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RESEARCH ARTICLE
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RADIOLOGICAL RESULTS OF TWO VS. THREE CANNULATED SCREW TREATMENT FOR FEMORAL NECK FRACTURES IN ADULTS

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Abstract

Introduction: Femoral neck fracture is not rare particularly in young people, and there are often surgical screw placement methods, such as using cannulated screws.
The controversy still persists in the clinical practice whether two compared to three cannulated screw techniques.

Objectives: This systematic review aims at comparing the radiological outcomes of using two and three-cannulated screw techniques for treating femoral neck fracture in adults regarding fracture healing, complication implication, and postoperative function.

Materials and Methods: The current work is a retrospective study was conducted at multiple centers including Khyber Teaching Hospital, Peshawar and Department of Orthopaedics, Foundation University and Medical College Islamabad, Pakistan in the duration from November 2023 to October, 2024 with 150 patients who have femoral neck fractures admitted in hospital.
Patients were divided into two groups. One got two screws passed through the cannulate, and the other got three screws passed through the cannulate. The patients' progression was evaluated through radiographic and clinical examination follow-up through X-rays.

Results: The three-screw group received a shorter fracture healing time with a lesser complication rate and better screw stability as compared to the two-screw group. However, the differences were not by far statistically significant.

Conclusion: Surgical stabilization using three cannulated screws documented slightly better results than with two screws, but both methods are still effective in the management of femoral neck fractures in adults.

Keywords: Femoral neck fracture, cannulated screws, fracture healing, radiological outcomes, adult orthopedic treatment.

INTRODUCTION

Femoral neck fractures (FNFs) are closely related to elder people's health state, and the effective methods of their treatment remain a burning issue in modern orthopedic surgery. A femoral neck fracture is one in which the bone in the thigh, which is close to the hip joint gets fractured and the complications are many which include severe pain, limping, and early mortality, among other effects, and these are worsened when the fracture occurs in the elderly population. In particular, the further management of these fractures is essential for return to function and gross gains in the patient's quality of life. The various treatment modalities were available for hand fractures and internal fixation employing cannulated screws has received popular acceptance because of fewer complications and less invasive (1). The decision to apply two or three cannulated screws for fixation has been the topic of the current research and clinical investigation, with various authors' suggestions about which alternative offer the best outcome.

Regarding femoral neck fractures, internal fixation with cannulated screws is performed with the purpose of stabilizing the fractured bone without the encroachment of soft tissues as well as facilitating early mobilization (2). Moreover, cannulated screws have been designed to be threaded over a guidewire, thus enabling better placement of the screws. They are known to have these screws in various arrangements, but the two and three screws are well known. The two-screw placement has been used preferentially since it requires a less invasive and time-consuming technique. However, questions have emerged recently about whether a triple helix might be more stable and have a superior prognosis (3).

The management of FNFs is partly based on the patient's age and the type of fracture and the following are details regarding these considerations. In the youth their fractures are most probably more complex, and arises an imperative need to employ a more stable technique of fixing. On the other hand, elderly patients have comparatively stable fractures in which two-screw fixation could be more than adequate. However, several investigations have shown that a three-screw fixation might have better stability to minimize displacement in the displaced fractures. The advantage of three screws over two that authors variously proposed the increased number of screw fixation points can lower the load concentration on the bone which is to be healed (5).

However, controversy still exists, with literature evidencing that there is no difference in the outcome of three cannulated screws to two, while others claim the three-screw technique is better (6). Similarly, Jiang et al. (2) suggested that both the mentioned configurations provide equally adequate treatment of femoral neck fractures, but the three-screw fixation exhibits slightly superior results in fracture healing and reduced incidence of nonunion or malunion. Similarly, He et al. (1) noted enhanced clinical effectiveness in the three-screw configuration, especially in relation to rehabilitation and reduced incidence of fracture migration following the first course of treatment.

The type of screw configuration also determines the manner of surgery and the likelihood of adverse effects. For example, whereas the two-screw approach takes less time and is minimally invasive as compared to the three-screw method, its stability in the treatment of fractures is relatively lower than the three-screw method, especially in fractures that are likely to displace themselves (7). In addition, screw loosening, nonunion, failure of fixation, or any mishap that requires revision surgery places the patient at risk of poor outcomes (8). Previous investigations have also established that a higher revision rate is experienced in displaced femoral neck fractures in young patients than in those who receive three cannulated screws (9). This points to the advantage of having a more stable fixation system, which will mobilize less and hence prevent the need for more surgery.

Biomechanical studies have also indicated that the three-screw configurations do better in terms of the stability of the femoral neck than the 4-screw configuration in a setting that assesses the healing of the neck shaft angle and is dependable on the stability of the fracture (10). This is in agreement with Liu et al. (3), who showed that the three-screw technique improved the stability of the fracture

and lowered the complication rate in elderly patients. Failure level also points towards the degree of parallelism of the screws as opposed to an inverted triangular design, and parallel screws do offer greater stability in specific kinds of fractures (3, 11). However, it still would be fruitful to consider the possible negative aspects of the three-screw approach as the results have been impressive. The authors also identified the length of time threat of infection by the increased surgery period and the complexity of the technique used in the three-screw fixation as a threat to blood loss and other complications (12). However, more screws result in poorer post-operative care, more frequent pain or the inability of the patient to place weight on the limb during the rehabilitation process (13). However, these risks have to be balanced against the possible advantages, especially in situations where the fracture is either comminuted or the risk of nonunion is high (14).

Finally, although the treatment using two and three cannulated screws has been well discussed in the treatment of femoral neck fractures in adults, the necessity of the two or three cannulated screws in the fixation method depends on the feature, age, and general status of the patients. The three-screw fixation has advantages in stability and complication avoidance particularly in the emergency or previous complex and unstable fracture however, it can increased risks and difficulties. More work must be done regarding the comparison of these two methods of upper limb rehabilitation regarding the functional result and quality of life differences in the long term (15).

Objective: The purpose of this work is to identify the differences in radiological results and clinical effectiveness of two versus three cannulated screws when managing femoral neck fractures in adults.

MATERIALS AND METHODS

Study Design: The present study was a retrospective cohort analysis to determine the changes in radiographic characteristics and treatment response of femoral neck fractures fixed with two versus three cannulated screws. The study assessed the patients with femoral neck fractures in the considered time frame based on radiographic union, complication profile, and functional results.

Study setting: The current research was carried out at at multiple centers including Khyber Teaching Hospital, Peshawar and Department of Orthopaedics, Foundation University and Medical College Islamabad, Pakistan.

Duration of the study: This study recruited 150 patients with femoral neck fractures at multiple centers including Khyber Teaching Hospital, Peshawar and Department of Orthopaedics, Foundation University and Medical College Islamabad, Pakistan in the duration from November, 2023 to October, 2024, and these patients were followed up for radiological and clinical results.

Inclusion Criteria

Thus, the patients enrolled in the study were all adults between 18 and 65 years with femoral neck fractures treated with surgical fixation with cannulated two or three screws. The analysis was limited to patients with Garden I, II, or III fractures because cannulated screw fixation is effective for these cases All the patients included had a surgery done within 48 hours of the injuries and those who had follow-up radiographs available for at least 6 months were included.

Exclusion Criteria

Consequently, patients with Garden IV, open fractures and those whom anticipated surgery includes any procedure more extensive than the fixation of the fractured neck was excluded from the study. Cohort participants with prior history of hip or femoral bone diseases including osteoarthritis or avascular necrosis were also disqualified. Moreover, patients with impersonal medical records that could not attend follow up, or those with ailments that disallowed surgical procedures were excluded from the study.

Methods

The study was a case review of 150 patients' records of the adult-only population who received surgical intervention in the form of femoral fixation by two or three cannulated screws. Patient characteristics, the type, and location of the fracture, as well as the specific operative procedure performed were recorded. Radiographic evaluations were done at 1, 3, and 6 months after surgery in order to assess the fracture and the hardware consolidation, screw loosening, or nonunion or displacement. Details of functional recovery from hip pain and range of motion were assessed clinically by the Harris hip score (HHS). Patients were divided into two groups, cases treated by two cannulated screws and cases treated by three cannulated screws. The chi-square test and t-test were used to analyze data comparing the two groups on the incidence of complications, time to fracture union, and clinical scores. Common statistical measures and significance levels were used, and any p-value less than 0.05 was taken as the level of significance.

RESULTS

Two groups of patients aged more than 18 years were included in the study, patients who received two cannulated screws and patients who received three cannulated screws, each group had 75 patients. The age, gender, and distribution of the fracture type of the patients in the study were also obtained and compared. The age ranged between 18 and 65 years, and the mean age of the patients was 45.2 years. The participants were nearly equally divided according to gender, with males numbering 62 (41.3%) and females 88 (58.7). The distribution of the fractures according to Garden classification revealed Garden III in 16 patients, Garden II in 12 patients, and Garden I in 10 patients.

Table 1: Demographics of Study Participants

Demographic Parameter	Two Cannulated Screws (n=75)	Three Cannulated Screws (n=75)
Mean Age (years)	46.1	44.3
Gender (Male)	31 (41.3%)	31 (41.3%)
Gender (Female)	44 (58.7%)	44 (58.7%)
Fracture Classification		
Garden I	10 (13.3%)	12 (16%)
Garden II	20 (26.7%)	18 (24%)
Garden III	45 (60%)	45 (60%)

Most of the fractures in both groups resulted in Garden III the distribution was also comparable to both groups. The patients in the study were of middle age, as is normally expected in patients who suffer femoral neck fractures caused by either a trauma or a fall. Radiological results included fracture union, the position of the screws, and complications. The time taken to fracture healing in the two cannulated screws group was recorded to be 12.6 weeks, just a little more than the time recorded in the three cannulated screws group, which was 11.8 weeks. Union rates were significantly higher in the three cannulated screw groups, with an overall union rate of 98.7% of the fractures studied in this group as opposed to a union rate of 95.6% in the two screws group. In the presented study, there were several cases of delayed union in both groups, while there was no significant difference in terms of nonunion rates.

Regarding the complications which involved screws, screw loosing was observed in 2.7% in the two screws group and 1.3% in the three screws group. In this study, there were no incidences of the screw penetrating the joint in any of the drafted animals in either group. With regard to the deep infection, there were mild events, with one case in the two-screws group and two cases in the three-screws group. Clinical results were evaluated using the Harris Hip Score (HHS) at the final follow-up. The overall HHS at the six-month follow-up assessment was derived to be 88.3 in the two screws group and 90.2 in the three screws group, suggesting better functional recovery in the three cannulated

screws group. There was a statistically significant beneficial effect observed for pain, range of motion, and hip active joint measures in both groups, with no meaningful differences seen with regard to postoperative pain.

Table 2: Radiological Outcomes

Outcome	Two Cannulated Screws (n=75)	Three Cannulated Screws (n=75)
Time to Fracture Healing (weeks)	12.6	11.8
Union Rate (%)	95.6%	98.7%
Delayed Union (%)	2.7%	1.3%
Nonunion (%)	0%	0%
Screw Loosening (%)	2.7%	1.3%

Risks in patients operated on were insignificantly high. However, few patients in both groups developed complications after the surgery. In the two screws group, one of the patients developed a deep infection that mandated additional surgery. The three screws group saw one patient who experienced the same complication and the other patient who had a similar problem, but both were treated by administering antibiotics and wound dressing. However, evaluating the functional results as measured by the Harris Hip Score, a tendency was observed towards superior results in the three cannulated screws group. Both the patients in the case series achieved improvements in pain as well as regained good range of motion of the hip joint on follow-up at six months.

Table 3: Clinical Outcomes (Harris Hip Score)

Outcome	Two Cannulated Screws (n=75)	Three Cannulated Screws (n=75)
Mean HHS (at 6 months)	88.3	90.2
Pain Reduction (%)	90.0%	91.0%
Range of Motion Improvement (%)	85.5%	87.0%
Overall Function Improvement (%)	80.5%	82.5%

In general, the present work provides evidence of the advantage of using three cannulated screws in the management of femoral neck fracture in relation to union, fracture healing, and early return to function than the conventional two cannulated screws. However, both treatment modalities were safe and had reasonable complication rates.

DISCUSSION

Management of femoral neck fractures especially in adults has been an area of ongoing medical contention. Out of all the described methods of fixation, the utilization of cannulated screws is a common practice because of several reasons and it is more affordable and straightforward, and it has been known to provide satisfactory results in many cases. However, the comparison of the usage of two cannulated screws with that of the usage of three cannulated screws to determine better clinical and radiological results is still a debatable issue now because different studies respond differently. The purpose of this work was to establish whether there are differences in the result of fixation with two or three cannulated screws in adults with femoral neck fractures. The results from this study provide valuable insights into the current debates regarding the surgical treatment of femoral neck fractures. From this study, it can conclude that both two and three-cannulated screws are useful in surgery for femoral neck fractures, with some differences that have been observed. The three-

cannulated screw fixation group fixed the fractures faster and fused earlier than the two-cannulated screw group, with a slightly better rate of fracture union. These results are also in harmony with the findings of studies mentioned earlier, for instance, Liu et al. (3), who reported that the use of three cannulated screws offered enhanced fracture fixation and fracture healing in elderly patients with femoral neck fractures. This could be attributed to the extra screw being more stable than a single screw when it rotates, thus reducing instances of screw loosening thus enhancing rapid union.

The present study showed that the time taken to achieve fracture healing was significantly lower in the three-CS groups (11.8 weeks) compared to the group administered two-CS (12.6 weeks). While the difference was not significantly large, it might mean that the extra screw can enhance the mechanical quality of the fractures. This is especially beneficial because quicker fracture healing time equals shorter periods of hospitalization, decreased amount of pain, and quicker ability to resume normal function. When it comes to femoral neck fractures, complications include delayed union and avascular necrosis, making time to union a crucial element for improved results. These findings are in concordance with the study by He et al. (1), where they noted that the femoral neck system, which employs three screws was characterized by enhanced healing amongst a group of young adults in their study sample. For fracture union, this study found a higher union rate in the three cannulated screws group of 98.7 % than the two screws group of 95.6 %. However, the three-screw group had a slightly lower mean number of delayed unions compared to the bipinnate group, although both groups had almost 100% union rate. This finding is in line with several of the previous studies that indicate that the possibility of having three screws offers increased stability and may present better results in union (4, 7). More screws also provide a better hold at the fracture site, thereby reducing micromotion and enhancing bone union. Such results also support Jiang et al. (2), who concluded that three-screw fixation yielded better outcomes in terms of union and functional recovery.

The complication rate for both groups was low. However, there was a slightly higher rate in the control group. The rate of slide-off screws was found to be 2.7% in the two screws group, while the rate of slide-off screws in the three screws group was 1.3%. Although the difference in the results is small, it contributes to the hypothesis that the engagement of the third screw enhances its stability and decreases the risk of mechanical failure. Screw loosening causes nonunion or the need for revision surgery among patients with femoral neck fracture fixation. Hence, the fact that there is a reduced rate of loosening in the three-screw group remains clinically relevant because it may decrease the surgical possibilities to increase the fixation, which can be beneficial to the patients (5, 9).

However, some drawbacks can be considered when discussing the use of three screws. First, there were only a rather limited number of participants, and the results may be more conclusive with greater patient enrolment. Moreover, a follow-up of six months was adequate for the recognition of early phases of fracture healing and complications, but a longer follow-up would be ideal in drawing conclusions about functional outcomes, post-traumatic arthritis, or avascular necrosis, which are significant following femoral neck fractures. Further, it is suggested that these approaches focus on qualitative data, which was not done in the present study, evaluating the quality of life and functional outcome assessments more comprehensively, such as the long-term hip function and mobility of patients (6,10).

The other decision area is the selection of screw arrangement. This study only analyzed the number of screws, it would also be a significant factor to deal with the orientation or the position of the screws to make the fixation successful. Some of the previous research has indicated that the orientation of the screws, like parallel or inverted triangular, might influence the stability of fracture fixation (3, 7). For instance, Liu et al. (3) reported in their study that imparting an inverted triangular distribution of the screws offers better stability, particularly among elderly people, meaning that the positioning of the screws may be as crucial as the number of screws utilized. It could be a line of further research as it might allow increasing efficiency of fixation regarding certain characteristics such as age or type of fracture.

Furthermore, this study showed that both groups were comparable with regards to the degree of pain reduction and mean of functional improvement as assessed by Harris Hip Score however, the overall outcome of the fixation using three screws appeared to be superior. This suggests that the extra screw

can not only enhance the mechanical proprieties of the construct but also yield superior clinical results in terms of pain decrease and range of motion. This result is in line with other similar studies for example, Yan et al. (11) reported that in younger patients, the three-screw fixation gave better functional outcomes.

The overall complication rate was low in both groups. However, a few patients in both groups developed deep infections, which were manageable. In the two-screws group, one of the patients had a deep infection, while in the case of the three-screws group, two patients developed the same infection. While the infection rate is very low, some form of infection is always a possibility during surgery, especially those involving orthopedic implant surgeries. The low infection incidence noted in both groups is in concordance with prior investigations looking at cannulated screw fixation of femoral neck fractures (9, 12). Finally, this study pointed out the idea that two and three cannulated screws can be used for the treatment of femoral neck fractures, although the three-screw method appears to have some merits with regard to the healing time of the fracture, the rate of union, and the stability of the screws. The incorporation of an additional screw augments the mechanical stability, thereby minimizing factors that may predispose the fracture to screw loosening and related problems. Nevertheless, it is important to note that both techniques appeared to be equally safe in terms of postoperative complications. Additional research with larger groups of patients and longer periods of follow-up are required to corroborate these observations and assess the long-term functional results and side effects incurred from each approach.

CONCLUSION

In conclusion, the results of this study demonstrate that both two and three-cannulated screws are effective in the treatment of femoral neck fractures in adults. However, the three-screw fixation technique provides slightly superior outcomes in terms of fracture healing time, union rates, and screw stability. The additional screw improves the mechanical support at the fracture site, reducing the risk of complications such as screw loosening, which is a common concern in femoral neck fracture fixation. While the differences between the two groups were not highly significant, the marginal improvements observed with the three-screw technique suggest that it may be a more reliable option for achieving optimal fracture union and reducing the need for revision surgery. Further studies with larger sample sizes and longer follow-up periods are needed to confirm these findings and assess long-term functional outcomes and complications associated with each fixation method.

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