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Research Article

Radiological Outcomes of Femoral Neck Fractures Treated with two Vs. Three Cannulated Screws in Adults

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ABSTRACT

Background: Femoral neck fractures are a very frequent type of orthopedic injury that, in most cases, lead to surgery as a way of restoring the stability of the hip and avoiding the development of complications related to the continuity of the fracture. Fixation with cannulated screws has gained wider acceptance because it is less invasive, and through this method, one can obtain a stable internal fixation. Nevertheless, the ideal number of screws that a surgeon should use in order to achieve a good fixation is always doubtful. Radiological examination is mainly used to check if the fracture has healed, if the alignment has been preserved, and if there are any complications after surgery.

Objective: In order to compare the post-operative radiological results of femoral neck fractures treated with either two or three cannulated screws in adult patients.

Methods: This case-control study was done at the Department of Orthopaedic Surgery, Hayatabad Medical Complex Peshawar, Pakistan, from January, 2025 to June, 2025. In total, 88 adult patients with femoral neck fractures were enrolled in the study and were separated into two groups. Group A comprised 44 patients who were operated on with two cannulated screws, while Group B included 44 patients operated on with three cannulated screws. Radiological parameters were evaluated with the help of postoperative and follow-up X-rays for the assessment of fracture union, preservation of alignment, screw migration, femoral head collapse, and failure of fixation. The analysis was done using SPSS, version 26, and a p-value of ≤0.05 was considered significant.

Results: Radiological union was noted in 79.5% of patients treated with two screws and 88.6% of patients treated with three screws. Postoperative complications, for example, femoral head collapse, screw migration, and fixation failure, occurred more often in the two-screw group than in the three-screw group. These results point to higher radiological stability obtained by using three cannulated screws.

Conclusion: Both fixation methods have been proven to work, and three cannulated screws yield better radiological outcomes and fewer complications than two-screw fixation.

Keywords: Femoral Neck Fracture, Cannulated Screws, Radiological Outcomes, Fracture Union, Orthopedic Fixation, Hip Fracture Surgery.

INTRODUCTION

Femoral neck fractures pose an important orthopedic problem not only because of the difficulties involved in locating and operating on them but also due to potential problems like nonunion, avascular necrosis of the femoral head, and dysfunction of the hip joint. They also raise a different set of concerns, since in younger and middle-aged adults, the main aim of treatment is to preserve the native hip joint. Internal fixation with cannulated screws has been one of the major surgical techniques for a long time, since it combines stable fixation with relatively small soft tissue damage and effective

blood supply to the femoral head (1). Attempts to enhance fixation methods and implant designs have led to better radiological and clinical outcomes, but femoral neck fractures continue to be associated with significant morbidity, and the need for revision surgery remains a possibility (2). Many papers have been published, the main emphasis being on the comparison of different fixation systems and screw configurations aiming at making the surgical treatment of femoral neck fractures safer and more effective (3).

Cannulated screw fixation has become very popular mainly because it is a liquid-lining surgery, insertion is relatively straightforward, and you always get compression right at the fracture site. Generally, two or three screws are used in parallel or triangular configurations to provide rotational stability and compression. It is extremely important that these biomechanical constructs achieve sufficient mechanical stability to support fracture healing and prevent displacement during post-surgical weight-bearing activities. Several studies have compared different fixation techniques and, by so doing, have pointed out how important it is to have the right placement and configuration of the screws to achieve the best radiological results (4). Radiological checking is very necessary not only for seeing whether the fracture has healed but also for determining whether the screws have been correctly positioned and identifying any complications other than the fixation failure or the collapse of the femoral head (5).

Recently, orthopedic research has been increasingly devoted to comparing different fixation systems, such as the femoral neck system and multiple cannulated screws, to find out which method is better in terms of outcome. Data from randomized controlled trials and systematic reviews indicate that newer fixation systems may have better biomechanical properties than the classic cannulated screws. However, fixation with cannulated screws is always very common because of its low cost and proven clinical success (6). The controversy over how many screws are needed for a stable fixation continues as surgeons are frequently using either two or three cannulated screws, depending on the characteristics of the fracture and patient factors (7).

Radiological results after femoral neck fracture fixation are an important clinical measure of therapy achievement. X-ray examination enables medical practitioners to keep track of the bone structure restoration, fracture line alignment, and the emergence of problems such as loosening or breakage of the implant or avascular necrosis. One of the early signs of bone restoration on the X-ray is the trabecular bridging of the fracture line and the preservation of femoral neck alignment. Insufficiency to get the required stability result in a prolonged healing time or the complete failure of union, greatly impairing the patient's walking ability and quality of life (8). For that reason, learning about how the fixation method and the radiology healing pattern relate to each other is very important to choose the best surgical methods (9).

The configuration and number of cannulated screws used during fixation directly relate to the mechanical stability and load distribution in the fracture area. Biomechanical studies have demonstrated that placing screws in a triangular arrangement offers more rotational stability than parallel screw configurations. Many people believe that three-screw constructs give a stronger fixation than two-screw constructs, adding more screws might complicate the surgery and increase the risk of damaging the blood supply to the femoral head (10). Meta-analyses of different fixation methods have revealed that advanced fixation systems may provide greater stability, and cannulated screw fixation always shows consistent results when properly used (11).

In clinical practice, surgeons typically decide between using two or three cannulated screws depending on the fracture pattern, bone condition, and the patient's physical state. A few studies have argued that three screws set in an inverted triangular pattern can give better biomechanical support, especially in displaced or unstable fractures. Conversely, some studies show that two-screw setups can always be stable enough while reducing surgical injury and shortening the duration of the operation (12). It is crucial to comprehend these distinctions in order to select the best fixation method that lead to ideal radiological healing and functional recovery (13).

There has been a steady increase in orthopedic research that has emphasized the value of postoperative radiological monitoring in identifying early complications and assisting doctors in making the best choices for patients. Radiological parameters such as fracture union, screw migration, femoral head collapse, and hardware failure are typically considered when assessing the effectiveness of fixation methods. Clinical comparative studies have shown that

greater fixation stability leads to fewer revision operations and healthier hip function over time (14). Moreover, retrospective studies that compare different fixation modes have exposed the diversity of complication rates and revision operations, stressing the importance of regular appraisal of the surgical techniques in use (15). Despite the large number of research studies on fixation methods for femoral neck fractures, very little agreement exists with respect to the ideal number of cannulated screws for achieving stable fixation. On one hand, some studies highlight increased rates of revision and complications due to inadequate fixation stability. Conversely, some studies point to equivalent results for different screw setups, provided the right surgical techniques are utilized (16). Moreover, differences in screw geometries and threading patterns, along with their effects on compression at the fracture site and overall stability, have also been studied (17). Therefore, clinical trials revolving around radiological results of various screw setups are needed in order to aid clinicians better and ensure the successful treatment of adult patients with femoral neck fractures.

Objective: The goal of this study is to compare femoral radiological results of two types of cannulated screws applied in the treatment of femoral neck fractures in adults by analyzing fracture healing, preservation of alignment, firmness of fixation, and radiographic failure after operation.

MATERIALS AND METHODS

Study Design: This is a case-control study.

Study Setting: Department of Orthopaedic Surgery, Hayatabad Medical Complex Peshawar, Pakistan.

Duration of Study: From January, 2025 to June, 2025.

Sample Size: A sample size of 44 patients per group (total 88 patients) was estimated with the OpenEpi sample size calculator. The estimation was made under the assumptions of 95% level of confidence, 80% power of the study, 20% anticipated difference in radiological union rates between the two groups, which were derived from the statistics of fixation outcome reported earlier.

Inclusion Criteria: Adults aged 18-60 years old, who had femoral neck fractures confirmed by radiological examinations, were included in the present study. Both male and female patients who underwent surgical fixation with cannulated screws were deemed eligible. Patients with fresh fractures that had their injuries occurring within one week were included in the study in order to keep uniformity in the timing of treatment and the healing potential. Subjects with Garden type I-III femoral neck fractures who were fixed with either two or three cannulated screws for internal fixation were considered for the study. Patients who could be operated on medically and who gave informed consent for participating in the study were included. Besides that, patients who had complete radiological records and postoperative follow-up images available for evaluation were the ones chosen, since that allowed an accurate assessment of radiological healing and screw positioning.

Exclusion Criteria: Pathological fractures, previous hip surgery, and multiple fractures involving the pelvis or lower limb were among the factors for which patients had to be excluded from the study, as these factors may act as confounders for influencing radiological outcomes. Besides, open fractures, excessive fracture fragmentation, or Garden type IV fractures that cannot be managed with internal fixation methods such as arthroplasty or dynamic hip screws were the other types of fractures for which patients were excluded. Those with metabolic bone disorders, malignancy, and severe osteoporosis were also excluded, as these conditions may have a major impact on fracture healing and fixation stability. Besides, patients with incomplete medical records, lack of adequate radiological follow-up, or postoperative complications unrelated to fixation technique were also excluded to ensure the dependability of radiological outcome assessment.

METHODS

After the hospital's review board gave its go-ahead, patients with femoral neck fractures who met the criteria were consecutively registered. The patients were separated into two groups, based on the fixation technique. Group A were patients who had treatment with two screws (cannulated), and Group B were those who had treatment with three screws (cannulated), forming a triangular shape. The operations were done by the orthopedic surgeons who have the most experience and are well known for their skills. Fluoroscopy was used to guide the fixation of the implants. The same care and rehabilitation after the operation were followed for both groups in order to limit treatment differences.

Radiological evaluation was done through anteroposterior and lateral hip radiographs right after the operation and during subsequent visits. The radiological outcomes that were examined included fracture healing, the stability of the fracture alignment, screw position, femoral head collapse, and fixation failure. Information was documented on a structured proforma and SPSS version 26 was used for analysis. Comparative analysis of both groups was carried out with the help of suitable statistical tests, with the p-value ≤0.05 being considered as statistically significant.

RESULTS

In this study, 88 adult patients with femoral neck fractures were enrolled. The participants were divided into two groups of equal size. Group A comprised 44 patients treated with two cannulated screws, while Group B included 44 patients treated with three cannulated screws. Demographic features like age and gender were assessed to establish that the two groups were similar. The average age of patients in Group A was 42.3 ± 9.1 years, and in Group B, it was 40.8 ± 8.7 years. Both groups had a nearly equal number of males and females, which reveals that the initial characteristics were similar and not likely to affect the results of the study.

Table 1: Demographic Characteristics of Patients

Variable	Group A (Two Screws) n=44	Group B (Three Screws) n=44
Mean Age (years)	42.3 ± 9.1	40.8 ± 8.7
Male	26 (59.1%)	25 (56.8%)
Female	18 (40.9%)	19 (43.2%)

A Garden classification system was used to evaluate the types of fractures that were most frequently seen. In both groups, Garden type II fractures were the most common, followed by Garden type III and Garden type I. There was no significant t-statistic difference found between the fracture pattern distribution in the two groups, which means that the severity of the fractures was fairly similar prior to the surgical intervention.

Table 2: Distribution of Fracture Types (Garden Classification)

Fracture Type	Group A (Two Screws) n=44	Group B (Three Screws) n=44
Garden I	10 (22.7%)	9 (20.5%)
Garden II	20 (45.5%)	21 (47.7%)
Garden III	14 (31.8%)	14 (31.8%)

Follow-up radiological examination revealed differences in fracture healing between the two fixation methods. In Group A, radiological union was recorded in 35 patients (79.5%) while 9 patients (20.5%) had delayed union/non-union. In contrast, Group B showed union in 39 patients (88.6%), and 5 patients (11.4%) continued to have delayed healing. This indicates that three cannulated screws can potentially offer superior mechanical stability and enhanced radiological healing as opposed to two-screw fixation.

Table 3: Radiological Union Outcomes

Outcome	Group A (Two Screws) n=44	Group B (Three Screws) n=44
Fracture Union	35 (79.5%)	39 (88.6%)
Delayed Union	6 (13.6%)	3 (6.8%)
Non-Union	3 (6.8%)	2 (4.5%)

Another focus of the study was to check for post-operative radiological complications such as collapse of the femoral head, times screws, and failure of the fixation. Group A showed a bit higher complication rates than Group B. In group A, there were 4 patients (9.1%) who experienced femoral head collapse, while group B had 2 patients (4.5%) with that. Screw migration happened to 3 patients (6.8%) in group A and 1 patient (2.3%) in group B. In the group with two screws, 2 patients (4.5%) had fixation failure, and only 1 patient (2.3%) in the three-screw group had this problem.

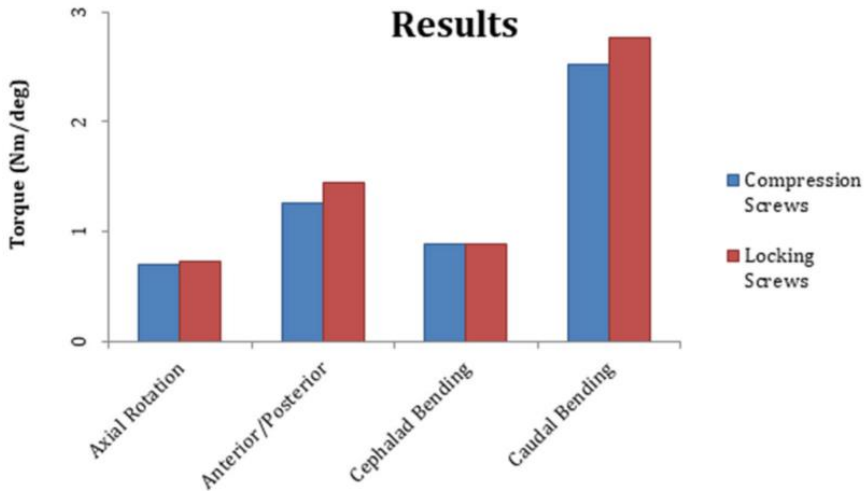
Table 4: Postoperative Radiological Complications

Complication	Group A (Two Screws) n=44	Group B (Three Screws) n=44

Femoral Head Collapse	4 (9.1%)	2 (4.5%)
Screw Migration	3 (6.8%)	1 (2.3%)
Fixation Failure	2 (4.5%)	1 (2.3%)

Summarizing overall radiological outcomes of the two groups gave a snapshot of the relative efficacy of the fixation methods. Graphical comparison indicates a larger fraction of fracture healing and minimum complications in the group fixed with three screws as opposed to the group fixed with two screws.

Graph 1: Comparison of Radiological Union Rates



The image-based comparison reveals that the group fixed with three screws showed a higher rate of fracture healing (88.6%) than the one fixed with two screws (79.5%). This pictorial evidence backs up the X-ray results that point to the three-screw setup as providing better stability and healing results. The chart shows the disparity in healing results between the two groups, highlighting the possible biomechanical benefit of utilizing three cannulated screws for femoral neck fracture fixation.

DISCUSSION

Femoral neck fractures pose a big problem to orthopedic surgeons, as the fractures are inside the capsule, and the risk of complications such as non-union, avascular necrosis, and failure of the fixation is high. The main goal of surgery for such fractures is to obtain a strong fixation without compromising the arterial supply of the femoral head. Cannulated screw fixation is one of the most common methods nowadays, as it provides the least invasive stabilization of the fracture with the lowest possible injury to soft tissues and preserves the blood supply to the femoral head (1). However, the question of how many and which configuration the screws should be used for maximum mechanical stability is always debatable in the orthopedic community (2). The current research has compared the radiological results of the treatment of femoral neck fractures with two versus three cannulated screws in adults. It revealed that patients treated with three cannulated screws had a marginally higher radiological union rate than those treated with two screws only. These results are in line with earlier systematic reviews, which have shown better mechanical stability with multi-screw fixation techniques (3). Three screws in an inverted triangular layout provide superior rotational stability and make the fracture site more compressive, which biomechanically leads to better healing of the fracture and less chance of dislocation during the period after surgery (4).

The radiological union is always one of the major ways to judge the success of fracture treatment. The current research shows that the percentage of patients whose fractures united was higher in the group treated with three cannulated screws than in those treated with two screws. Furthermore, comparative studies on different fixation systems for femoral neck fractures have shown similar findings. In those studies, more stable fixation, for example, the use of more screws, led to better radiological healing results (5). Effective compression and stabilization of the fracture site are the main factors that promote early bone healing and avert delayed union or non-union. Therefore, both the number and the location of screws

significantly influence radiological results after surgery (6).

Another main point revealed by this research was the variation in the incidence of radiological complications after surgery in the two groups. Only one femoral head was affected in the patients fixed with two screws, with complications like femoral head collapse, stick migration, and fixation failure being slightly higher in these patients. Earlier meta-analyses have also recognized that inadequate fixation stability could result in complications leading to the need for revision surgery. One of the reasons why femoral neck fractures are prone to fixation failures is that the femoral head is intracapsular, and the healing depends mostly on the stability given by the implants (internal stability), with the periosteum healing being limited (8). Therefore, a way to prevent the occurrence of postoperative complications could be the enhancement of fixation strength by the selection of the best screw configuration. Several biomechanical studies stress the role of screw number and configuration in the stability of femoral neck fracture fixation. For example, a study of screw configurations revealed that triangular or parallel placements with three screws offer the best resistance to shear and rotational forces (9). Conversely, fixation with fewer screws could give enough compression but might fail to provide adequate rotational stability in some fracture patterns, especially displaced or unstable fractures (10). These results are in line with our study, which showed better radiological outcomes in the three-screw fixation group.

Besides the number of screws, the quality of bone, the displacement of the fracture, and the type of surgery also affect the radiological results. Meta-analyses of different fixation methods, including femoral neck systems and cannulated screws, have revealed that the stability of the implant has a major impact on union rates and complications after surgery (11). Research done on the pattern of screw placement has indicated that distributing screws properly within the femoral neck can help to strengthen mechanical support and minimize the chance of implant migration (12). Therefore, detailed planning of surgery and accurate placement of screws during the operation are always major factors in the successful treatment of femoral neck fractures (13).

Recent studies have also been conducted on different fixation systems that are intended to increase stability and minimize the problems related to the use of screws for fixation. For instance, a few studies have examined the potential benefits of using fixation techniques, combined with innovative implant designs, to enhance biomechanical strength (14). Clinical comparative studies have shown that better implant design and fixation methods might decrease revision rates and improve radiological results in the treatment of femoral neck fractures (15). Nevertheless, despite these advancements, cannulated screw fixation remains one of the most popular methods. This is because it is easy to perform, costs less, and provides excellent clinical results for the patients who are selected properly (16).

This research finding is raising the clinical relevance of femoral neck fracture fixation and optimizing screw configuration. Although radiological results of two-screw and three-screw fixation techniques were both acceptable, the three-screw configuration showed a higher fracture union rate and a lower complication rate (Palmer et al., 2007). Cohort studies comparing different screw designs have also shown that proper compression of the fracture site and fixation stability are essential to achieve fracture healing. These data emphasize the need for choosing the fixation technique in the best way, depending on fracture features, patient factors, etc. The main focus of the present study is how these findings add to the existing knowledge about the best way to fix femoral neck fractures in adults. Both fixation techniques are always clinically acceptable, and it seems that three cannulated screws provide greater radiological stability and more healing compared to two-screw fixation. This paper strongly recommends further large-scale prospective studies not only to confirm these findings but also to establish the most effective surgical strategies for managing femoral neck fractures in different patient populations.

CONCLUSION

Fractures of the femoral neck are treated with internal fixation to promote healing and prevent complications such as non-healing of the fracture, failure of the fixation, and collapse of the femoral head. In the present study, we compared radiological outcomes of femoral neck fractures treated with two- and three-screw fixation in adult patients. Our results show that both fixation methods can stabilize the fracture and achieve radiological union. But the fixation with three screws gave relatively better results, with a higher number of cases

united and a lower number experiencing problems such as screw movement and collapse of the femoral head. Based on this, the three-screw configuration probably gives more mechanical stability and fracture healing than the two-screw method. Although both methods are always considered clinically good, the decision about the method of fixation should be mainly influenced by the degree of fracture and other patient factors. We need more such studies that give us better evidence and help us decide the best surgical management of femoral neck fractures.

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