



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

**Muhammad Rafique Joyo¹, Nizam Ahmed², Ghazanfar Ali Shah³,
Aftab Alam Khanzada⁴, Tanveer Afzal⁵, Niaz Hussain Keerio^{6*}
and Syed Shahid Noor⁷**

¹Department of Orthopedic, Bone Care Trauma Centre, Heerabad Hospital, Hyderabad, Pakistan.

²Department of Orthopedic, Liaquat University of Medical and Health Science, Jamshoro, Pakistan.

³Department of Orthopedics, SMBBIT, Dow University of Medical and Health Sciences, Karachi, Pakistan.

⁴Department of Orthopedic, Red Crescent General Hospital, Pakistan.

⁵Ameer-u-Din Medical College, Lahore General Hospital, Lahore, Pakistan.

⁶Muhammad Medical College and Hospital, Mirpurkhas, Pakistan.

⁷Liaquat National Hospital and Medical College Karachi, Pakistan.

Authors' contributions

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

Article Information

DOI: 10.9734/JPRI/2021/v33i33A31771

Editor(s):

(1) Dr. Mohamed Salem Nasr Allah, Weill Cornell Medical College, Qatar.

Reviewers:

(1) Veenesh Selvaratnam, UK.

(2) Bishnu Prasad Patro, AIIMS Bhubaneswar, India.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/69426>

Original Research Article

Received 14 April 2021

Accepted 19 June 2021

Published 23 June 2021

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

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 (66.44 ± 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.

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 fractures². This alarming situation demands a quick medical response in terms of surgical management. In younger people, osteosynthesis is considered an ideal treatment, wherein the elder 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 access 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 10mm, 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

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

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

Follow up duration	Mean±SD		Median (interquartile range)	
	Osteosynthesis	Hemiarthroplasty	Osteosynthesis group	Hemiarthroplasty
Harris Hip Score				
3 months	66.44±8.520	74.44±8.480	68 (73.5-61.5)	72 (83.5-68.5)
6 months	74.12±7.705	80.12±7.005	74 (78-72)	77 (82-72)
12 months	78.14±7.125	92.14±7.125	78 (84-74)	86 (94-80)
Palmer and Parker mobility score				
3 months	5.33±1.308	6.24±1.211	5 (5-6)	5 (5-6)
6 months	6.88±1.191	7.28±1.261	6 (6-6.65)	7 (7.2-7.68)
12 months	7.21±0.458	7.88±0.824	7.6 (7-7.50)	7.8 (7.2-7.70)

Table 3. Comparison of Harris Hip score and Palmer and Parker mobility score at 3rd-, 6th-, and 12th-month follow-up in the osteosynthesis versus hemiarthroplasty group [8]

Follow up duration	Hemireplacement group	Osteosynthesis with CCS group	p-value
Harris Hip Score			
3 months	74.44±8.48	66.44±8.52	0.0001
6 months	80.12±7.005	74.12±7.705	0.013
12 months	92.14±7.125	78.14±7.125	0.0054
Palmer and Parker mobility score			
3 months	6.24±1.211	5.33±1.308	0.583
6 months	7.28±1.261	6.88±1.191	0.0015
12 months	7.88±0.824	7.21±0.458	0.0019

4. DISCUSSION

Internal fixation osteosynthesis with CSS 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 delay 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

1. Karagas MR, Lu-Yao GL, Barrett JA, Beach ML, Baron JA. Heterogeneity of hip fracture: Age, race, sex, and geographic patterns of femoral neck and trochanteric fractures among the US elderly. *Am J Epidemiol.* 1996;143:677-82.
2. Wang Y, Tao Y, Hyman ME, Li J, Chen Y. Osteoporosis in China. *Osteoporos Int.* 2009;20:1651-62.
3. Nicolaides V, Galanakis S, Mavrogenis AF, Sakellariou VI, Papakostas I, Nikolopoulos CE, et al. Arthroplasty versus internal fixation for femoral neck fractures in the elderly. *Strategies Trauma Limb Reconstr* 2011;6:7-12.
4. Lykke N, Lerud PJ, Strømsøe K, Thorngren KG. Fixation of fractures of the femoral neck. A prospective, randomised trial of three Ullevaal hip screws versus two Hansson hook-pins. *J Bone Joint Surg Br.* 2003;85:426-30.
5. Rogmark C, Johnell O. Primary arthroplasty is better than internal fixation of displaced femoral neck fractures: A meta-analysis of 14 randomized studies with 2,289 patients. *Acta Orthop.* 2006; 77:359-67.
6. Bhandari M, Devereaux PJ, Swiontkowski MF, Tornetta P 3rd, Obremskey W, Koval KJ, et al. Internal fixation compared with arthroplasty for displaced fractures of the femoral neck. A meta-analysis. *J Bone Joint Surg Am.* 2003;85-A(9):1673-81.
7. Masson M, Parker MJ, Fleischer S. Internal fixation versus arthroplasty for intracapsular proximal femoral fractures in adults. *Cochrane Database Syst Rev.* 2003; 2:CD001708.
8. Singh CK, Khare GN, Deshpande J, Kumar M, Prajapati S. Outcome analysis of osteosynthesis versus hemiarthroplasty for the treatment of displaced femoral neck fracture in young elderly patients of Northern India. *J Orthop Traumatol Rehabil.* 2019;11:89-94.
9. Ficat P, Arlet J. Pre-radiologic stage of femur head osteonecrosis: Diagnostic and therapeutic possibilities. *Rev Chir Orthop Reparatrice Appar Mot* 1973;59:(Suppl 1):26-38.
10. Jiang J, Yang CH, Lin Q, Yun XD, Xia YY. Does arthroplasty provide better outcomes than internal fixation at mid- and long-term followup? A Meta-analysis. *Clin Orthop Relat Res.* 2015;473:2672-9.
11. Parker MJ, White A, Boyle A. Fixation versus hemiarthroplasty for undisplaced intracapsular hip fractures. *Injury.* 2008;39: 791-5.
12. Parker MJ. Prediction of fracture union after internal fixation of intracapsular femoral neck fractures. *Injury.* 1994;25 (Suppl 2):B3-6.
13. Heetveld MJ, Raaymakers EL, van Eck-Smit BL, van Walsum AD, Luitse JS. Internal fixation for displaced fractures of the femoral neck. Does bone density affect clinical outcome? *J Bone Joint Surg Br.* 2005;87:367-73.
14. Jenny JY, Rapp E, Cordey J. Type of screw does not influence holding power in the femoral head: A cadaver study with shearing test. *Acta Orthop Scand.* 1999;70:435-8.
15. Sjöstedt A, Zetterberg C, Hansson T, Hult E, Ekström L. Bone mineral content and fixation strength of femoral neck

- fractures. A cadaver study. *Acta Orthop Scand.* 1994;65:161-5.
16. Han SK, Song HS, Kim R, Kang SH. Clinical results of treatment of garden type 1 and 2 femoral neck fractures in patients over 70-year old. *Eur J Trauma Emerg Surg.* 2016;42: 191-6.
 17. Barrett-Connor E, Siris ES, Wehren LE, Miller PD, Abbott TA, Berger ML, et al. Osteoporosis and fracture risk in women of different ethnic groups. *J Bone Miner Res.* 2005;20:185-94.
 18. Viberg B, Ryg J, Overgaard S, Lauritsen J, Ovesen O. Low bone mineral density is not related to failure in femoral neck fracture patients treated with internal fixation. *Acta Orthop.* 2014;85: 60-5.
 19. Araujo TP, Guimaraes TM, Andrade-Silva FB, Kojima KE, Silva Jdos S. Influence of time to surgery on the incidence of complications in femoral neck fracture treated with cannulated screws. *Injury* 2014;45(Suppl 5):S36-9.
 20. Yang JJ, Lin LC, Chao KH, Chuang SY, Wu CC, Yeh TT, et al. Risk factors for nonunion in patients with intracapsular femoral neck fractures treated with three cannulated screws placed in either a triangle or an inverted triangle configuration. *J Bone Joint Surg Am.* 2013; 95:61-9.
 21. Berry DJ, von Knoch M, Schleck CD, Harmsen WS. Effect of femoral head diameter and operative approach on risk of dislocation after primary total hip arthroplasty. *J Bone Joint Surg Am.* 2005; 87:2456-63.
 22. Wang F, Zhang H, Zhang Z, Ma C, Feng X. Comparison of bipolar hemiarthroplasty and total hip arthroplasty for displaced femoral neck fractures in the healthy elderly: A meta-analysis. *BMC Musculoskelet Disord.* 2015;16:229.
 23. Burgers PT, Van Geene AR, Van den Bekerom MP, Van Lieshout EM, Blom B, Aleem IS, et al. Total hip arthroplasty versus hemiarthroplasty for displaced femoral neck fractures in the healthy elderly: A meta-analysis and systematic review of randomized trials. *Int Orthop* 2012;36:1549-60.
 24. Conn KS, Parker MJ. Undisplaced intracapsular hip fractures: Results of internal fixation in 375 patients. *Clin Orthop Relat Res.* 2004;421:249-54.
 25. Sherrington C, Lord SR, Herbert RD. A randomised trial of weight-bearing versus non-weight-bearing exercise for improving physical ability in inpatients after hip fracture. *Aust J Physiother.* 2003;49:15-22.

© 2021 Joyo et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/69426>