National Journal of Clinical Orthopaedics

ISSN (P): 2521-3466
ISSN (E): 2521-3474

www.orthoresearchjournal.com
2018; 2(4): 25-29
Received: 27-08-2018
Accepted: 28-09-2018

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# A comparison of two different surgical treatment methods for Ao-Ota type 31a2 hip fractures in patients aged over 75 years

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**Abstract**
**Introduction:** The aim of the this studyis to compare PFNa application and uncemented bipolar partial prosthesis in AO/OTA 31 A2 type fractures in patients aged >75 years, in terms of functional scores and complication rates, and to then discuss the advantages and disadvantages of the two different methods.
**Material and Method:** A retrospective examination was made of a total of 132 patients who were operated on because of unstable femoral proximal fracture in 2 different centres between January 2012 and June 2016. 27 patients who selected according to specified criteria in each group were compared in respect of functional scores at the final follow-up examination, complications, hospital length of stay, use of fluoroscopy, time to mobilization, and blood transfusion.
**Result:** In respect of functional scores, the mean postoperative HHS in groups 1 and 2 were 82.3 and 79.8, respectively (p=0.425), and the pre-postoperative change in KAI in respective order was determined as -0.98 and -1.36 (p=0.114 the length of stay in hospital was found to be statistically significantly shorter in group 1 (p<0.05). The duration of fluoroscopy use was determined to be shorter in group 2.
**Conclusion:** PFNa usage with applied according to fixation principles can be considered more preferable in these types of fractures. However, in patients with an additional systemic disease, poor bone quality, and where problems may be experienced in fixation, hemiarthroplasty can be considered a good alternative to PFNa.

**Keywords:** fractures, patients, PFNa, Shapiro-Wilk, surgical treatment

## Introduction
Although osteosynthesis is the accepted primary treatment choice in intertrochanteric femoral fractures, because of fixation losses occurring in unstable fractures and fixation difficulties caused by low bone quality, the application of hemiarthroplasty in geriatric unstable intertrochanteric fractures has had a place in orthopedic practice for some time [1]. The mortality rate is known to be high in these patients with unstable fractures and there is a low probability of them regaining the pre-fracture level of activity [2]. One of the most important factors in reducing the morbidity and mortality in these patients is the provision of early mobilization. In respect of preventing complications such as atelectasis, deep vein thrombosis (DVT), pulmonary embolism, and bedsores, early mobilization is of great importance [3]. Partial weight-bearing mobilization is a significant problem for the majority of patients aged over 75 years and the desired mobility often cannot be obtained in these patients.
The application of hemiarthroplasty provides the advantages of early movement and mobilization and has taken a step forward with new-generation anti-rotation proximal femoral nails (PFNa). Therefore, because of the superior biomechanical properties of significant resistance to deforming forces, the possibility of early full weight-bearing and biologic application is provided, so it has become the preferred treatment option in many centers [3, 6]. Biomechanical and clinical studies made with PFN a have shown that this implant could make a significant contribution to overcoming the problems related to fixation in unstable intertrochanteric femoral fractures [7, 8]. However, in cases where the appropriate implant has not been selected or appropriate reduction and fixation techniques have not been used, the rate of possible failure increases.
In comparative studies made following surgery without the use of appropriate implants and

Techniques, the results could be misleading [9]. Therefore, in this study, a comparison was made of functional scores, perioperative parameters, and complication rates in AO-OTA 31 A2 type fractures in patients aged over 75 years who received uncommented bipolar partial prosthesis or PFN a with the defined technical criteria, and the advantages and disadvantages of the two methods are discussed according to the results obtained.

**Material and Method**

A retrospective examination was made of a total of 132 patients who were operated on because of unstable femoral proximal fracture in 2 different centres between January 2012 and June 2016. Fixation was applied with PFNa in 74 patients and with calcar replacement bipolar partial prosthesis in 58. Patients with at least 1 year of follow-up were included in the study. During the follow-up period, 3 patients applied with PFNa and 9 patients applied with prosthesis were determined as exitus. A total of 23 patients in the PFNa group and 18 in the hemiarthroplasty group were excluded because of mortality, follow-up of less than 1 year, immobility before the fracture, or severe comorbities that could affect bone quality such as chronic renal failure, rheumatoid arthritis, or advanced osteoporosis.

When planning the study, it was aimed to compare the two methods in respect of both functional outcomes and complications in the operations performed according to the scientific criteria of the techniques. Therefore, the patients remaining after the exclusion criteria were applied were evaluated radiologically by 2 separate surgeons and their conformity to the operation applied was assessed in terms of the technique. The PFNa group were evaluated in respect of the fixation principles such as placement of the lag screw, tip-apex distance, and reduction quality and 36 of the 51 patients remaining after the exclusion criteria were found to conform to the technical criteria [10]. In the group applied with hemiarthroplasty, 27 of the 40 patients remaining after the application of the exclusion criteria were determined to have been operated on appropriately in respect of prosthesis size, correct placement in respect of height and offset angle and t.major fixation [11]. Finally, of the 132 patients retrospectively reviewed, 36 in the PFNa group and 27 in the hemiarthroplasty group were found to meet the study criteria.

To equalise the groups of 36 patients in the PFNa group and 27 in the hemiarthroplasty group, patients from each group closest in terms of age, gender, comorbidities and bone quality were selected to form Group 1 (PFNa, n=27) and Group 2 (hemiarthroplasty, n=27).

The patients in each group were compared in respect of functional scores at the final follow-up examination, complications, hospital length of stay, use of fluoroscopy, time to mobilization, and blood transfusion. The functional evaluations of the patients at the final follow-up examination were made by two surgeons independent of the study. The evaluation of the functional scores was made using the Harris Hip Score (HHS) and the Katz Activity Index (KAI). For the evaluation of osteoporosis in both groups, the Singh Index was used (12). The ethical research committee approved study protocol.(ANEAH/2.8.2017-94). Written consent from the patients next-of-kin has been consent.

**Statistical Analysis**

The data obtained in the study were analyzed using SPSS Ver. 20 software.

When assessing the conformity of the variables to normal distribution, the Shapiro-Wilk test was used because of the unit numbers. In the interpretation of the results, a significance level of 0.05 was used: a value of $p<0.05$ indicated that the variables did not conform to normal distribution and $p>0.05$ indicated conformity to normal distribution.

In the examination of differences between the groups, the Mann-Whitney U test was used because the variables did not conform to normal distribution.

In the examination of relationships between groups of nominal variables, Chi-square analysis was applied. In the interpretation of the results, a significance level of 0.05 was used.

**Results**

With 27 patients in each group, a total of 54 patients were evaluated in the study. In group 1, the mean age was 83 years, (range, 75-92 years) and the mean follow-up period was 29.3 months (range, 15-49 months). In group 2, the mean age was 84.1 years, (range, 76-98 years), and mean follow-up period was 31.2 months (range, 14-50 months). With the exception of 3 patients in group 1 and 4 patients in group 2, the follow-up period was longer than 2 years. Both groups were similar in respect of sex, comorbidities, Singh Index, and affected side (Table 1).

In respect of functional scores, the mean postoperative HHS in groups 1 and 2 were 82.3 and 79.8, respectively ($p=0.425$), and the pre-postoperative change in KAI in respective order was determined as -0.98 and -1.36 ($p=0.114$). The results were superior in group 1 (PFNa) but not to a statistically significant level. (Figure 1, figure 2).The length of stay in hospital was found to be statistically significantly shorter in group 1 ($p<0.05$). The duration of fluoroscopy use was determined to be shorter in group 2. (Figure 3, Figure 4)No statistically significant difference was determined between the groups in respect of operating time and time to mobilization (Table 2).

Complications developed in 4 (14.8%) patients in group 1; infection in 2 patients, cutout in 1, and malunion in 1. In group 2, complications developed in a total of 9 (33.3%) patients; infection in 3 patients, acetabular erosion in 1, loosening in 1, trochanteric non-union in 2, and luxation in 2. The complication rate in group 2 was determined to be statistically significantly higher (Table 3).

**Discussion**

The aim of treatment in geriatric hip fractures is to rapidly mobilize the patient and to regain an activity level close to that of the pre-fracture period in a short time with as few complications as possible [11]. However, even after successfully performed operations, this is not always possible [13, 14]. Throughout the development period of fixation materials, fixation loss, excessive collapse, and malunion associated with low bone quality and an unstable structure of the fracture in AO/OTA 31 A2 type fractures have resulted in poor functional scores of osteosynthesis in the elderly. As a result of complications such as fixation loss, implant failure or malunion in the past caused by the use of fixation materials such as Ender nails, angulated plates or dynamic hip screws (DHS) in unstable intertrochanteric fractures, hemiarthroplasty has been accepted as the first treatment choice in these types of fractures by some authors. An area of use for hemiarthroplasty in these types of fractures has been created in this process, which is still ongoing [1, 15-19].

Authors who performed hemiarthroplasty have emphasized that partial prosthesis application is superior to fixation because of the advantage of early weight-bearing in addition to low

complication rates [1, 19]. Furthermore, this process has shown a development and differentiation trend in the fixation methods used in unstable intertrochanteric fractures. In recent studies of the design and biomechanics of PFN, intramedullary implants have revealed superior qualities compared with DHS. With the design of PFN a, early and full weight-bearing has become possible even in unstable fractures, and implants that could be an alternative with the advantages suggested of hemiarthroplasty have started to be used with better functional results and fewer complications [16].

PFN started to be used at an increasing rate in clinical practice with low complication rates and less bleeding compared with other intramedullary nailing systems (5, 20-22). Over time, large-series studies revealed clinical and biomechanical advantages, and because a superiority over hemiarthroplasty was found in certain parameters, it became the first treatment choice in many centres for these types of fractures [11, 2-25]. In the current study, patients with poor results associated with technical procedural errors of both methods were excluded from the study and thus it was aimed to compare the results of the two implants that were thought to have been applied successfully according to the defined standards.

In a study that reported the results of uncemented, calcar-support partial prosthesis use in unstable proximal femoral fractures, it was stated that fixation obtained without resection of the calcar section was important in respect of the long-term stability and life of the prosthesis [26]. However, in many studies, such an application of hemiarthroplasty is not recommended. In the current study, the fractured calcar section was resected and the prosthesis was placed by calculating the appropriate calcar length. In the mean 22-month follow-up of the current study patients, no negativity was determined in respect of function or prosthesis life. Nevertheless, a more robust conclusion could be drawn from long-term follow-up.

In these types of fractures, it is very important to provide appropriate and stable reduction and fixation of the trochanter major. It is essential that stable and anatomic fixation is made of the trochanter major. Furthermore, it must not be forgotten that there is a relatively increased risk of dislocation in intertrochanteric fractures [27]. In the current study, in the 2 dislocations seen in the prosthesis group, there was a displaced fracture in the trochanter major. In both cases, despite obtaining radiologically appropriate reduction and fixation, the observation of luxation supports the hypothesis that an increased dislocation rate is expected following intertrochanteric fractures, even if trochanter major fixation has been performed appropriately.

In previous comparative studies, just as there are publications that have reported the superiority of hemiarthroplasty in respect of functional scores [22, 23, 28], there are also studies that reported no significant difference between the two groups or that PFNa was superior [6, 12, 18, 19]. In the current study, in the clinical evaluation at the end of a mean 22-month follow-up period, although no significant difference was found in the functional scores, PFN awas determined to be superior in respect of hospital length of stay, blood loss, and complication rates. Although hemiarthroplasty was found to be superior in terms of the time to mobilization and the use of fluoroscopy, with longer follow-up there will be an increased probability of problems associated with the implant such as acetabular erosion, loosening, and late infection because hemiarthroplasty is not a biologic treatment option, and these remain a possibility throughout the life of the patient. The most important advantages of hemiarthroplasty in these fractures was early mobilization and early weight-bearing, and a better functional score was seen after the use of PFN a, but because no significant difference was seen between the groups in the current study, as in several previous studies, fixation with PFN a can be considered a more preferable treatment choice in AO/OTA type 31 A2 type fractures.

The limitations of the current study were that the follow-up period was insufficient and the groups formed were operated on by different surgeons. With a longer follow-up period, additional problems such as function loss and changes in complications, which could form in both groups, could be shown and these might affect the results. However, that evaluations were made of conformity to the technical criteria by independent surgeons when forming the groups can be considered to have somewhat mitigated problems that could have been created by differences in approach and experience of the surgeons.

## Conclusion

It must not be forgotten that a successfully applied fixation that has reached its goal will spare the patient from problems in the medium and long-term such as late infection, loosening, and acetabular wear, which require severe and costly interventions. PFNa usage with a well-performed reduction, and applied according to fixation principles can be considered more preferable in these types of fractures. However, in patients with an additional systemic disease, poor bone quality, and where problems may be experienced in fixation, hemiarthroplasty can be considered a good alternative to PFNa and it is important that it is readily available in cases where fixation problems may occur in primary osteosynthesis However, in patients with an additional systemic disease, poor bone quality, and where problems may be experienced in fixation, hemiarthroplasty can be considered a good alternative to PFN a and it is important that it is readily available in cases where fixation problems may occur in primary osteosynthesis.

## Legends of Table and Figures

**Table 1**: Comparison of the groups in respect of age, gender, Singh index and comorbidities

| | Number of patients | Gender | Age (mean) | Mean Singh index value | Comorbidities (DM,HT, CVD, COPD) | Side |
|---|---|---|---|---|---|---|
| Group 1 | 27 | M:10 F:17 | 83.0 (75-92) | 2.5 ± 0.6 | 23 (%85.1) | L:14R:13 |
| Group 2 | 27 | M:9 F:18 | 84.16 (76-98) | 2.3 ±0.7 | 25(%92) | L:15 R:12 |

**Table 2:** Distribution Table by Value by Groups

| | | Grup | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **n** | **Mean** | **Median** | **Min** | **Max** | **ss** | **p** |
| Pre Activity Score | Group 1 | 27 | 4,88 | 5 | 4 | 6 | 0,78 | 0,892 |
| | Group 2 | 27 | 4,84 | 5 | 4 | 6 | 0,69 | |
| Post Activity Score | Group 1 | 27 | 3,9 | 4 | 3 | 6 | 1 | 0,415 |
| | Group 2 | 27 | 3,48 | 4 | 3 | 5 | 0,7 | |
| Post Harris | Group 1 | 27 | 82,3 | 78 | 70 | 92 | 7,42 | 0,425 |
| | Group 2 | 27 | 79,8 | 77 | 69 | 88 | 5,28 | |
| Hospitalization period | Group 1 | 27 | 2,8 | 3 | 2 | 4 | 0,71 | 0,001 |
| | Group 2 | 27 | 3,6 | 4 | 2 | 5 | 0,82 | |
| Mobilization time | Group 1 | 27 | 1,96 | 2 | 1 | 3 | 0,79 | 0,472 |
| | Group 2 | 27 | 1,8 | 2 | 1 | 3 | 0,71 | |
| Activity score difference | Group 1 | 27 | -0.98 | - | - | - | | 0.114 |
| | Group 2 | 27 | -1.36 | - | - | - | | |
| Fluoroscopy Time(s) | Group 1 | 27 | 142.04 | 145 | 100 | 188 | 22.57 | - |
| Transfusion(u) | Group 1 | 27 | 0.6 | 1 | 0 | 2 | 0.77 | 0.032 |
| | Group 2 | 27 | 1.6 | 1 | 0 | 3 | 0.82 | |

**Table 3**: Comparison of complications

| | **Group 1 (n=27)** | **Group 2 (n=27)** | **P value** |
|---|---|---|---|
| Complications | 4(14.8%) | 8(29.6%) | <0.05 |
| Length of stay (days)* | 2.8 | 3.9 | <0.05 |
| Blood transfusion (units)* | 0.9 | 2.1 | <0.05 |
| Operating time (mins)* | 51.4 | 79.2 | <0.05 |
| Time to mobilization (days)* | 2.8 | 1.2 | <0.05 |
| Fluoroscopy time (secs)* | - | 142 | |

Values are given as means

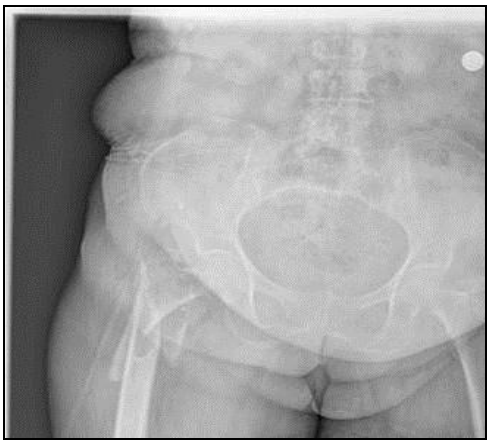

**Fig 1:** Anteroposterior radiograph showing an unstable intertrochanteric fracture of the right hip in an eighty-eight-year-old woman who fell at home.

**Fig 3:**: Anteroposterior radiograph showing an unstable intertrochanteric fracture of the left hip in an eighty two years old woman who fell at home.

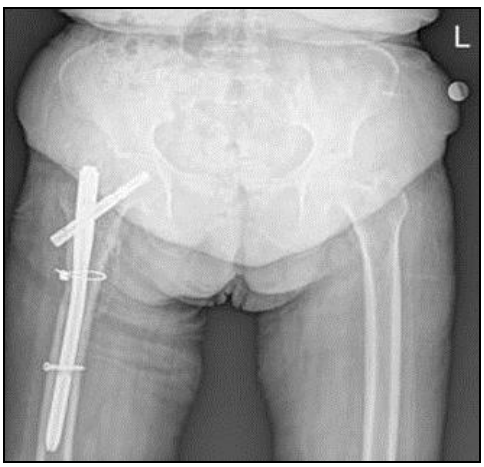


**Fig 2:** Radiograph made fifhteen months after fixation with a proximal femoral nail, a healed fracture.

**Fig 4:** Radiograph made eleven months after a cementless calcar-replacement hemiarthroplasty.

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