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Comparison of Screws Alone Versus Screws Plus Bone Graft for Garden Type III Femur Fractures

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ABSTRACT

Background & Objectives: Femoral neck fractures (FNF) are common injuries and are associated with complications such as non-union and osteonecrosis. The management of these fractures is a subject of ongoing debate, particularly concerning deciding whether to save or replace femoral head. In younger patients, surgical interventions that prioritize the preservation of hip anatomy and function are essential. This study evaluated the functional outcomes and union rates of Garden type III FNFs treated with cannulated screws alone versus cannulated screws with bone grafting.

Methodology: A prospective comparative cross-sectional study was conducted at the Department of Orthopaedic Surgery, Mayo Hospital, Lahore. Seventy patients with Garden type III FNFs were randomly allocated into two groups. Group A underwent fixation with cannulated screws only, while Group B received cannulated screws with bone grafting. Functional outcomes were assessed using the Harris Hip Score (HHS), and radiological healing was evaluated with Radiographic Union Score for Hip (RUSH).

Results: Group B demonstrated significantly better outcomes compared to Group A. The mean HHS was 88.86 ± 3.16 in Group B versus 84.57 ± 4.46 in Group A ($p < 0.001$). Bone healing was also superior in Group B, with mean RUSH bridging scores of 9.89 ± 0.86 compared to 8.63 ± 1.14 in Group A ($p < 0.001$). The fracture line reduction score was higher in Group B (9.83 ± 0.66 vs 8.71 ± 0.95, $p < 0.001$).

Conclusion: Cannulated screw fixation supplemented with bone grafting significantly improves functional recovery and bone healing compared with screw fixation alone.

KEY WORDS: Femoral neck fracture, Garden type III fracture, Cannulated screws, Bone graft, Functional outcome

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INTRODUCTION

Femoral neck fracture (FNF) is a common injury in elderly people resulting from trivial trauma due to osteoporosis, accounting for almost half of the fractures around the hip, and its incidence is rising in parallel with an increase in the aging population.[1,2] Despite this, fractures in younger patients constitute only a limited share, representing 3% of the total hip fractures, which are predominantly the result of high-velocity injuries such as those occurring in road traffic accidents, sports-related incidents, and falls from heights.[3] It is estimated that its incidence will reach to about 6.3 million by 2050 from 1.7 million in 1990.[4] In Pakistan, of all femoral neck fractures, Garden type III fracture is observed in 46.3% patients.[5] The classification of femoral neck fractures as "un-solved fractures" arises from the contentious nature of their treatment, with significant discussion surrounding the decision to either conserve the femoral head or to opt for its replacement, particularly in older individuals.

There is a strong correlation between these fractures and the occurrence of osteonecrosis of the femoral head, as well as non-union. Various factors are instrumental in preventing these complications and improving overall outcomes. Achieving anatomical reduction and ensuring accurate internal fixation are imperative. The treatment aims for femoral neck fractures include early diagnosis, timely surgical procedures, anatomical reduction, decompression of the capsule, and stable internal fixation.[6] The ongoing management of FNF presents considerable difficulties. A range of treatment options exists, such as sliding hip screws (SHS), cannulated screws (CS), total hip arthroplasty (THA), and dynamic hip screws (DHS). Furthermore, dynamic hip screws can be utilized with a blade (DHS-blade) or supplemented with comparable implants that incorporate muscle pedicle grafts and free fibular grafts, which may be vascularized or non-vascularized.[7] At present, considerable evidence endorsing the regular application of hip replacement surgery for individuals at risk of osteonecrosis is present. However, in younger patients, it is crucial to pursue preservation techniques that maintain the natural structure, function, and biomechanics of the hip, given their elevated functional demands.[8]

The utilization of fibular bone grafts in the treatment of FNF is well established. This method has yielded positive clinical results in cases involving non-union and avascular

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necrosis of the femoral head, particularly through the use of a fibular strut graft that enhances the likelihood of union. It also helps to prevent avascular necrosis and the collapse of the femoral head. Additionally, the process of graft harvesting is considered to be technically uncomplicated.[9]

There is still contention regarding the most effective fixation method to promote union and prevent osteonecrosis of the femoral head. This study aimed to assess the functional results and healing of Garden type III femoral neck fractures treated with cannulated screws, both with and without the application of bone graft.

METHODOLOGY

A prospective cross-sectional study was conducted at the Department of Orthopaedic Surgery Unit-I, King Edward Medical University, Mayo Hospital, Lahore, for a duration of 1 year from July 2024 to June 2025. Patients aged 18-60 years of both genders presenting with a closed Garden type III FNF within one week of injury. Patients with surgical site infection, septic arthritis, avascular necrosis, or requiring open reduction were excluded.

The required sample size was calculated to be 70 patients, divided equally into two groups of 35. This calculation utilized a significance level of 5% and a power of 95%, with expected functional outcome rates of 66.6% for the screws-only group and 28.5% for the screws plus bone graft group.[10]

Before commencing the study, the ethical review certificate for the study was approved by the ethical review board of King Edward Medical University, with the IRB number 12429/REG/KEMU/24. Before inclusion, all the participants provided informed consent. Participants were assured of the confidentiality of any information obtained.

The non-probability, convenient sampling technique was utilized for the sampling. Demographics of the participants, including age and gender, were recorded. Patients were randomly divided into two groups. The participants in Group A were managed with cannulated screws alone, while all patients in Group B were managed with cannulated screws with bone graft.

All surgeries were performed on a fracture table in spinal anaesthesia. Initially, the reduction was done by exerting traction on the hip in an abducted and externally rotated position, subsequently performing internal rotation. The reduction was confirmed through the use of a C-arm image intensifier. A reduction was considered satisfactory when the angle was recorded between 160 and 180 degrees from both angles of view. In Group A, subsequent to the closed reduction, internal fixation was done using two or three partially threaded cannulated screws measuring 16/32mm in diameter and 6.5mm in length. At least one screw was strategically placed along the calcar, while another was aligned with the posterior cortex. In Group B, the procedure involved the use of two or three partially threaded cannulated screws of the same specifications, in conjunction with fibular bone graft. A surgical team meticulously created a tunnel in the proximal femur to accommodate the fibular strut grafts, utilizing a 10 mm cannulated reamer. Meanwhile, another team harvested the fibular graft from the same leg through the conventional posterolateral approach. Following the stabilization of the reduction with several 2 mm K wires, the channel for the fibular graft was established in the central or superior region of the head and neck. The fracture was subsequently stabilized using three 6.5 mm partially threaded cannulated screws, after which the fibular graft was properly impacted.

Patients were discharged on the 1st post-operative day and were followed at intervals of 2nd, 4th, 6th, and 8th weeks. Bone union was observed using the Radiographic Union Score for Hip (RUSH) criteria.[11] Functional outcome of the affected limb was assessed using the Harris Hip score.[12]

Data was analysed using the Social Package for Statistical Analysis (SPSS) version 28.0. Continuous variables as age, RUSH union, and Harris hip score, were presented as mean ± standard deviation. Categorical variables as gender, were presented as frequencies and percentages. Group A and Group B were compared by using the independent sample t-test. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

The mean age of the participants was 43.36 ± 11.30 years, and the majority of the participants were females. (Table I)

Table I: Demographics of the participants

Variables	*Group A*	*Group B*	*Total*
Age (Years)	43.80 ± 12.32	42.91 ± 10.34	43.36 ± 11.30
Gender			
Male	12 (34.3%)	14 (40.0%)	26 (37.1%)
Female	23 (65.7%)	21 (60.0%)	44 (62.9%)

Group B exhibited markedly better outcomes across all evaluated parameters. The Haris Hip score was significantly elevated in Group B (88.86 ± 3.16) than in Group A (84.57 ± 4.46) (p <0.001). Similarly, the RUSH score was significantly higher in Group B (9.89 ± 0.86) than in Group A (8.63 ± 1.14) (p <0.001). Additionally, the resolution of the fracture line was significantly more evident in Group B (9.83 ± 0.66) compared to Group A (8.71 ± 0.95) (p<0.001). (Table II)

Table II: Comparison of post-operative outcomes of Group A and Group B

Variables	*Group A*	*Group B*	*p-Value*
Haris Hip Score	84.57 ± 4.46	88.86 ± 3.16	<0.001*
RUSH score			
Bridging	8.63 ± 1.14	9.89 ± 0.86	<0.001*
Disappearance of fracture line	8.71 ± 0.95	9.83 ± 0.66	<0.001*

**Significant*

DISCUSSION

FNF is a considerable challenge in orthopaedic practice, primarily due to association with non-union, avascular necrosis, and prolonged functional impairment. The treatment of Garden type III fractures, specifically, is a topic of discussion owing to their inherent instability and reduced vascular supply. In this study, patients received treatment with cannulated screws either alone or supplemented with fibular bone graft, and the outcomes were evaluated through both radiological and functional metrics.

The Haris Hip score was used for the clinical assessment of bone healing, with the outcome that the Haris Hip score was higher in the cannulated screw group with bone graft than in the cannulated screw group. RUSH score was used for the radiological assessment of the bone healing in terms of bridging of margins and disappearance of the fracture line. RUSH score for bridging and disappearance of fracture line in the cannulated screw group with bone graft was higher than the cannulated screw group alone. The higher value indicates that the functionality achieved by the bone graft, along with the cannulated screws, is higher than the cannulated screw alone.

Wei et. al had reported that the Haris Hip score in the cannulated screw group with fibular allograft was higher at 80.8 ± 7.15 and 90.2 ± 2.86 in comparison to the ordinary cannulated screw group fixation as 79.3 ± 6.99 and 85.4 ± 5.49, with a p-value of 0.195 and < 0.001 on a follow-up time period of 1 year and 3 years, respectively.[13] Mehraj et al. indicated that in a study involving 32 patients (Garden III/IV), the use of femoral neck osteosynthesis with fibular strut grafts and cannulated screws resulted in union for 30 patients within an average duration of 4.5 months; the Harris Hip Scores ranged from good to excellent, and there were no instances of AVN noted.[14] This highlights the significance of graft augmentation in improving stability and vascular support in cases of unstable fractures.

Dewei and Xiaobang reported that the use of vascularized bone graft along with cannulated screws for fracture of the neck of the femur resulted in excellent Harris Hip score in 50% of the patients and fair score in 10% of the patients.[15] Li et. al found that deep circumflex iliac artery-bone grafting, along with cannulated screws, for the management of fracture of the neck of femur, the mean Harris Hip score at the post-operative time period of 24 months was significantly higher than the group without bone graft (92.09 vs. 84.98, $p < 0.001$).[1]

The strengths of this study encompass its prospective design, specific inclusion criteria, and a standardized outcome assessment utilizing the RUSH and HHS systems. The limitations include a moderate sample size, a single-center setting, and a follow-up period restricted to the early postoperative phase. Long-term evaluations are necessary to ascertain durability, the occurrence of AVN, and the potential need for conversion to arthroplasty

CONCLUSION

Fibular strut graft combined with cannulated screw fixation for Garden III femoral neck fractures in younger patients demonstrates promising union and functional outcomes, with a low incidence of complications such as avascular necrosis. This technique appears to be a valid hip-preserving alternative to screw fixation alone. Further multicenter randomized trials with long-term follow-up are warranted to establish its broader applicability and durability.

Ethical approval:

Ethical approval was taken from institutional review board of of King Edward Medical University, with the IRB number 12429/REG/KEMU/24 Dated 24-6-2024.

Conflict of Interest:

Authors declare no conflict of interest.

Financial Disclosure:

None

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