No 1
18. Narayan KK, George T (2006) Functional outcome of fracture neck of femur treated with and without prophylactic antibiotic in a South Asian community. Arch Orthop Trauma Surg 126(8): 545–548.
19. Zuckerman JD (1996) Hip fractures. N Engl J Med 334: 1519.
20. Mariani EM, Rand JA (1987) Nonunion of intertrochanteric fractures of the femur following open reduction and internal fixation. Clin Orthop Relat Res 218: 81.
21. Haidukewych GJ, Berry DJ (2003) Hip arthroplasty for salvage of failed treatment of intertrochanteric hip fractures. J Bone Joint Surg Am 85(5): 899–904.
22. Cho CH, Yoon SH, Kim SY (2010) Better Functional Outcome of Salvage THA Than Bipolar Hemiarthroplasty for Failed Intertrochanteric Femur Fixation. Orthopedics 11; 33(10).
23. Watson JT, Moed BR, Craner KE, Karges DE (1998) Comparison of the compression hip screw with the Medoff sliding plate for intertrochanteric fractures. Clin Orthop Relat Res 348: 79–86.
24. Adams CI, Robinson CM, Court-Brown CM, McQueen MM (2001) Proven randomized controlled trial of an intramedullary nail versus dynamic hip screw and plate for intertrochanteric fractures of the femur. J Orthop Trauma 15(6): 394–400.
25. Boldin C, Seibert EJ, Fankhauser F, Pfeil G, Grechenig W, et al. (2003) The proximal femoral nail (PFN): a minimal invasive treatment of unstable proximal femoral fractures: a prospective study of 55 patients with a follow-up of 15 months. Acta Orthop Scand 74(1): 53–58.
26. Kenzora JE, McCarthy RE, Lowell JD, Sledge CR (1984) Hip fracture mortality. Relation to age, treatment, preoperative illness, time of surgery, and complications. J Bone Joint Surg Am 66: 43–56.
27. Baumgaertner MR, Curtin SL, Lindskog DM (1998) Intramedullary versus extramedullary fixation for the treatment of intertrochanteric hip fractures. Clin Orthop 348: 87–94.
28. Brostrom LA, Barrios G, Kronberg M, Stark A, Wallheim G (1992) Clinical features and walking ability in the early postoperative period after treatment of trochanteric hip fractures. J Bone Joint Surg 74-B: 217–225.
29. Albareda J, Laderiga A, Palanca D (1996) Complications and technical problems with the gamma nail. Int Orthop 20: 47–50.
30. Aprin H, Kilfoyle RM (1980) Treatment of trochanteric fractures with Ender rods. J Trauma 20: 32–42.
31. Chan KC, Gill GS (2000) Cemented hemiarthroplasties for elderly patients with intertrochanteric fractures. Clin Orthop Relat Res 371: 206.
32. Green S, Moore T, Pravos F (1987) Bipolar prosthetic replacement for the management of unstable intertrochanteric intertrochanteric hip fractures in the elderly. Clin Orthop Relat Res 224: 169.
33. Stern MB, Angerman A (1987) Comminuted intertrochanteric fractures treated with a Leinbach prosthesis. Clin Orthop Relat Res 218: 73.
34. Haentjens P, Casteleyn PP, De Boeck H, Handelberg F, Opdecam P (1989) Treatment of unstable intertrochanteric and subtrochanteric fractures in elderly patients. Primary bipolar arthroplasty compared with internal fixation. J Bone Joint Surg Am 71(8): 1214–25.
35. Haentjens P, Lamraoui G (2005) Endoprosthetic replacement of unstable, comminuted intertrochanteric fracture of the femur in the elderly, osteoporotic patient. Disabil Rehabil 27(18–19): 1167–1180.
36. Haentjens P, Casteleyn PP, Opdecam P (1994) Primary bipolar arthroplasty or total hip arthroplasty for the treatment of unstable intertrochanteric and subtrochanteric fractures in elderly patients. Acta Orthop Belg 60: 124–128.
37. Hummel MT, Makkani AI, Yakkanti MR, Baker DL (2009) Decreased dislocation after revision total hip arthroplasty using larger femoral head size and posterior capsular repair. J Arthroplasty 24(6): 73–76.
38. Phillips TW (1989) Thompson hemiarthroplasty and acetabular erosion. J Bone Joint Surg Am 71(6): 915–917.
39. Sierra RJ, Cabanela ME (2002) Conversion of failed hip arthroplasties after femoral neck fractures. Clin Orthop Relat Res 399: 129–139.
40. Gebhard JS, Amstutz HC, Zinari DM, Dorey EJ (1992) A comparison of total hip arthroplasty and hemiarthroplasty for treatment of acute fracture of the femoral neck. Clin Orthop Relat Res 282: 123–131.
41. Jamal Sepah Y, Umer M, Khan A, Ullah Khan Niazi A (2010) Functional outcome, mortality and in-hospital complications of operative treatment in elderly patients with hip fractures in the developing world. Int Orthop 34(3): 431–435.