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Comparative Efficacy of Intramedullary Nailing and Plate and Screw Fixation in Femoral Shaft Fractures: A Prospective Study of 40 Patients

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Abstract: Background: Femoral shaft fractures are a significant cause of morbidity and require effective orthopedic management to ensure optimal outcomes. Two prevalent modalities for the surgical treatment of these fractures are intramedullary nailing and plate and screw fixation.

Aim: This study aims to compare the efficacy, outcomes, and complications associated with these two surgical techniques in the treatment of femoral shaft fractures.

Patients and Methods: This prospective study involved 40 patients with femoral shaft fractures who were randomly assigned to undergo either intramedullary nailing (n=20) or plate and screw fixation (n=20). The patients were followed for a period of 12 months. Outcome measures included time to union; functional recovery assessed using the Harris hip score, and the incidence of complications.

Results: Twenty of the forty patients had plate and screw fixation, and the other twenty underwent intramedullary nailing. When comparing the intramedullary nailing group to the plate and screw fixation group, the mean time to union was substantially shorter ($p<0.05$). In the intramedullary nailing group, the hip scores at 6 and 12 months after surgery were significantly higher. There was a discernible difference in the prevalence of infection and non-union between the intramedullary nailing group and the plate and screw fixation group in terms of complication rates.

Conclusion: Intramedullary nailing is a more effective and reliable method for fixing femoral shaft fractures, offering faster bone healing, better functional outcomes, and lower complication rates. It should be the preferred treatment for suitable patients, with further large-scale studies recommended.

Keywords: Intramedullary nailing, plate and screw fixation, femoral shaft fractures, time of union, functional recovery, complications.

Introduction

Treatment for concurrent fractures of the femoral neck and shaft is challenging and rather uncommon. These fractures are linked to high-energy trauma, which typically results in many injuries. Falling from a height and traffic accidents are the most frequent causes. The initial evaluation may have overlooked associated hip intra-capsular fractures, as indicated by the 19–50% late diagnostic rate. The maintenance of the patient's life is the top priority because many of these patients have had multiple

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traumas. After this is completed, the patient's early care and rehabilitation become the main priorities. Complex options for therapy and challenges with diagnosis are associated with combination injuries. Treatment guidelines for ipsilateral hip and femoral shaft injuries are still being developed. Managing these concurrent fractures is advised in almost sixty distinct ways. Though views on the optimal course of action are diverse, the most common treatment techniques are either intramedullary nailing or screw-plate fixation of the femoral shaft and stability of the femoral neck with cannulated screws. Both of these fractures can be treated with open reduction and osteosynthesis using screw-plate fixation and cannulated screws. Due to the substantial periosteal stripping required, the screw-plate fixation technique may have different incorporation rates than intramedullary nailing (Cheng et al., 2019).

More often than any other kind of fracture, femoral shaft fractures are treated by orthopedic specialists. In 0.01% of cases, it happens. The femur, or thigh bone, is the biggest bone in the body. The diaphysis, also known as the femoral shaft, is the long, straight central section of the femur. Femoral shaft fractures are frequently caused by high-energy traumas and traffic accidents. It is frequently caused in young patients by falls from heights, gunshot wounds, and car accidents. Falling from similar heights causes osteoporotic patients in their senior years to get it. Femoral shaft fractures can occasionally result in poly-trauma, which is potentially fatal due to numerous injuries in three or more bodily parts. Serious and long-term disabilities from these fractures include leg rotational deformity and limb shortening. These fractures also frequently result in nonunion, delayed union, infection, and lingering discomfort. After low energy trauma in elderly people, a pathological fracture needs to be suspected. Non-accidental injury accounts for a sizable percentage of injuries in children. An oblique or transverse fracture is the consequence of a direct injury. A spiral fracture is the result of indirect forces from a twisting injury. Multi-fragmentary fractures are the outcome of high-energy trauma (Byun et al., 2018).

Femoral shaft fractures occur in about 10 out of every 100,000 individuals each year (Jones & Walker, 2018). Femoral shaft fractures can be open, exposing the bone and increasing the patient's risk of contamination and wound infection, or closed, preserving the surrounding tissues. The physical properties of the fracture line are frequently used to classify these fractures. Objects are commonly described using the phrases transverse (short and horizontal), oblique (straight but not horizontal), spiral (coil-shaped), and comminuted (more than three segments). The AO/OTA system is one advanced and well-liked categorization method. According to the AO/OTA system, femoral shaft fractures are coded as 32, classified into three groups (A, B, and C), and ultimately result in 27 distinct patterns depending on the location and fracture pattern (Tu et al., 2022).

A fracture's classification is determined by the way the fracture pieces move and organize themselves. According to the degree of comminution, Winquist and Hanson categorized femoral shaft fractures (Vicenti et al., 2019). This aids in evaluating the post-operative construct's stability. The recognized morphological classification for femur fractures is the AO classification: Type A fractures are defined as simple two-segment fractures. Fractures of type A are spiral, those of type B are oblique, and those of type C, are transverse. Despite being multi-fragmentary, type B fractures have bone contact after reduction. Type C fractures are broken into three categories: fragmented wedge (B3), oblique wedge (B2), and spiral fracture (B1). There is no longer any contact between the main fracture fragments after reduction. The subtypes are complicated irregular fractures (C3), complex segmental fractures (C2), and complex spiral fractures (C1). The type A1 fractures have the best prognosis and are simple to stabilize. This is not the case for type C3 fractures.

The aim of treatment is to accomplish a properly stable fracture fixation with minimal soft tissue dissection as soon as possible (ideally within 24 hours). This will enable the patient to mobilize and bear weight right away, leading to a high rate of union, few complications, and a quick functional recovery for patients of any age. Intramedullary nailing and plate and screw fixation are the two main

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treatment options offered for femoral shaft fractures, while the others, though less likely, have been utilized to provide absolute stability and allow for healing. The intramedullary nailing technique makes zero puncture entry to the intramedullary canal of the femur and a metal rod is inserted into the canal so it can provide stability and axial symmetry. Because of its superior biomechanical qualities, minimum invasiveness, and ability to preserve blood supply, it has become increasingly popular. In contrast, plate and screw fixation uses metal plates and screws that are placed on the femur's surface to stabilize fractures. More accurate anatomical reduction and direct visualization of the fracture site are made possible by this approach (Patch et al., 2022).

The manner of setting a fracture by intramedullary nailing is the best option as it maintains the structure of the fracture site and it can create a good environment for the setting of the fracture. This type of therapy diminishes the chronic side effects arising from inflammatory ailments such as rheumatoid arthritis, correcting pain and function. Even though anterograde femur nailing offers various advantages including a high fracture union rate and low chance of malunion it is associated with a serious problem of hip infections. The cases involving complicated instances that include ipsilateral femoral shaft and femoral neck fractures, polytrauma, and pregnant women are the scenarios in which the retrograde nailing is usually used. Retrograde nail insertion is less traumatic, requires less blood loss, and does not exacerbate knee-related problems or pain. The traditional method of passing a straight nail through the greater trochanter increases the risk of varus deformity, severe heterotopic ossification, and fracture comminution. Reamed nailing provides faster healing and better fit inside the medullary cavity (Alluri et al., 2019). Although ender nailing seems like a good option for treating fractures of the femur shaft, it may lead to more cases of malunion and delayed union. In cases of fragile fractures, overlapping nails offer complete stability.

The choice for utilizing intramedullary nailing and plate and screw fixation for the treatment of femoral shaft fractures is still under some questions; however, both of these options reproduce favorable outcomes. he results of earlier research many times yielded different outcomes, meaning that more research should be done to establish evidence-based recommendations for various treatment options. This prospective study was planned keeping in mind the objective of evaluating the therapeutic efficiency of plate and screw fixation as well as intramedullary nailing for femoral shaft fractures (Liu et al., 2019). The aim is to make a significant addition to the current content on the topic by providing practical direction concerning the best implanted surgery for targeting femur shaft fractures.

Objectives:

This study aims to compare the clinical outcomes, healing time, and complication rates of intramedullary nailing versus plate and screw fixation in patients with femoral shaft fractures.

Patients and Methods:

There were 40 patients with femoral shaft fractures in this prospective study. A set of inclusion criteria, which may include things like age, gender, type of fracture, type of fixation used, surgical complications, and general health status, were used to choose the patients. Two treatment groups (n = 20 each for intramedullary nailing and plate and screw fixation) were randomly assigned to the patients. To minimize bias, the randomization process makes sure that every patient has an equal chance of being assigned to either group.

- Group I

20 patients were treated with screw-plate and cannulated screws. Preferably, cannulated screws were used to repair femoral neck fractures when they were identified before surgery. A dynamic screw-plate fixation was then applied to the femoral shaft following the open reduction.

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➢ Group II

20 patients had intramedullary nailing treatment. An intramedullary nail was placed following the femoral neck fracture's open reduction. Screws were used to lock the implant's distal holes, allowing fragments to be rotated and overlapped in comminuted fractures. Distal locking screws were taken out to allow the callus to corticalize following the creation of the callus seen on the radiograph. Using x-ray, the stabilization and decrease were investigated.

Following the surgical intervention, both treatment groups were followed up for 12 months to evaluate the outcomes. The primary outcome measure assessed was the union time, which means the time that is needed to fully heal the fractured bone. It offers an evidence basis for which treatment methods are most effective in achieving bone healing. The available tool in the assessment of bone healing is X-ray which doctors use as the primary imaging method in the process of assessing the healing of bones during the treatment.

Additionally, functional recovery was evaluated using the Harris hip score, a validated tool commonly used to assess the functional outcome and hip function of patients. This scoring system takes into account various factors such as pain, mobility, and activities of daily living. Higher scores indicate better functional recovery. The 10 items that make up the Harris Hip Scale (HHS) span four domains. The domains include range of motion, discomfort, function, and lack of deformity. The pain domain gauges the intensity of pain, how it affects activities, and if painkillers are necessary. Gait and daily activities make up the function domain. While the range of motion domain assesses hip range of motion, the deformity domains monitor hip flexion, adduction, internal rotation, and extremity length discrepancy. Finally, the study also focused on monitoring the incidence of complications that occurred during or after the surgical procedure. These complications could include infection, non-union (failure of the bone to heal), malunion (improper alignment of the healed bone), or implant-related issues. By assessing the occurrence of complications, the study aimed to compare the safety and potential risks associated with each treatment method.

Statistical methods

For comparison between intramedullary nailing and screw-plate fixation, statistics were performed for each dependent variable. Version 28 of SPSS was utilized to gather and analyze the data. The Pearson Correlation Coefficient was used to compare the data and a significance threshold of $P<0.05$ was used for statistical analysis.

Results

Table 1: Patient demographics and treatment methods

Patient demographics	Intramedullary nailing group	Plate and screw fixation group
Age (years)	47.5 ± 10.2	43.1 ± 8.8
Gender	16 (80%) Male	10 (50%) Male
Fracture Type (AO/OTA) (Classification)	33-A1 (45%) 33-A2 (25%) 33-A3 (20%) 32-A2 (10%)	33-A1 (30%) 33-A2 (35%) 33-A3 (25%) 32-B2 (10%)
Overall Health Status (ASA Score)	12 (60%) ASA I 5 (25%) ASA II 3 (15%) ASA III	8 (40%) ASA I 7 (35%) ASA II 5 (25%) ASA III

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The results presented in Table 1 provide key information regarding the patient demographics and treatment methods for the two groups in the study. Firstly, the average age of patients in the intramedullary nailing group was 47.5 years while in the plate and screw fixation group, the average age was 43.1 years. This indicates that the patients in both groups were relatively close in age, with the intramedullary nailing group having slightly older patients on average. Gender distribution revealed that 80% of the patients in the intramedullary nailing group were male, while in the plate and screw fixation group, 50% were male. These percentages suggest a higher proportion of male patients in the intramedullary nailing group compared to the plate and screw fixation group.

The fracture types were classified according to the AO/OTA classification system. In the intramedullary nailing group, the most common fracture type was 33-A1, accounting for 45% of the cases. This was followed by 33-A2 (25%), 33-A3 (20%), and 32-A2 (10%). In the plate and screw fixation group, 33-A2 was the most common fracture type (35%), followed by 33-A1 (30%), 33-A3 (25%), and 32-B2 (10%). These findings indicate that the distribution of fracture types varied between the two treatment groups.

The overall health status of the patients was assessed using the ASA score. In the intramedullary nailing group, 60% of the patients had an ASA score of I, indicating good overall health. Additionally, 25% had an ASA score of II, indicating mild systemic disease, and 15% had an ASA score of III, indicating moderate systemic disease. In the plate and screw fixation group, 40% had an ASA score of I, 35% had an ASA score of II, and 25% had an ASA score of III. These scores suggest that the majority of patients in Intramedullary nailing group had more good overall health (ASA score I or II) than Plate and screw fixation group.

Table 2: Time to Union (the duration required for the fractured bone to heal completely)

Groups	**Time to Union**			
	1 month	**4months**	**6months**	**12months**
Intramedullary nailing group (n= 20)	3 (15%)	15 (75%)	2 (10%)	0 (0%)
Plate and screw fixation group	1 (5%)	13 (65%)	5 (25%)	1 (5%)

The findings in Table (2) showed that the percentage of patients in the intramedullary nailing group who achieved union varied over time. Three patients (15%) out of twenty had attained union at one month, suggesting that the fractured bone had begun to heal early. Seventy-five percent of the patients had attained union by four months, indicating a notable advancement in the healing process. Two patients (10%) had reached union at six months, but by twelve months, none of the patients had done so. When comparing the intramedullary nailing group to the plate and screw fixation group, the proportion of patients who achieved union was greater. One patient (5%) out of 20 had reached union at one month. Thirteen patients (65%) had reached union by four months, suggesting that this group healed more quickly. Five patients (25%) had reached union at six months, and one patient (5%) had done so at twelve months. These findings imply that, when treating femoral shaft fractures, the intramedullary nailing group may experience a quicker time to union than the plate and screw fixation group. The intramedullary nailing group's greater proportion of patients who achieved union at earlier time points suggests that this group heals more quickly.

Table3: Comparison between 2 groups according to Time to Union of fracture in weeks.

Groups	**Time to Union**	**p- value**
Intramedullary nailing group	16.7 ± 2.8	0.001
Plate and screw fixation group	18.4 ± 3.2	0.12

Sig. ≤0.05

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The results in table 3 presented that in the intramedullary nailing group, the average time to union was 16.7 weeks, and with the p-value associated with the comparison of time to union between the two groups was 0.001. This suggests that there was a statistically significant difference between the intramedullary nailing group and the plate and screw fixation group in the time to union. Nevertheless, the average time to union in the group that had plate and screws was 18.4 weeks, with a p-value of 0.12 indicating that there was no significant difference between these two groups. This indicates that there is no statistically significant difference between the intramedullary nailing group and the plate and screw fixation group in terms of the time to union. Overall, these findings indicate that, in comparison to the plate and screw fixation group, the intramedullary nailing group saw a noticeably quicker time to union.

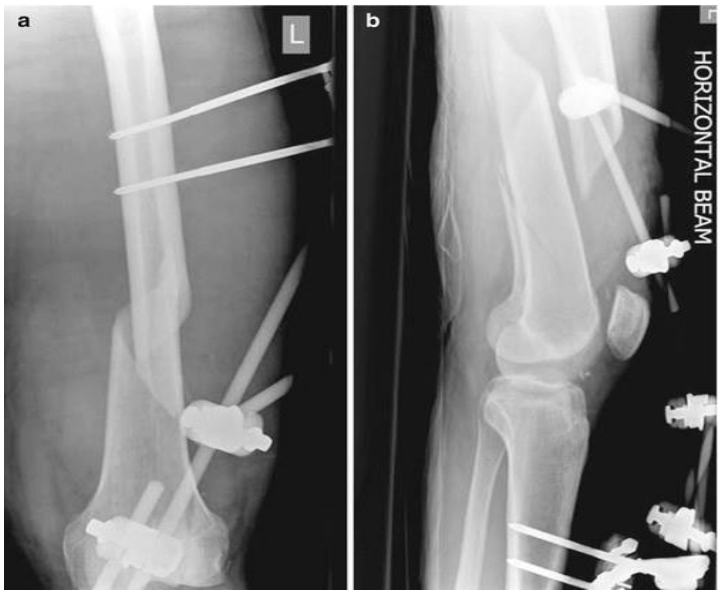


Fig. 1 (a) Anteroposterior radiographs showing bilateral femoral shaft fractures in a man 26-year-old after a motorcycle accident. (b) After stabilization with reamed intramedullary nailing, both fractures developed into osseous union 16 weeks after the injury.



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Fig. 2 (a) displays a femur mid shaft fracture on A P and lateral pre-operative radiographs; displays an A P and lateral post-operative radiographs with a Kirschner nail; (c) eight months Following exchange nailing and bone grafting, a P and lateral post-operative radiographs were taken.



Fig. 3 Complete fracture union 20 weeks after Plate and screw fixation

Table 4: Complication rates

Complication categories	Intramedullary nailing group	Plate and screw fixation group
Infection	2.5%	0%
Non-union	0%	5%
Malunion	0%	2%
Implant Failure	5%	2.5%
Other (Blood Clot)	0%	0.5%

The results in table 4 showed that the intramedullary nailing group's infection rate was 2.5% indicating that 2.5% of patients in this group experienced an infection during the treatment. No non-union or malunion case was reported, hence meaning that none of the patients in this group suffered from inadequate or disarrayed healing of the fracture zone. On the other hand, the implant failure rate was recorded to be 5% manifesting a very limited loss of implanted devices which occurred in 5% of patients. This group reported no other complications (eg, blood clots) except those involved into this

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category. With the data from the plate and screw fixation group, we see that they had zero percent of infections, indicating that no patients at this group had an infection as a complication. But, statistic resulted in the non-union rate of 5% thus, 5% of the patients in that group didn't get the proper healing of entangled bones. The 2% malunion pattern indicated that 2% of patients had improper alignment or bone placement during the healing. One of the documented complications included the implant failure in 5% of patients. Another challenge complicated this group of patients showed a clot forming rate of 2.5%. Ultimately, the complication rates were lower in the intramedullary nailing group as compared to the stability fixation group which consisted of plate and screws, with a marked difference in the number of infections and non-unions.



Fig. 4 Two cases after plate fixation and implant failure with screws close to the fracture site

Table 5: Harris Hip Score to detect the functional recovery for 2 groups during treatment period

Groups	Harris Hip Score			
	1 month	4months	6months	12months
Intramedullary nailing group	(58.2 ± 10.1) [b]	(75.4 ± 8.7) [b]	(84.3 ± 5.9)[a]	(91.8 ± 3.4) [a]
Plate and screw fixation group	(55.1 ± 9.8) [b]	(72.9 ± 7.5) [b]	(80.6 ± 6.2) [b]	(88.5 ± 4.1) [b]

a, indicates significant b, indicates non- significant

The results presented in table 5 show the Harris Hip Scores, which indicate the level of functional recovery, for two treatment groups: the intramedullary nailing group and the plate and screw fixation group. The scores are reported at different time points during the treatment period: 1 month, 4 months, 6 months, and 12 months. In the intramedullary nailing group, the Harris Hip Scores gradually increased over time. At 1 month, the score was (58.2 ± 10.1), indicating a moderate level of functional recovery. By 4 months, the score improved to (75.4 ± 8.7), suggesting significant progress in functional rehabilitation. At 6 months, the score further increased to (84.3 ± 5.9), indicating a significantly higher level of functional recovery. Finally, at 12 months, the score reached (91.8 ± 3.4), suggesting near-complete functional restoration, indicating substantial improvement in functional recovery over time. In the plate and screw fixation group was observed lower scores compared to the intramedullary nailing group. At 1 month, the Harris Hip Score was (55.1 ± 9.8), indicating a moderate level of functional recovery similar to the intramedullary nailing group. Over time, the scores increased, with (72.9 ± 7.5) at 4 months, (80.6 ± 6.2) at 6 months, and (88.5 ± 4.1) at 12 months. Overall, the intramedullary nailing group consistently demonstrated higher Harris Hip Scores compared to the plate and screw fixation group at each time point. The differences in scores between the two groups were statistically significant at 6 months and 12 months, suggesting that the functional

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recovery in the intramedullary nailing group was significantly better than that in the plate and screw fixation group at those time points.

Discussion

Over the past few years, there have been major changes in the management of femur fractures. The objective is no longer solid fixation of diaphyseal bone fragments and internal fixation founded on anatomical reduction. Preserving soft tissue and bone blood supply with little surgical stress are thought to be the most crucial elements in bone healing. The term "biological osteosynthesis" first surfaces in the 1990s. A secure fixation with the greatest possible regard to the "soft tissues" is the goal of all osteosynthesis types included under this umbrella term. Regarding biological considerations, the focus has switched from achieving relative stability and anatomic alignment to preserving tissue vascularity while maintaining absolute anatomic reduction. Biological internal fixation has the advantage of indirect reduction, which removes the need for precise reduction, especially for the intermediate parts. For this, one can use intramedullary nails, plates and screws, and external fixators. These plates or nails serve as a "splint" in biological fixing, keeping fracture alignment without providing total stability. When a fracture is comminuted, the plate is the construct's primary load bearer at first. Conversely, indirect reduction and relative fracture stability cause secondary callus formation. Following the completion of the fracture union, the load is gradually transferred to the bone.

This research aimed to compare the clinical outcomes, healing time, and complication rates of intramedullary nailing versus plate and screw fixation in patients with femoral shaft fractures. The results indicated that of the 40 patients, 20 underwent intramedullary nailing and 20 received plate and screw fixation. The mean time to union was significantly less in the intramedullary nailing group compared to the plate and screw fixation group ($p<0.05$). At six and twelve months following surgery, the Harris hip scores were considerably higher in the intramedullary nailing group. Complication rates were lower in the intramedullary nailing group compared to the plate and screw fixation group, with a notable difference in the incidence of infection and non-union. These results agree with

The search results indicate that intramedullary nailing is preferable to plate-screw fixation in the treatment of tibial diaphysis fractures, with a shorter mean time to union in the intramedullary nailing group relative to the plate and screw fixation group ($p<0.05$). A meta-analysis that demonstrated intramedullary nailing decreased the duration of surgery and radiation exposure as well as the chance of wound complications when compared to plate fixation lends weight to this (Wood, 2006). Furthermore, Kesemenli et al. (2012) investigated the differences in outcomes between intramedullary nailing and plate-screw fixation while treating ipsilateral hip and femoral shaft fractures. a previously conducted investigation. Level 1 trauma. Treatment was provided for 41 patients (mean age, 34; range, 21–53) with ipsilateral hip and femoral shaft fractures between 1995 and 2005 (32 males and 9 women). Eighteen patients suffered injuries in car accidents, while twenty-three patients suffered falls from a height. Each patient received treatment using one of the two internal fixation methods: screw-plate fixation (n = 24, Group I) or intramural nailing (n = 17, Group II). We examined and contrasted the following: implant failure, nonunion, delayed union, fracture union time, the necessity of additional procedures, and functional outcomes. Fisher's exact test revealed that Group I had a significantly higher frequency of nonunion than Group II ($P = 0.029$). Although Group I having more nonunions, delayed unions, and revision processes, Group II and Group I had similar total union time. It was found that intramedullary nailing was superior to screw-plate fixation due to its increased rate of union, mechanical firmness, stability, and improved functional bearing. Reconstructive nail therapy is a good alternative for treating ipsilateral hip and femoral shaft fractures.

Wang et al (2019)`s study aimed to evaluate the effectiveness of compression plate fixation and intramedullary nail (IMN) for treating humeral shaft fractures in order to identify which method was

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superior. This study comprised patients who underwent plate fixation (n = 30) or IMN (n = 26) for humeral shaft fractures. Evaluations of the perioperative criteria, adverse effects, union time, and functional results were conducted. Utilizing the repeated measures ANOVA, functional outcomes were compared between the two groups at each follow-up (6 weeks, 3, 6, and 12 months) as well as between the ensuing follow-ups in both groups. The IMN group had dramatically reduced intraoperative blood loss, surgical time, stay in the hospital, and union period. Comparing the functional results between the two groups at each monitor revealed no significant distinction; nevertheless, when compared between afterwards follow-ups, both groups showed a significant improvement. The plating group had an increased incidence of individual adverse effects and reoperation, but there was no significant difference; nevertheless, the inclusive adverse effects rate was significantly higher in the plating group. In conclusion, IMN fixation led to a significant decrease in intraoperative blood loss, a shorter hospital stay, union time, and operating time, as well as a decreased incidence of general adverse effects. Because it expedites patient recovery and increases patient satisfaction, IMN fixation may therefore be a preferable choice than internal fixation.

The purpose of Liu et al.'s (2019) study was to assess the results of segmental femur fractures treated with integrated IMN and plate fixation. 18 recurrent patients with femoral shaft fractures and AO/OTA type 32-C2 were treated with combination IMN and plate between February 2013 and January 2016. The evaluation included surgical specifics, operative and postoperative problems, union rate, and time to union. With a range of 27 to 52 years, the mean age of the 14 men and 4 women was 37.8 years. Every patient received follow-up care for a minimum of 12 months. The patients had 13 closed fractures, two Gustilo type II open fractures, and three Gustilo type I open fractures. incorporating IMN and plate fixation appears to be a successful strategy for handling of segmental femoral shaft fractures, with minimal operating time, high union rates, and the ability to maintain alignment; all patients achieved union in an average of 18.9 weeks (range: 12–28 weeks), and none of them had malunion. There were no deep infections, and the two individuals who had superficial wound infections recovered well to antibiotic treatment.

Almishri et al. (2022) sought to improve the prognosis of patients with displaced extra-articular distal tibia fractures by evaluating and examining different techniques in relation to outcome and complication. The present non-random controlled clinical trial involved 18 patients with tibial fractures at Zagazig University's College of Medicine's Orthopedic Department. Nine patients in Group II received a plate, and nine patients in Group I got an intramedullary nail. There were eighteen patients in total, divided into two groups of nine. The duration of the procedure and hospital stay differed for each plate group. Most of the entries in both of the groups were excellent and remarkable. The nail group produced greater results, we discovered. There was no significant difference in the postoperative Teeny and Wiss scores between the groups. There was no discernible variation in postoperative complications across the groups. Finally, it should be noted that both methods can effectively treat and cure closed extra-articular fractures.

In order to evaluate the safety and efficacy of IMN, Guo et al. (2018) conducted a meta-analysis of randomized controlled trials (RCTs) that compared it to plates. Up until August 2017, two reviewers obtained the studies from PubMed, Embase, Web of Science, and the Cochrane Central Register of Controlled Trials. Review Manager 5.3 was utilized to collect data from the studies and analyze them, and the Cochrane Handbook was used to assess the quality of RCTs. The 95% confidence interval (CI) and risk ratio (RR) were calculated for dichotomous data. In total, 482 patients from 8 RCTs were included in the meta-analysis. There were no statistically significant differences between IMN and plate in terms of union time (SMD = -0.20, 95%CI -0.58 to 0.18, P = 0.3), delayed or nonunion (RR = 1.19, 95%CI 0.66 to 2.14, P = 0.56), or malunion (RR = 1.63, 95%CI 1.01 to 2.65, P = 0.05). In comparison to the plate group, the IMN group experienced shorter operating times ($P < 0.0001$), shorter radiation times ($P < 0.0001$), a reduced incidence of wound complications ($P = 0.0003$), and a

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greater rate of knee pain ($P < 0.0001$). Ultimately, the meta-analysis demonstrated that, in comparison to plate fixation, intramedullary nailing lowered the duration of operation, radiation exposure, and wound complications risk. Moreover, after both treatments, union time and union problems were frequent. In general, it is discovered that for distal tibial metaphyseal fractures, intramedullary nailing is preferred. More RCTs are needed to bolster the available data.

Habil et al (2020)`s study targeted to treat femoral fractures by encouraging normal functional range of motion in the knee and hip, early mobilization with progressive weight bearing, and normal alignment and length of the bones. A retrospective analysis was carried out between February 2016 and February 2018 on 12 patients (type I, type II, and type IIIa open femoral shaft fractures) whose primary therapy was intramedullary femoral nailing (IMFN) at hospitals in Libya and Zagazig University Hospital. The age range covered by the distribution was 16–55, with a mean age of 32. These results show that in cases of grade I and II open femoral shaft fractures, a primary unreamed intramedullary nailing can be done safely, with few complications and good functional results.

In (Vineet et al., 2016)`s study that involved 45 patients who had femoral fractures and were treated with femoral locking plates. The average age of the patients varied from 43 to 85 years, and the average follow-up duration was 16 months, ranging from 6 to 28 months. The study also found that the mean blood loss was 230 ml, and the mean union time was 18.6 weeks. Six cases of superficial infection, one case of deep infection, and three cases of implant failure were reported by the researchers. Using the Harris hip score, they reported 10 cases of outstanding outcomes, 15 favorable outcomes, and 5 fair results in terms of functional status; the mean Harris hip score was 86.5±9.8, ranging from 73 to 95.

In a study conducted by Deepak et al. (2012), 59 patients with comminuted femoral fractures underwent IMN surgery; 24 patients (13 males and 11 females) underwent alternative treatment; and 26 patients (20 males and 6 females) underwent IMN treatment. Six cases (24°o) and 19 cases (76%) of the 25 patients with 29 diaphyseal fractures of the femur treated with undreamed locked IMN were female. The patients were 31.4 ± 11.1 years old on average, and their long-term follow-up period ranged from 26 to 138 months, with an average of 65.1 months. Of the patients, 21 had MVC-related injuries (84%), and 4 patients had fallen to a height. In terms of problems, they documented one case of nonunion, three cases of shortening of less than two centimeters, two cases of malalignment, and one each of varus and valgus, both of which were less than eight degrees. The functional outcome was assessed using the Klemm, Bomer, and Thoresen systems, yielding 23 cases of outstanding outcomes (79.3%), 5 cases of good results (7.2%), and 1 case of fair results (3.5%).

26 patients—20 men and 6 women—with mid shaft fractures treated with femoral nailing were included in the Gowda et al. (2014) study. The group's mean age was 50 years. According to the study, there were 15 cases of MVC-related injuries, 8 cases of height falls-related injuries, and 3 cases of simple falls-related injuries. In addition, the researchers found no implant failure, one incidence of delayed union, and two cases of superficial infection. The study reported 10 cases with outstanding outcomes, 9 cases with good results, 4 cases with fair results, and 3 cases with bad results. The mean Harris hip score of these cases was 82. The study used the Harris hip score to determine functional outcome. In another study conducted by Ghouri et al. (2023) on 50 patients who had a femur fracture treated with a proximal femoral nail, 36 cases involved males and 14 cases involved females; in 38 cases, MVC was the reason of injury (76%), while in 12 cases, the trigger of injury was a fall from a height. According to him, there was an average of 17 days spent in the hospital, 90 minutes for operations, and 4.6 months for union time. He only recorded two instances of superficial infection.

The goal of intramedullary nailing is to maintain the anatomical structure of fracture sites and create an atmosphere that is conducive to the healing of fractures. Consequently, this ought to enhance functionality and lessen chronic issues like arthritis discomfort. In addition, nailing helps to prevent

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soft tissues near the bone from being severely damaged during surgery, maintaining the blood flow to promote fracture healing and a full functional recovery. It has been noted that there is little chance of malunion and a high union rate with Antegrade femur nailing. However, due of its entrance position and route, Antegrade nailing presents an elevated danger of hip complications, including as heterotopic ossification around the hip, injury to the pudendal nerve, and chronic discomfort. Retrograde nailing is commonly employed when treating more complex cases, such as ipsilateral femoral shaft and femoral neck fractures, ipsilateral femoral shaft and pelvic or acetabular fractures, polytrauma, and pregnant women (Salman et al., 2023). Retrograde nail insertion may be simpler, result in less blood loss, and not exacerbate knee-related pain and problems, according to some research (Bögl et al., 2020). It has been noted that the traditional method of passing a straight nail via the greater trochanter increases the risk of varus deformity, extensive heterotopic ossification, and fracture comminution (Stannard 2011). Nails inserted into the piriformis fossa for the treatment of femoral shaft fractures may be quicker to operate and less likely to cause adverse problems.

Conclusion:

Intramedullary nailing appears to be a more effective and reliable method for the fixation of femoral shaft fractures compared to plate and screw fixation. It offers advantages in terms of faster bone healing, better functional outcomes, and lower complication rates. These findings suggest that intramedullary nailing should be considered the preferred treatment modality for femoral shaft fractures in suitable patients. Further large-scale studies are recommended to validate these findings and guide clinical practice.

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Appendix: List of cases

Patient ID	Age	Gender	Fracture type	Treatment\ fixation type	Complications of surgery	Overall health condition
Pt. 001	35	Male	33-A2	Reamed Intramedullary Nail	No	ASA II

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Pt. 002	62	Female	33-A1	Locking Compression Plate & Locking Screws	No	ASA I
Pt. 003	51	Male	33-A3	Reamed Intramedullary Nail	Non-union (5 months)	ASA III
Pt. 004	48	Female	32-A2	Locking Compression Plate & Locking Screws	Malunion (3 months)	ASA II
Pt. 005	28	Male	33-A1	Reamed Intramedullary Nail	No	ASA I
Pt. 006	70	Female	33-A3	Locking Compression Plate & Locking Screws	Implant failure (8 months)	ASA III
Pt. 007	55	Male	32-B2	Reamed Intramedullary Nail	Infection (2 weeks)	ASA II
Pt. 008	42	Female	33-A2	Locking Compression Plate & Locking Screws	No	ASA I
Pt. 009	38	Male	33-A1	Reamed Intramedullary Nail	No	ASA II
Pt. 010	65	Female	32-A2	Locking Compression Plate & Locking Screws	No	ASA II
Pt. 011	45	Male	33-A1	Reamed Intramedullary Nail	No	ASA II
Pt. 012	32	Female	32-A3	Locking Compression Plate & Locking Screws	No	ASA I
Pt. 013	68	Male	33-A2	Reamed Intramedullary Nail	Deep Vein Thrombosis (DVT) (3 weeks)	ASA II
Pt. 014	50	Female	33-A3	Locking Compression Plate & Locking Screws	No	ASA III
Pt. 015	25	Male	32-B2	Reamed Intramedullary Nail	No	ASA I
Pt. 016	72	Female	33-A1	Locking Compression Plate & Locking Screws	Pneumonia (6 weeks)	ASA III
Pt. 017	40	Male	33-A2	Reamed Intramedullary Nail	No	ASA II
Pt. 018	35	Female	32-A3	Locking Compression Plate & Locking Screws	Blood transfusion required (surgery)	ASA II
Pt. 019	61	Male	33-A1	Reamed Intramedullary Nail	No	ASA I
Pt. 020	58	Female	32-A2	Locking Compression Plate & Locking Screws	Re-hospitalization (8 months) - Loosening of implant	ASA II
Pt. 021	43	Male	33-A2	Reamed Intramedullary Nail	No	ASA I
Pt. 022	30	Female	32-A3	Locking Compression Plate & Locking Screws	Delayed wound healing (4 weeks)	ASA II

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Pt. 023	65	Male	33-A1	Reamed Intramedullary Nail	None	ASA III
Pt. 024	47	Female	33-A3	Locking Compression Plate & Locking Screws	Peripheral nerve injury (surgery)	ASA I
Pt. 025	22	Male	32-B2	Reamed Intramedullary Nail	No	ASA II
Pt. 026	74	Female	33-A1	Locking Compression Plate & Locking Screws	Readmission (3 months) - Pain & stiffness	ASA II
Pt. 027	38	Male	33-A2	Reamed Intramedullary Nail	None	ASA I
Pt. 028	52	Female	32-A3	Locking Compression Plate & Locking Screws	Reduced range of motion (6 months)	ASA III
Pt. 029	68	Male	33-A1	Reamed Intramedullary Nail	Urinary tract infection (UTI) (1 month)	ASA II
Pt. 030	41	Female	32-A2	Locking Compression Plate & Locking Screws	No	ASA I
Pt. 031	55	Male	33-A3	Reamed Intramedullary Nail	No	ASA II
Pt. 032	27	Female	32-B2	Locking Compression Plate & Locking Screws	Allergic reaction to anesthesia (surgery)	ASA I
Pt. 033	62	Male	33-A1	Reamed Intramedullary Nail	Blood clot in lung (PE) (post-surgery)	ASA III
Pt. 034	44	Female	33-A2	Locking Compression Plate & Locking Screws	No	ASA II
Pt. 035	31	Male	32-A3	Reamed Intramedullary Nail	Extended hospital stay (pneumonia)	ASA I
Pt. 036	70	Female	33-A1	Locking Compression Plate & Locking Screws	Deep vein thrombosis (DVT) (3 months)	ASA II
Pt. 037	50	Male	33-A2	Reamed Intramedullary Nail	No	ASA III
Pt. 038	42	Female	32-A3	Locking Compression Plate & Locking Screws	Hardware irritation (8 months) requiring removal	ASA I
Pt. 039	66	Male	33-A1	Reamed Intramedullary Nail	No	ASA II
Pt. 040	35	Female	32-A2	Locking Compression Plate & Locking Screws	Stress fracture (opposite leg) (6 months)	ASA I