Outcome Analysis of Osteosynthesis Versus Hemiarthroplasty for the Treatment of Displaced Femoral Neck Fracture in Young Elderly Patient

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Authors’ contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study was designed to compare the osteosynthesis and hemiarthroplasty treatment among the elderly population and evaluate the postoperative functional performance of these two recommended treatments of a displaced femoral neck fracture.

Methodology: This retrospective study was conducted in Bone Care trauma center Heerabad Hospital Hyderabad Pakistan from March 2019 to March 2020. A total of 74 patients of age between 60 to 70 years were selected. All the selected patients were diagnosed with femoral neck fractures (Garden’s III and IV). Harris’s hip score was used to evaluate the clinical status of patients.

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with pain, whereas we used Palmer and Parker's mobility to access mobility. Implant breakage, screw cut, and nonunion were considered as parameters of osteosynthesis failure. At the same time, hemiarthroplasty failure was defined as two or more recurrent dislocation, aseptic loosening, periprosthetic fracture, and infection.

**Results:** In the first three postoperative months, the mean score of the hemiarthroplasty group was reported as 74.44±8.480, which was comparatively high than the osteosynthesis group (66.4±8.520). After six months, this score reached 80.12±7.005 in the hemiarthroplasty group and reached its maximum of 92.1±7.125. After the first three months, the increment ratio was relatively slow with six ratios, but in the last visit, we observed a sudden increase in score in both groups. Regarding Palmer and Parker's mobility score, the hemiarthroplasty group reflected better outcomes than the osteosynthesis group.

**Conclusion:** Our study concluded that management of displaced femoral neck fracture with osteosynthesis revealed a high probability of nonunion, screw cutout complications and enhanced the risk of reoperation. Patients treated with osteosynthesis showed delay rehabilitation.

**Keywords:** Displaced femoral neck injury; osteosynthesis; hemiarthroplasty.

### 1. INTRODUCTION

Every year estimated 1.6 million people reported hip fractures. These hip fractures cause disability in 5 million people in all parts of the world. Hip fractures are a life-changing event for many patients because they not only enhance the risk of disability but also increases the mortality ratio [1]. The majority of the hip fractures are intracapsular femoral neck fractures which usually handle with surgical intervention. However, in recent five decades, these surgical methods are controversial due to severe complications in the form of reoperation that occurs after internal fixation still there is no best treatment found yet [2].

In recent years region Asia reported a high ratio of femoral neck fractures among the old age population. Due to recent advancements in the medical field, the average lifespan of the Asian population increased, which enhances the risk of osteoporosis [1]. The low bone density of the Asian population is an independent risk factor for osteoporotic fractures. Recent statistics revealed that in 2050, a total of 50% Asian elder age population will be at risk of femoral neck fractures [2]. This alarming situation demands a quick medical response in terms of surgical management. In younger people, osteosynthesis is considered an ideal treatment, wherein the elderly population arthroplasty is advised to manage fractures [3]. In young patients, even with severe displaced femoral neck fractures, internal fixation is recommended; whereas, in elderly populations, osteosynthesis reported a 20% risk of fixation failure, nonunion, osteonecrosis, and delayed postoperative mobilization [4]. Three meta-analyses observed treatment of displaced femoral neck fractures and also examined the reoperation risk by using different methods of treatment. They found an overall 7-11% risk of reoperation after arthroplasty, whereas internal fixation has a high risk of reoperation (33-45%) [5-7].

This study was designed to compare the osteosynthesis and hemiarthroplasty treatment among the elderly population and evaluate the postoperative functional performance of these two recommended treatments of a displaced femoral neck fracture. Our aim was to validate the results of previous studies we observed similar outcomes.

### 2. METHODOLOGY

This retrospective study was conducted in Bone Care trauma center Heerabad Hospital Hyderabad Pakistan from March 2019 to March 2020. In this study total of 74 patients of age between 60 to 70 years were selected. All the selected patients were diagnosed with femoral neck fractures (Garden’s III and IV). The average follow-up of the patient's visit was reported as 12.8 months. We excluded all the patients with a history of neoplasia, coronary vascular disease. Patients with rheumatoid arthritis, osteomyelitis were also not included in this research. We assured to exclude all those patients who consume steroids because it may enhance the avascular necrosis incidents. All patients with ipsilateral and contralateral limb fractures and pelvic or spinal fractures were not part of the study. With the help of Singh’s index grading, patients who scored four or less than 4 based on trabecular pattern type in the femoral head and proximal femur were identified as osteoporosis.
cases. Harris's hip score was used to evaluate the clinical status of patients with pain, whereas Palmer and Parker's mobility was used to assess mobility. Implant breakage, screw cut, and nonunion were considered as parameters of osteosynthesis failure. Furthermore, avascular necrosis was also categorized under the operational definition of osteosynthesis failure. At the same time, hemiarthroplasty failure was defined as two or more recurrent dislocation, aseptic loosening, periprosthetic fracture, and infection.

For the allocation of patients in groups, in the emergency area, a total of 37 pieces of paper was randomly placed in an envelope with the word "Hemi" and the rest 37 with the word "screws" we sealed those envelopes and mixed them before mentioning them g the patient number. After the recruiting of patients, the surgeon opened the envelope and used the method of the envelope.

During surgery, we used Garden Alignment Index to calculate the reduction. This calculation was done in both postoperative plain radiographs. We considered 160° to 180° reduction in AP image and 170° to 190° in the lateral radiograph as acceptable. In achieving both of these grades, we marked them as an excellent achievement; if the score falls in one range, it was considered good, and if none of them fall within a degree, it was marked as bad. We used two parameters, including tip apex distance and three-point fixation, to assess the fixation quality. Infratemporal cortical bone of the femoral neck was used to evaluate the three-point fixations. If we acquired an average 10 mm or shorter distance with good three-point fixation to the subchondral boundary of the femoral head, it was graded as excellent, whereas distance longer than 10 mm with good three-point fixation was marked as good. In case of unsatisfactory fixation with a length longer than 10 mm, we evaluated it as inferior.

Grading of avascular necrosis was done by using Ficat and Arlet staging. Patients with avascular necrosis were diagnosed through MRI and digital radiographs. Cases of displacement, screw loosening or cutout, absence of a bony union, and persistent hip pain were diagnosed as fixation failure.

With the help of spinal anesthesia, internal fixation was performed. Patients were placed in a supine position on a fracture table, and reduction was checked through C-Arm/Garden’s Alignment Index. We used three 6.5-mm cannulated cancellous screws (CCS) in an inverted triangle fashion to perform internal fixation. In contrast, cemented Hemiarthroplasty was performed in lateral decubitus position (using a posterior approach to the hip) with the help of an uncemented BHU bipolar modular hip device. We used Dorr’s criteria to evaluate the need for the uncemented or cemented stem. Patients were allowed to do hamstring strengthening exercises on a postoperative day 14 after suture removal. Patients were followed at 3, 6, and 12 months after surgery [8].

For this research, we used SPSS 23.0 version for data analysis. In this research, baseline characteristics and outcome measurements were analyzed through proportion, whereas categorical variables were accessed through mean and standard deviations. For continuous variables, the median (interquartile range) was used to evaluate the statistical performance. Friedman test was applied to the data, and comparison was conducted through the Chi-square formula. We set 0.05 as a statistically significant level of this research.

3. RESULTS

Total of 74 patients who fulfilled the inclusion criteria was categorized into two groups: A (osteosynthesis) and B (hemiarthroplasty) for surgical intervention. Hemiarthroplasty was performed in 41 patients, whereas 33 patients underwent osteosynthesis. The mean age of patients in the hemiarthroplasty group was reported as 68 years, whereas 64.6 years was declared as the mean age of osteosynthesis group patients. Out of 33 patients in the osteosynthesis group, 18 belonged to the female sex, whereas the male prevalence was reported as 15. Comparatively, in the hemiarthroplasty group, 26 female patients were recruited with a high ratio of trivial fall incidents (30/44). We observed a high proportion of left side injury (22/44 and 18/33) than the right side (19/44 and 15/33). In the osteosynthesis group, we watched a 2.60 mean value of the American Society of Anesthesiologists score, whereas the researcher observed a 3.72 mean score of ASA score in the hemiarthroplasty group. The average duration of injury until surgery was reported as 2.5 days in the osteosynthesis group, whereas 7.27 days were reported as the mean duration of injury to surgery in the hemiarthroplasty group. A 12.19% mortality ratio was observed in the
hemiarthroplasty group, whereas an 18.8% death ratio was observed in the osteosynthesis group.

In both groups, we observed a steady increase in Harris hip score during follow-up. In the first three postoperative months, the mean score of the hemiarthroplasty group was reported as 74.44±8.480, which was comparatively high than the osteosynthesis group (66.44±8.520). After six months, this score reached 80.12±7.005 in the hemiarthroplasty group and reached its maximum of 92.14±7.125. After the first three months, the increment ratio was relatively slow with six ratios, but in the last visit, we observed a sudden increase in score in both groups. Regarding Palmer and Parker’s mobility score, the hemiarthroplasty group reflected better outcomes than the osteosynthesis group.

In the osteosynthesis group, a complication of avascular necrosis of the femoral head was reported in 6 patients and 12 patients suffered from nonunion with screw cut-out. Total 16 patients underwent reoperation. We did not observe any case of postinfection in the osteosynthesis group, whereas, in the hemiarthroplasty group, we observed 1 case that led to reoperation debridement of one hip. Overall complications ratio was comparatively low in the hemiarthroplasty group.

### Table 1. Patient Demographic information of osteosynthesis group and hemiarthroplasty group

<table>
<thead>
<tr>
<th>Variables</th>
<th>Hemiarthroplasty group n= 41</th>
<th>Osteosynthesis group n = 33</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age (years)</td>
<td>68</td>
<td>64.6</td>
<td>0.284</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>15</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>26</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td><strong>Mode of injury</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road traffic accident</td>
<td>11</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td>30</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td><strong>Unilaterality</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>19</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>22</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Average timing from injury to surgery (days)</td>
<td>7.27</td>
<td>2.5</td>
<td>0.0023</td>
</tr>
<tr>
<td>Average Singh’s index</td>
<td>2.36</td>
<td>4.8</td>
<td>0.056</td>
</tr>
<tr>
<td>Average ASA score</td>
<td>3.72</td>
<td>2.60</td>
<td>0.0538</td>
</tr>
<tr>
<td>Mortality rate within 12 months of surgery (%)</td>
<td>5 (12.19%)</td>
<td>6 (18.18%)</td>
<td>0.235</td>
</tr>
</tbody>
</table>

### Table 2. Comparison of the median, interquartile range of Haris Hip score and Palmer and Parker mobility score during follow up in the osteosynthesis versus hemiarthroplasty group [8]

<table>
<thead>
<tr>
<th>Follow up duration</th>
<th>Mean±SD</th>
<th>Median (interquartile range)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Osteosynthesis</td>
<td>Hemiarthroplasty</td>
</tr>
<tr>
<td><strong>Harris Hip Score</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 months</td>
<td>66.44±8.520</td>
<td>74.44±8.480</td>
</tr>
<tr>
<td>6 months</td>
<td>74.12±7.705</td>
<td>80.12±7.005</td>
</tr>
<tr>
<td>12 months</td>
<td>78.14±7.125</td>
<td>92.14±7.125</td>
</tr>
<tr>
<td><strong>Palmer and Parker mobility score</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 months</td>
<td>5.33±1.308</td>
<td>6.24±1.211</td>
</tr>
<tr>
<td>6 months</td>
<td>6.88±1.191</td>
<td>7.28±1.261</td>
</tr>
<tr>
<td>12 months</td>
<td>7.21±0.458</td>
<td>7.88±0.824</td>
</tr>
</tbody>
</table>
4. DISCUSSION

Internal fixation osteosynthesis with CCS is a better technique than hemiarthroplasty with less probability of future complications in patients [9]. Previous literature and meta-analysis failed to observe any mortality differences among osteosynthesis and arthroplasty groups at mid and long-term follow-up [10]. Comparatively, arthroplasty has less chance of displaced fracture than the osteosynthesis group, as described in the previous meta-analysis [11]. Our study is similar to these results, and we observed fewer displaced fractures in the arthroplasty group. We observed that Hemi replacement could be a better treatment for the patients under the 50-60 age group with less reoperation. Our study observed high complications ratio and high reoperation probability among the osteosynthesis group. Association of age with a high complication ratio was observed in many previous studies. Age factor can cause the risk of non-union in the neck of femur fracture [12]. Contrary, the association of osteoporosis with osteosynthesis of neck femur fracture is still debatable [13-15]. Comparatively, undisplaced fractures have better bony contact and vascularity than displaced fractures. Still, incidents of nonunion and fixation failure are high among the patients with undisplaced fractures with severe osteoporosis [16]. A study by Barrett et al. [17] reported that elderly Asian women had low bone density as compared to Western women. Still, they failed to find any statistically significant association between the risk of fixation failure and osteoporosis. In our study, all the patients with low Singh’s Index were considered at high risk of non-union or fixation failure. These patients were deemed to be suitable for hemiarthroplasty. To avoid the complications like internal fixation obstacles, fracture displacement, and insufficient reduction, surgeons must be cautious before taking any treatment decision [18].

Araujo et al. [19] reported insufficient factors as a predictor of complications, whereas they did not find any association of injury and surgery duration with complications. Many researchers observed a high incidence of nonunion in insufficient reduction, so they prioritize arthroplasty over other treatments to reduce the risk of displaced neck femur fracture [20]. In our study, we observed low incidents of fixation failure, whereas some patients in the internal fixation (CCS) group reported an anatomical reduction. We observed very few incidents of inadequate removal, so we failed to follow any statistical significance. The overall functional performance of the arthroplasty group during follow-up was relatively more excellent than the osteosynthesis group. We observed a higher mean value of Harris hip score and Palmer and Parker mobility score in hemiarthroplasty. Comparatively quick postoperative rehabilitation and ambulation were observed in the hemiarthroplasty group. Due to delayed fracture union and guarded prognosis, we observed a 6-month duration of ambulation and postoperative rehabilitation in the osteosynthesis group.

On the contrary, complications like recurrent dislocation and infection were observed after the arthroplasty [21,22]. In a recent meta-analysis, evidence reported a higher dislocation rate in hip replacement than a hemiarthroplasty [23-25]. Our findings are in parallel to this meta-analysis. In our study, we performed hemiarthroplasty and did not observe any case of postoperative dislocation.

5. CONCLUSION

Our study validates the results of previous studies. Our study concluded that management
of displaced femoral neck fracture with osteosynthesis revealed a high probability of nonunion, screw cutout complications, and enhanced the risk of reoperation. Patients treated with osteosynthesis showed delayed rehabilitation. On the other hand, hemiarthroplasty minimizes the risk of reoperation with better outcomes, and patients reflect early mobilization after treating with hemiarthroplasty. It also helps to reduce the mortality ratio. Therefore the results of our study declared hemiarthroplasty as the best and preferable treatment of displaced femoral neck fractures among the elderly population.

CONSENT
As per international standard or university standard, patients’ written consent has been collected and preserved by the author.

ETHICAL APPROVAL
As per international standard or university standard written ethical approval has been collected and preserved by the author.

COMPETING INTERESTS
Authors have declared that no competing interests exist.

REFERENCES


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