Outcome Analysis of Osteosynthesis versus Hemiarthroplasty for the Treatment of Displaced Femoral Neck Fracture in Young Elderly Patients of Northern India

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Abstract

Objective: The objective of this study lies in the outcome analysis of osteosynthesis versus hemiarthroplasty for the treatment of displaced femoral neck fracture in young elderly patients of northern India. Study Design: Retrospective study. Setting and Duration: This study was conducted at the Department of Orthopaedics, Institute of Medical Sciences, Benaras Hindu University (BHU), at a trauma center setting from January 2015 to January 2017 and were followed up for an average duration of 12 months. Methods: Patients of displaced neck of femur fracture (Pauwell’s Types III and IV) divided into two groups who were treated with osteosynthesis with cannulated cancellous screws versus hemiarthroplasty at a trauma center, BHU, were considered for this study, and their retrospective data were analyzed for the incidence of union, infection, functional outcome, and complications in the osteosynthesis versus hemiarthroplasty group. Out of a total of 84 patients studied, 40 belonged to the osteosynthesis group and 44 belonged to the hemiarthroplasty group. Results: In terms of functional outcome, the hemiarthroplasty group consistently outperformed the osteosynthesis group using Harris Hip Score and Palmer and Parker mobility score. This difference was found statistically significant ($P = 0.003$). As for the complications, in the osteosynthesis group, 6 patients suffered avascular necrosis of the femoral head and 12 patients suffered nonunion of the femoral head with screw cutout. This led to the reoperation of 16 patients. None of the patients in the osteosynthesis group suffered infection. In the hemiarthroplasty group, one patient suffered infection leading to reoperation and thorough debridement of one hip. Hemireplacement group showed a significantly lower percentage of complication as compared to the osteosynthesis group. Conclusion: It is evident that the functional outcome is much better in the hemiarthroplasty group as compared to the osteosynthesis group in displaced femoral neck fractures. Advantages of hemiarthroplasty are early mobilization and rehabilitation, early return to work as compared to the osteosynthesis group which has higher incidence of nonunion, screw cutout, delayed rehabilitation, and prolonged period of nonweight bearing. A significant disadvantage of osteosynthesis is prolonged immobilization, which has cost implications and loss of daily wages in a low-resource country like India.

Keywords: Cannulated cancellous screw, displaced elderly femoral neck fracture, Harris Hip Score, hemiarthroplasty, Palmer and Parker mobility score

INTRODUCTION

There is a rapid increase in the incidence of femoral neck fractures in old age. The probable reasons are increasing the average life span of Indian population due to recent advances in medical care, increasing social status, osteoporosis, and the ability of elderly population to lead an active outdoor lifestyle. Especially in Asia, the incidence of femoral neck fracture is steadily increasing and according to a study, more than 50% of fractures are expected to occur in Asia by 2050. The mainstay of treatment of femoral neck fracture is operative. Osteosynthesis is the preferred modality of treatment in younger patients, whereas in elderly patients,
arthroplasty is the commonly advised treatment method. In young patients, internal fixation should be preferred even in severely displaced femoral neck fractures. Because of complications such as fixation failure, nonunion, osteonecrosis, and delayed postoperative mobilization, the failure rate of osteosynthesis is found to be as high as 20% in elderly neck femur fractures.\[3,4\] Low bone density in the Asian population as compared to the Western population is an independent risk factor for osteoporotic fractures, which increases the possibility of fixation failure and elderly femoral neck fracture.

The purpose of this study is to compare the clinical results between osteosynthesis and hemiarthroplasty for displaced femoral neck fractures in North Indian elderly patients aged between 60 and 70 years and study the associated factors causing failure of osteosynthesis.

**Methods**

We included 84 patients in this study aged between 60 and 70 years who were diagnosed as having femoral neck fracture (Garden’s III and IV) treated in the Trauma Center, Institute of Medical Sciences, Benaras Hindu University (BHU), from January 2015 to January 2017. The average follow-up duration for these patients was 12.8 months (range 5–21 months). Patients with a medical history (neoplasia, coronary vascular disease, rheumatoid arthritis, osteomyelitis, and steroid intake causing increased incidence of avascular necrosis) were excluded from the study. In addition, patients with ipsilateral limb fractures or deformities, contralateral limb fractures or deformities, pelvic and spine fractures, and pathological fractures or any other neuromuscular condition which hamper rehabilitation of the patient were excluded from the study. Osteoporosis was diagnosed as Singh’s Index grade 4 or lower, based on trabecular pattern type in the femoral head and proximal femur. Clinical evaluation of the patient was made using Harris Hip Score with pain and gait as the main components. Palmer and Parker Mobility Score was also used to assess mobility. Failure of osteosynthesis was defined as nonunion, avascular necrosis, screw cutout, and implant breakage. Aseptic loosening, periprosthetic fracture, two or more recurrent dislocation, infection, etc., were defined as failure of hemiarthroplasty in our study.

Intraoperative assessment of reduction was done by calculating Garden Alignment Index in both anteroposterior (AP) and lateral images on C-arm and in postoperative plain radiograph. Acceptability criterion was between 160° and 180° in AP image and 170° and 190° in the lateral radiograph. It was graded as excellent reduction if both radiographs fell within the range, good reduction if only one fell within the range, and bad reduction if none were in the range. The quality of fixation was assessed using the following two parameters: (1) tip apex distance – the distance between the screw tip and femoral articular surface in both the planes and (2) three-point fixation was assessed using infratemporal cortical bone of the femoral neck. If the average distance to the subchondral boundary of the femoral head was 10 mm or shorter and three-point fixation was satisfactory, it was graded as excellent. If the average distance was longer than 10 mm with satisfactory three-point fixation or if the average distance was 10 mm or shorter with unsatisfactory three-point fixation, the case was defined as good. If the average distance was 10 mm or longer and there was an unsatisfactory fixation, it was assessed as poor.

We used Ficat and Arlet staging for grading of avascular necrosis. Patients suspected of suffering from avascular necrosis were evaluated using digital radiographs and magnetic resonance imaging. Fixation failure was diagnosed when displacement, screw loosening or cutout, absence of bony union, and persistent hip pain were observed.

Internal fixation was done under spinal anesthesia with the patient positioned supine on a fracture table, with the required traction and reduction checked using C-Arm/Garden’s Alignment Index. Using a percutaneous incision, internal fixation was done using three 6.5-mm cannulated cancellous screw (CCS) in an inverted triangle fashion. After suture removal, patients were allowed to touch weight bearing and active quadriceps and hamstring strengthening exercises on the postoperative day 14 under the supervision of a physiotherapist and they were put on gradual rehabilitation during their follow-up visits.

Hemiarthroplasty was done under spinal anesthesia in lateral decubitus position using a posterior approach to the hip. Uncemented BHU bipolar modular hip device was used in most cases. Dorr’s criterion was used for deciding the need for cemented versus uncemented stem. Patients were followed up regularly at 6 weeks, 3 months, 6 months, and at 1 year postoperatively, and their radiographs were taken and clinical outcome was evaluated using Harris Hip Score and Palmer and Parker mobility score.

Statistical analysis was done using the following method:

1. Baseline characteristics were summarized using proportions for categorical variables and mean (standard deviation) or median (interquartile range) for continuous variables
2. Outcome measures (nonunion, malunion, and complication) were expressed in terms of proportions.

Proportions and means were compared using the Chi-square test and Friedman test using SPSS software version 20 (IBM, Chicago, USA). \( P < 0.05 \) was considered statistically significant.

**Results**

In our study, we included a total of 84 patients: 40 patients in the osteosynthesis group and 44 patients in the hemiarthroplasty group. The average age in the osteosynthesis group patients was 64.6 years, whereas the average age in the hemiarthroplasty group patients was 68 years. Out of the 40 patients in the osteosynthesis group, 16 are male and 24 were female, whereas out of 44 patients in the hemiarthroplasty group, 20 were male...
and 24 were female patients. In the osteosynthesis group, 16 patients suffered a fracture in the right neck of femur and 24 suffered injury on the left side, but in the hemiarthroplasty group, 23 fractured the right neck and 21 fractured the left neck of the femur. In the osteosynthesis group, 8 patients had a road traffic accident (RTA) and 32 had trivial fall. In the hemiarthroplasty group, 13 had RTA and 31 patients suffered trivial fall. The American Society of Anesthesiologists score was found to be 2.60 in the osteosynthesis group, whereas in the hemiarthroplasty group, it was found to be 3.72. The average time of injury till the time of operation in the osteosynthesis group was 2.5 days and in the hemiarthroplasty group, it was 7.27 days. Six out of the forty (15%) patients died within 12 months of follow-up period in the osteosynthesis group, whereas 5 out of the 44 (11.5%) patients died in the hemireplacement group [Table 1].

Table 2 shows follow-up Harris Hip Scores in the osteosynthesis group; there was a steady increase seen throughout in the follow-up period. At 3-month postoperative follow-up period, the mean score was 66.44 ± 8.520 which showed a steep increase to 74.12 ± 7.705 at 6 months and at 12 months, the mean Harris Hip Score was found to be 78.14 ± 7.125. The mean increment in the score was more in the initial 3-month interval as compared to the next 6-month interval.  

Table 3: Comparison of Palmer and Parker mobility score in both the groups, at 3 months, the Harris Hip Score increased, but the increase was more prominent in the initial 3-month interval as compared to the next 6-month interval.  

According to Table 3, when analyzing the Palmer and Parker mobility score in both the groups, it was considered clinically significant.

According to Table 4, in the hemiarthroplasty group, the mean Harris Hip Score at 3 months was 74.44 ± 8.480. However, at 6 months, it increased to a mean score of 80.12 ± 7.005 and at 12-month follow-up, patients registered a mean score of 92.14 ± 7.125 with a bipolar hemireplacement of the hip. According to Table 5, Palmer and Parker mobility score also followed a similar trend and increased from 6.24± 1.21 at 3 months to 7.28 ± 1.2161 at 6 months, and it further increased to 7.88 ± 0.824 at 12 months.

According to Table 6, in the osteosynthesis group, Harris Hip Score was found to be 66.44 ± 8.52 as compared to the hemireplacement group where the mean Harris Hip Score was found to be 74.44 ± 8.48. At 6 months, it was 74.12 ± 7.705 and 80.12 ± 7.005 in the respective groups. And, at 12 months in both the groups, Harris Hip Score increased, but the increase was more prominent from the 3rd to 6th month as compared to the 6th to 12th month. In the osteosynthesis group, the Harris Hip Score was 78.14 ± 7.125, and in the hemiarthroplasty group, the mean score was 92.14 ± 7.125.
Comparing 74.44±8.48 [Median (interquartile range)], Therefore, it can be concluded that hemireplacement group showed a significantly lower percentage of complication as compared to the osteosynthesis group. The hemireplacement group showed a mean score of 7.21 ± 0.458 as compared to 7.88 ± 0.824 in the hemireplacement group. As far as the incidence rate of complication depending on Singh’s Index which is an indicator of osteoporosis is concerned, the osteosynthesis group showed a higher incidence of complication when they had osteoporosis of the proximal femur. However, the difference was not statistically significant.

**Discussion**

Osteosynthesis by internal fixation with CCS is a minimally invasive technique as compared to hemiarthroplasty and may seem to prevent the patient from possible complications of a major surgical procedure, i.e., hemiarthroplasty. However, in literature, recent meta-analyses do not show any difference in mortality rate at mid- and long-term follow-up between the osteosynthesis and arthroplasty groups. Comparing complication rates in both the groups, a meta-analysis has shown that arthroplasty is better than osteosynthesis in a displaced fracture, which is similar to the outcome of our study. Therefore, it can be concluded that hemireplacement could be considered as a preferred treatment modality in the 50–60 years’ age group in the Indian population. Our study indicates that, in the osteosynthesis group, the rate of complications and the rate of reoperation were significantly higher than those in the hemiarthroplasty group. Age is already a well-known risk factor and predictor of the risk of nonunion in the neck of femur fractures. However, the effect of osteoporosis in osteosynthesis of neck femur fracture is still debated. Even in undisplaced fractures with severe osteoporosis, there is a very high incidence of nonunion and fixation failure in spite of having better bony contact and vascularity than displaced fracture.

Another study reported that the bone mineral density of elderly Asian women is generally lower than that of their Western counterparts. In this study, there was no statistical difference between osteoporosis and the risk of fixation failure. We mostly performed hemiarthroplasty in patients with poor Singh’s Index considering the high risk of nonunion and fixation failures in such patients. This goes to say that, the operating surgeon should be cautious in making treatment decisions even in case of the undisplaced neck of femur fractures. Among the numerous different risk factors causing complication of internal fixation, displacement of fracture and poor reduction are the most common causes.

According to this study, duration from injury to operation was not a relevant factor causing complication during internal fixation, but insufficient reduction was a predictive factor for complication. Some authors reported that displaced neck femur fracture or poor reduction leads to a high probability of nonunion in using internal fixation; hence, arthroplasty could be considered on priority for the treatment of such fractures.

Our study showed that, in internal fixation (CCS) group [Figures 2-4], in case of anatomical reduction was well-achieved, the incidence of fixation failure was significantly lower than in the case with poor anatomical reduction. We could not demonstrate any statistical significance to this as the number of poor reduction cases is small in our study. The arthroplasty group consistently outperformed the osteosynthesis group.

### Table 5: Comparison of Palmer and Parker mobility score at 3rd-, 6th-, and 12th-month follow-up in the hemiarthroplasty group

| Follow-up duration (months) | Mean ± SD | Median (interquartile range) | P |
|-----------------------------|-----------|-----------------------------|---|
| 3                           | 6.24±1.211| 5 (5–6)                     | 0.035|
| 6                           | 7.28±1.261| 7 (7.2–7.68)                |   |
| 12                          | 7.88±0.824| 7.8 (7.2–7.70)              |   |

Friedman test (Chi-square test = 41.218, the degree of freedom = 2).

SD: Standard deviation

### Table 6: A comparison of Harris Hip Score at 3rd-, 6th-, and 12th-months follow-up in the osteosynthesis versus hemiarthroplasty group

| Follow-up duration (months) | Osteosynthesis with CCS group | Hemireplacement group | P |
|-----------------------------|-------------------------------|-----------------------|---|
| 3                           | 66.44±8.52                   | 74.44±8.48            | 0.0001|
| 6                           | 74.12±7.705                  | 80.12±7.005           | 0.013|
| 12                          | 78.14±7.125                  | 92.14±7.125           | 0.0054|

CCS: Cannulated cancellous screws

### Table 7: Comparison of Palmer and Parker mobility score at 3rd-, 6th-, and 12th-month follow-up in the osteosynthesis versus hemiarthroplasty group

| Follow-up duration (months) | Osteosynthesis with CCS group | Hemireplacement group | P |
|-----------------------------|-------------------------------|-----------------------|---|
| 3                           | 5.33±1.308                   | 6.24±1.211            | 0.583|
| 6                           | 6.68±1.191                   | 7.28±1.261            | 0.0015|
| 12                          | 7.21±0.458                   | 7.88±0.824            | 0.0019|

CCS: Cannulated cancellous screws

osteosynthesis group had a mean score of 5.33 ± 1.308 as compared to hemireplacement group with a score of 6.24 ± 1.211. At 6 months, the mean scores were 6.88 ± 1.191 in the osteosynthesis group as compared to 7.28 ± 1.261 in the hemireplacement group. At the 12th month in the osteosynthesis group, the mean mobility score was 7.21 ± 0.458 as compared to 7.88 ± 0.824 in the hemireplacement group.

As for the complications, in the osteosynthesis group, six patients suffered avascular necrosis of the femoral head and 12 patients suffered nonunion of the femoral head with screw cutout [Figure 1]. This led to reoperation of 16 patients. None of the patients in the osteosynthesis group suffered infection. In the hemiarthroplasty group, one patient suffered infection leading to reoperation and thorough debridement of one hip. The hemireplacement group showed a significantly lower percentage of complication as compared to the osteosynthesis group. None of the patients in the hemireplacement group showed postoperative dislocation or periprosthetic fracture.

As far as the incidence rate of complication depending on Singh’s Index which is an indicator of osteoporosis is concerned, the osteosynthesis group showed a higher incidence of complication when they had osteoporosis of the proximal femur. However, the difference was not statistically significant.
in overall functional outcome throughout our follow-up [Figures 5 and 6]. The mean Harris Hip Score and Palmer and Parker mobility score were higher in the hemiarthroplasty group as compared to the osteosynthesis group. This was attributed to quick postoperative rehabilitation and early ambulation in the arthroplasty group, and it was not possible in the osteosynthesis group. Postoperative ambulation and rehabilitation were much prolonged sometimes up to 6 months and more in the osteosynthesis group due to delayed weight bearing till fracture union and a guarded prognosis.

There are early complications with arthroplasty group such as recurrent dislocation and infection, particularly recurrent early postoperative dislocation is the most worrisome and major concern after total hip arthroplasty for the treatment of femoral neck fractures. In a recent meta-analysis, total
hip replacement for the treatment of femoral neck fracture had much higher dislocation rate than hemiarthroplasty, which is concordance with the current literature evidence.[19-21] This is the probable reason why most authors do not recommend total hip arthroplasty for the treatment of femoral neck fractures.

In our series, we performed hemiarthroplasty, and none of our cases had the complication of postoperative dislocation after hemiarthroplasty.

Culturally, our patients have the requirement of squatting and sitting crosslegged. We strictly advised against these practices in our postoperative rehabilitation protocol. However, few of our patients were found sitting crosslegged and squatting after 12 months of bipolar hemiarthroplasty surgery comfortably.

**Conclusion**

In displaced femoral neck fractures, osteosynthesis showed a significantly higher incidence of the nonunion, screw cutout, delayed rehabilitation, and reoperation. Hemiarthroplasty in comparison to osteosynthesis decreases the incidence of complication and surgical revision. It also provides quick postoperative recovery, early mobilization, better patient outcome, and reduced mortality rates. Therefore, in light of the current findings, hemiarthroplasty should be the preferred treatment option in displaced fractures of neck femur among North Indian elderly population aged between 60 and 70 years. The choice of hemiarthroplasty should be made carefully in such patients considering osteoporosis. Further well-planned studies are required to study the association between osteoporosis and osteosynthesis failure, leading to the subsequent need of hemiarthroplasty.

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**Conflicts of interest**

There are no conflicts of interest.

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