



Early clinical results of cementless, bipolar hemiarthroplasty in intracapsular femur neck fractures

Kapsül içi femur boynu kırıklarında çimentosuz, bipolar hemiarthroplastinin erken klinik sonuçları

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Objectives: In this study we report our initial experience with the use of cementless, bipolar hemiarthroplasty in elderly patients with intracapsular femur neck fractures.

Patients and methods: We operated 67 consecutive patients (39 females, 28 males; mean age 74.4±11.0 years; range 41 to 99 years) who admitted to our clinic June 2007 and November 2009, due to intracapsular femur neck fracture and implanted cementless, rectangular, dual-taper, straight femoral stem (Zweymüller stem) with bipolar head prosthesis. All patients were allowed to full weight bearing with a walker within the first postoperative 48 hours.

Results: According to the Garden's classification, there were nine type II, 53 type III and five type IV fractures. Twelve patients were lost to follow-up and 21 deceased during the postoperative follow-up period. Among 34 patients with complete follow-up, 30 were evaluated for the clinical outcome. The mean follow-up time and Harris hip score of the evaluated patients were 19.4 months and 79.4 points, respectively. It was seen that, the patient age significantly correlated with the clinical outcome and a better mean hip score was obtained in the "70 years and younger age group" (83.6 points) as compared to the "older than 70 years age group" (75.6 points) (p=0.014). Mortality rate was found to be higher in patients older than 70 years (47% vs. 18%; p=0.036) and with displaced fractures (45% vs. 0%; p=0.018).

Conclusion: Zweymüller cementless bipolar hemiarthroplasty may be an alternative treatment method for intracapsular femur neck fractures especially in the patients under the age of 70 years.

Key words: Bipolar head; cementless hemiarthroplasty; femur neck; fracture.

Amaç: Bu çalışmada kapsül içi femur boynu kırığı olan yaşlı hastalarda çimentosuz, bipolar hemiarthroplasti uygulamalarında elde ettiğimiz ilk deneyimlerimiz bildirildi.

Hastalar ve yöntemler: Haziran 2007 ile Kasım 2009 tarihleri arasında kliniğimize başvuran 67 ardışık hasta (39 kadın, 28 erkek; ort. yaş 74.4±11.0 yıl; dağılım 41-99 yıl) kapsül içi femur boyun kırığı nedeniyle ameliyat edildi ve bipolar başlı, çimentosuz, dikdörtgen kesit, düz femoral saplı (Zweymüller stem) protez uygulandı. Ameliyat sonrası ilk 48 saat içinde tüm hastaların yürüteç ile tam yük vererek yürütmesine izin verildi.

Bulgular: Garden sınıflamasına göre dokuz tip II, 53 tip III ve beş tip IV kırık vardı. On iki hasta izlemden çıkarken, 21'i ameliyat sonrası izlem döneminde öldü. Eksiksiz izlemi olan 34 hastadan 30'u klinik sonuçlar için değerlendirmeye alındı. Değerlendirmeye alınan hastaların ortalama izlem süresi 19.4 ay, ortalama Harris kalça skoru ise 79.4 puanı. Hasta yaşının klinik sonuçlarla anlamlı ölçüde ilişkili olduğu görüldü ve 70 yaş ve altı hasta grubunda (83.6 puan) 70 yaş üzeri hasta grubuna (75.6 puan) oranla daha iyi ortalama kalça skoru saptandı (p=0.014). Ölüm oranı 70 yaş üzeri hastalarda (%18'e karşılık %47; p=0.036) ve ayrılmış kırıklarda (%0'a karşılık %45; p=0.018) daha yüksek olarak bulundu.

Sonuç: Zweymüller çimentosuz, bipolar hemiarthroplastisi, özellikle 70 yaş altı hastalarda, kapsül içi femur boynu kırığı için alternatif bir tedavi yöntemi olabilir.

Anahtar sözcükler: Bipolar baş; çimentosuz hemiarthroplasti; femur boynu; kırık.

Hip fractures are a major public health problem in many countries. The number of worldwide hip fractures per year is estimated to be 2.6 million by the year 2025, and

4.5 million by the year 2050.^[1] Femur neck fractures frequently occur in elderly patients, more commonly in women than in men and are usually due to simple

• Received: September 27, 2010 Accepted: December 24, 2010

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• Presented at the 10th EFORT Congress as a Free Paper, June 2-5, 2010, Madrid, Spain (10. EFORT Kongresinde sözlü bildiri olarak sunulmuştur, 2-5 Haziran, 2010, Madrid, Spain).

low-energy trauma.^[2] A considerable reduction in bone strength and tendency to fall are the two most common risk factors for femur neck fractures in the elderly.^[2]

Non-displaced femur neck fractures are commonly treated by internal fixation (IF).^[2] Treatment of displaced femur neck fractures seems to vary mainly with the age of the patient. Most surgeons prefer to perform reduction and IF in displaced fractures of patients under the age of 60 years.^[2] Hemiarthroplasty (HA), or less commonly, total hip arthroplasty (THA) is usually the choice of treatment in patients over the age of 60 years.^[2] There is no universally accepted agreement on the type of replacement arthroplasty, type of femoral stem fixation, type of the replaced femoral head and configuration of the femoral stem.^[2]

In this clinical case series, we aimed to report our initial experience with the use of cementless, rectangular, dual-taper, straight femoral stem (Zweymüller stem) with bipolar head prosthesis in intracapsular femur neck fractures among elderly patients. We assessed the effect of several preoperative and intraoperative factors such as age, gender, laterality, fracture type and surgical approach on the clinical results and mortality rates.

PATIENTS AND METHODS

The Institutional Review Board/Ethics Committee decided approval was not obtained for this study. We operated on 67 consecutive patients (39 females, 28 males; mean age 74.4 ± 11.0 years; range 41 to 99 years) with intracapsular femur neck fractures and inserted Zweymüller cementless femoral stem (SL-PLUS®, Plus Orthopedics AG, Switzerland) with bipolar head prosthesis (Plus Orthopedics AG, Switzerland) at our department between June 2007 and November 2009. The right side was affected in 31 patients and the left in 36. Sixty-six of 67 patients had a history of simple fall. In patients older than 60 years we primarily performed a cementless bipolar HA in acute or neglected displaced femur neck fractures or non-displaced fractures admitted later than five days. In patients between 40 and 60 years of age, we primarily performed cementless bipolar HA in displaced femur neck fractures admitted later than five days. We only used cemented femoral stem if chronic renal failure, severe osteoporosis or local bone tumor was present, and used THA if osteoarthritic changes in the acetabulum were present.

We used a direct lateral approach in 37 patients and a posterior approach in 30 patients to insert the prosthesis. This was primarily the choice of the attending surgeon. The entire operating time did not exceed 90 minutes in any patient. We did not observe significant intraoperative bleeding requiring blood transfusion more than 450 cc. We allowed full

weight bearing with a walker within the first postoperative 48 hours. We administered routine postoperative parenteral antibiotic prophylaxis with a first generation cephalosporin for 72 hours and parenteral deep vein thrombosis prophylaxis with low molecular weight heparin for at least 10 days in all patients. We usually discharged the patients from the hospital at the end of the first postoperative week.

Twelve patients (18%) were lost to follow-up within the first six postoperative months. Among the remaining 55 patients, 21 (38%) expired. Of the remaining 34 patients, four were excluded from the study due to co-existence of a cerebrovascular disorder causing a non-ambulatory status (3 patients) and replacement of a revision THA (1 patient). The remaining 30 patients (20 females, 10 males; mean age 70.5 ± 12.0 years; range 41 to 88 years) with a complete follow-up more than six months, were included the study for the evaluation of the clinical results. The affected side was left in 16 patients and right in 14. The preferred surgical approach was lateral in 19 patients and posterior in 11.

Fracture type was graded using the Garden classification.^[3] Type I-II fractures were termed "non-displaced fracture" and type III-IV fractures as "displaced fracture". Latest clinical outcomes of the patients were assessed using the Harris hip score.^[4] According to this scoring system, a total of 90-100 points indicated an "excellent outcome", 80-89 points a "good outcome", 70-79 points a "fair outcome" and less than 70 points a "poor outcome".^[4]

Comparing the quantitative hip scores assessed the effect of several preoperative and intraoperative factors on the clinical outcome and the t-test for independent samples was the preferred statistical test. The effect of several preoperative and intraoperative factors on the mortality rate was assessed by comparing the frequencies between two groups and the Pearson's chi-square and the Fisher's exact tests were used for this purpose. A *p* value less than 0.05 was considered significant.

RESULTS

Among the initially admitted 67 patients, 9 (13%), had a Garden type II fracture, 53 (79%) type III and five (8%) type IV. It was seen that the >70 years age group had a considerable higher rate of displaced fracture than the ≤ 70 years age group (44/47; 94% vs. 14/20; 70%, $p=0.017$). The distribution of the types of fracture among the 30 clinically evaluated patients was as follows; type II: eight (26%), type III: 20 (67%), type IV: two (7%). The preferred surgical approach was not similar between age groups; a lateral approach was frequently preferred in the ≤ 70 years age group (15/20; 75%), whereas a

posterior approach was more commonly preferred in the >70 years age group (25/47; 53%, $p=0.034$).

Mean follow-up of the 30 examined patients was 19.4 ± 9.3 (range 7 to 35) months. Mean Harris hip score of these patients was 79.4 ± 9.2 (range 51-95) points, at the latest follow-up. According to the scoring system, four patients (13%) had excellent, 11 patients (37%) good, 12 patients (40%) fair and three patients (10%) poor clinical outcomes (Figure 1). Patients younger than 70 years had significantly better hip scores than patients older than 70 years (Table I). Furthermore, patients treated via the lateral approach had somewhat better hip scores than the patients treated via the posterior approach (Table I). Gender, laterality and fracture type did not have any significant influence on the clinical outcome (Table I).

Mean age at operation was 79.2 ± 10.1 (range 51-99) years in 21 deceased patients. Mean time of death in these patients was 5.3 ± 5.3 (range 0-22) months, postoperatively. Two of them expired within the first 24 postoperative hours, 17 between one and 10 months postoperatively and two within the second postoperative year. Age of the patient and fracture type had a considerable correlation with mortality rate. Mortality rates were higher in patients older than 70 years and with displaced fractures (Table II).

Three surviving patients were non-ambulatory due to cerebrovascular disorders. Two of them already had stroke preoperatively, and one became non-ambulatory due to a cerebrovascular accident at two months postoperatively. One patient had a two-stage revision THA due to infection one year postoperatively. We did not see periprosthetic osteolysis, periprosthetic femur fracture or prosthesis dislocation in any of the patients.

DISCUSSION

There are numerous debates on the optimum surgical management of femoral neck fractures in elderly patients. Internal fixation and arthroplasty are the two current options for the surgical treatment of intracapsular femur neck fractures.^[5] Comparison of IF and arthroplasty in the management of displaced femur neck fractures has revealed that arthroplasty has lower rates of surgical complications and of reoperation and better cost-effectiveness than IF.^[6-8] On the other hand, IF has a less significant rate of deep wound infection, shorter operating time, less intraoperative bleeding and lower rates of early mortality than arthroplasty.^[6,8] Comparison of IF and HA in the management of non-displaced femur neck fractures has revealed that HA has a higher rate of mortality than IF.^[2] We prefer arthroplasty rather than IF in patients older than 60 years if an acute or neglected Garden type III or IV fracture and a



Figure 1. Anteroposterior preoperative (a) and follow-up (b) radiographs of the left hip of an 86 years old female patient with a displaced intraarticular femur neck fracture. She was surgically treated using a Zweymüller cementless hemiarthroplasty. At postoperative 30 months Harris hip score was 84 points (good outcome).

TABLE I

Comparison of mean hip scores regarding several factors in 30 surviving patients having no stroke or prosthesis revision

Factor	Harris hip score ^[4]		
	Mean±SD	Range	<i>p</i>
Age			
≤70 years (n=14)	83.6±7.6	72-95	0.014*
>70 years (n=16)	75.6±9.0	51-87	
Gender			
Male (n=10)	79.7±11.9	51-92	0.891
Female (n=20)	79.2±7.9	66-95	
Side			
Right (n=14)	80.9±8.0	68-94	0.416
Left (n=16)	78.1±10.2	51-95	
Fracture type			
Non-displaced (n=8)	78.4±7.3	72-92	0.728
Displaced (n=22)	79.7±9.9	51-95	
Surgical approach			
Lateral (n=19)	81.8±8.1	68-95	0.056
Posterior (n=11)	75.2±9.9	51-84	

SD: Standard deviation; *: Significant difference.

TABLE II

Comparison of mortality rates concerning several factors in 55 patients who were not lost to follow-up

Factor	Mortality rate		
	n	%	<i>p</i>
Age			
≤70 years	3/17	18	0.036*
>70 years	18/38	47	
Gender			
Male	11/23	48	0.212
Female	10/32	31	
Side			
Right	11/27	41	0.701
Left	10/28	36	
Fracture Type			
Non-displaced	0/8	0	0.018*
Displaced	21/47	45	
Surgical approach			
Lateral	12/32	38	0.902
Posterior	9/23	39	

*: Significant difference.

neglected Garden type II fracture exists. We also prefer arthroplasty rather than IF in neglected Garden type III and IV fractures between 40 and 60 years of age.

Comparison of cementless and cemented femoral stems in the management of femur neck fractures has revealed that cementless stems have shorter operative time and lesser intraoperative bleeding than cemented stems.^[9-11] Conversely, cemented stems have less postoperative pain, better mobility and lower revision rates.^[9-11] Intraoperative death risk is significantly increased in elderly patients with pre-existing cardiovascular problems undergoing a cemented arthroplasty, especially for fracture diagnosis.^[12] Comparison of bipolar and unipolar heads in the management of femur neck fractures has revealed that there is no difference between bipolar and unipolar HA regarding the outcome and the rate of dislocation.^[11,13] However, failure of reduction by closed means is higher in bipolar heads than in unipolar heads.^[13] The most significant determinant of dislocation is the surgical approach, with the posterior approach having the highest dislocation rate.^[13] Comparison of HA and THA in the management femur neck fractures has shown that THA has better functional outcomes and lower rates of revision than HA, and is especially recommended in active elderly patients without significant medical comorbidities.^[6,11,14] We have been performing cementless bipolar HA in most of the elderly patients with femur neck fractures if an arthroplasty indication is present since 2007. We

have been using cemented HA, unipolar HA and THA only in selected cases. In our opinion, the cementless stem seems to have stronger bone fixation, lower risk of loosening, shorter operative time, and no risk of intraoperative complication due to cement application when compared with the cemented stem. In our opinion, the bipolar head may have lower risks of wear, acetabular protrusion and prosthesis dislocation than the unipolar head. We frequently prefer HA over THA due to surgical simplicity, shorter operative time, lesser intraoperative bleeding, and lower risk of dislocation and slightly cheaper implant cost.

The most important advantage of the Zweymüller cementless femoral stem is its stability due to existence of proximal fit, double-taper straight stem, rectangular cross section and surface microroughness providing suitable osteointegration.^[15] This early stability allows immediate postoperative full-weight bearing mobilization of patients with a walker. It was recently reported that there was no difference between a certain period of partial weight bearing and immediate full weight bearing postoperatively with regard clinical outcome, pain level, shaft migration or radiographic signs of bony ingrowth in cementless arthroplasty apart from the patient's age, if an initial solid fixation could be obtained.^[16] We have been allowing full weight bearing within the first postoperative 48 hours, due to the initial solid fixation of the Zweymüller cementless femoral stem.

Increasing age, cognitive impairment and any degree of preoperative impaired mobility are poor prognostic factors for obtaining an acceptable level of functional outcome in femur neck fractures undergoing replacement arthroplasty.^[2] The preferred surgical approach has no significant correlation with functional outcome.^[17] The results of the present study revealed that excellent or good short-term clinical outcome could be obtained in half of the patients and increasing age seemed to be the main poor prognostic factor for clinical outcome. The cut-off point for obtaining a better clinical outcome could be considered 70 years, as patients over the age of 70 years had worse clinical results than younger patients. Although surgical approach was found to slightly influence the clinical outcome, this finding was probably related to the age of the patient, as the lateral approach was commonly performed in younger patients and the posterior approach was commonly performed in patients older than 70 years in the present study. We did not evaluate the correlation between clinical results and coexisting medical morbidities of the patients, as this was not the primary aim of the study.

The risk of mortality after femoral neck fractures is significantly high. The rate of hospital mortality is 15% and the mortality rate at the end of the first postoperative year is 30%.^[2] The presence of concomitant medical problems, increasing age, male gender and prolonged time between injury and surgery are the known risk factors increasing the mortality rate in patients undergoing HA due to femur neck fractures.^[2,18,19] In the present study, the overall mortality rate was 38% and the rate of hospital mortality was about 10%. It was remarkable that more than two thirds of deaths occurred within the first six postoperative months. The possible explanation for obtaining slightly higher mortality rates than average could be that most of the patients with coexisting significant medical problems were referred to our university hospital serving nearly two million inhabitants. Age of the patient (>70 years) and type of the fracture (displaced fracture) were found to be associated with the most devastating complication. However, we suggest that the type of fracture might not directly relate with mortality rate as the older age group (>70 years) had considerably higher number of displaced fractures than the younger age group (\leq 70 years) in the present study. We did not assess the correlation between mortality rate and coexisting morbidities, as this was not one of the aims of the present study. It is not possible to draw stronger conclusions on the local infectious and systemic neurologic complications due to small number of affected patients.

Size of the patient population and the mean follow-up time of the patients in the present study can be

considered inadequate to draw stronger conclusions. However, the high rate of early mortality and limited life expectancy of the elderly patients undergoing arthroplasty for femur neck fractures prevent reporting case series, including higher number of patients with longer follow-up periods.

It is currently not possible to provide strong evidence on which type of arthroplasty is the best option to obtain enhanced clinical results, minor surgical complications and better cost-effectiveness in femoral neck fractures. With the numbers available in the present study, we may conclude that Zweymüller cementless femoral stem with bipolar head prosthesis give better clinical results in patients under the age of 70 years and the risk of mortality increases in patients older than 70 years. Therefore, Zweymüller cementless bipolar HA may be an effective treatment alternative for intracapsular femur neck fractures especially in patients under the age of 70 years.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding

The authors received no financial support for the research and/or authorship of this article.

REFERENCES

1. Gullberg B, Johnell O, Kanis JA. World-wide projections for hip fracture. *Osteoporos Int* 1997;7:407-13.
2. Keating J. Femoral neck fractures. In: Buchholz RW, Heckman JD, Court-Brown CM, Tornetta III P, editors. *Rockwood and Green's fractures in adults*. 7th ed. Philadelphia: Lippincott-Williams and Wilkins; 2010. p. 1561-96.
3. Garden RS. Low-angle fixation in fractures of the femoral neck. *J Bone Joint Surg [Br]* 1961;43:647-63.
4. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. *J Bone Joint Surg [Am]* 1969;51:737-55.
5. Parker MJ. The management of intracapsular fractures of the proximal femur. *J Bone Joint Surg [Br]* 2000;82:937-41.
6. Heetveld MJ, Rogmark C, Frihagen F, Keating J. Internal fixation versus arthroplasty for displaced femoral neck fractures: what is the evidence? *J Orthop Trauma* 2009;23:395-402.
7. Iorio R, Healy WL, Lemos DW, Appleby D, Lucchesi CA, Saleh KJ. Displaced femoral neck fractures in the elderly: outcomes and cost effectiveness. *Clin Orthop Relat Res* 2001;383:229-42.
8. Wang J, Jiang B, Marshall RJ, Zhang P. Arthroplasty or internal fixation for displaced femoral neck fractures: which is the optimal alternative for elderly patients? A meta-analysis. *Int Orthop* 2009;33:1179-87.

9. Ahn J, Man LX, Park S, Sodl JF, Esterhai JL. Systematic review of cemented and uncemented hemiarthroplasty outcomes for femoral neck fractures. *Clin Orthop Relat Res* 2008;466:2513-8.
10. Khan RJ, MacDowell A, Crossman P, Keene GS. Cemented or uncemented hemiarthroplasty for displaced intracapsular fractures of the hip—a systematic review. *Injury* 2002;33:13-7.
11. Parker MJ, Gurusamy KS, Azegami S. Arthroplasties (with and without bone cement) for proximal femoral fractures in adults. *Cochrane Database Syst Rev* 2010;6:CD001706.
12. Parvizi J, Holiday AD, Ereth MH, Lewallen DG. The Frank Stinchfield Award. Sudden death during primary hip arthroplasty. *Clin Orthop Relat Res* 1999;369:39-48.
13. Varley J, Parker MJ. Stability of hip hemiarthroplasties. *Int Orthop* 2004;28:274-7.
14. Goh SK, Samuel M, Su DH, Chan ES, Yeo SJ. Meta-analysis comparing total hip arthroplasty with hemiarthroplasty in the treatment of displaced neck of femur fracture. *J Arthroplasty* 2009;24:400-6.
15. Zweymüller KA, Lintner FK, Semlitsch MF. Biologic fixation of a press-fit titanium hip joint endoprosthesis. *Clin Orthop Relat Res* 1988;235:195-206.
16. Markmiller M, Weiß T, Kreuz P, Rüter A, Konrad G. Partial weightbearing is not necessary after cementless total hip arthroplasty: a two-year prospective randomized study on 100 patients. *Int Orthop* 2010 Jul 11. [Epub ahead of print]
17. Altay MA, Ertürk C, Işıkan UE. Bipolar hemiarthroplasty for the treatment of femoral neck fractures and the effect of surgical approach on functional results. [Article in Turkish] *Eklemler Hastalıkları Cerrahisi* 2010;21:136-41.
18. Lim YW, Kwon SY, Han SK, Sun DH, Choi SP, Kim YS. Postoperative mortality and factors related to mortality after bipolar hemiarthroplasty in patients with femoral neck fractures. *J Arthroplasty* 2009;24:1277-80.
19. Sener M, Onar V, Kazlımoğlu C, Yağdı S. Mortality and morbidity in elderly patients who underwent partial prosthesis replacement for proximal femoral fractures. [Article in Turkish] *Eklemler Hastalıkları Cerrahisi* 2009;20:11-7.