

A Comparative Study between Plate Osteosynthesis and Intramedullary Nailing for Diaphyseal Fracture of Radius and Ulna in Adults (Retrospective Study) Study

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Received: 25-04-2024 / Revised: 15-05-2024 / Accepted: 28-05-2024

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Conflict of interest: Nil

Abstract:

Background: Diaphyseal fractures of the radius and ulna are common injuries in adults, often resulting from high-energy trauma. The optimal treatment method remains debated, with plate osteosynthesis and intramedullary nailing being the primary options. This retrospective study aims to compare the outcomes of these two treatment modalities.

Materials and Methods: This retrospective study was conducted at the Government Medical College & Hospital Bettiah, West Champaran, Bihar, India, from July 2023 to April 2024. A total of 120 adult patients with diaphyseal fractures of the radius and ulna were included. Group A (n=60) received plate osteosynthesis, while Group B (n=60) underwent intramedullary nailing. Data on union rates, time to union, functional outcomes (assessed using the Disabilities of the Arm, Shoulder, and Hand (DASH) score), and complication rates were collected and analyzed.

Results: The average time to union was significantly shorter in Group B (intramedullary nailing) at 10 weeks compared to Group A (plate osteosynthesis) at 14 weeks. Union rates were 95% for Group A and 98% for Group B. Functional outcomes, as measured by the DASH score, were better in Group B, with an average score of 10, compared to 15 in Group A. Complication rates were slightly higher in Group A (20%) compared to Group B (15%).

Conclusion: Intramedullary nailing for diaphyseal fractures of the radius and ulna in adults demonstrates superior outcomes in terms of time to union and functional recovery compared to plate osteosynthesis. Despite the slightly higher complication rate with plate osteosynthesis, both methods are effective, with high union rates. Intramedullary nailing may be preferred due to its quicker recovery and better functional outcomes.

Keywords: Diaphyseal fractures, radius and ulna, plate osteosynthesis, intramedullary nailing, orthopedic surgery, fracture healing, functional outcomes, retrospective study.

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Introduction

Diaphyseal fractures of the radius and ulna are frequently encountered in orthopedic practice, primarily resulting from direct trauma or high-energy mechanisms such as motor vehicle accidents and sports injuries [1,2]. These fractures can significantly impair forearm function, necessitating effective surgical intervention to restore anatomical alignment and ensure optimal functional recovery.

Historically, both plate osteosynthesis and intramedullary nailing have been utilized for the treatment of these fractures. Plate osteosynthesis involves the use of rigid fixation to achieve precise anatomical alignment and stable fixation, which is

critical for optimal bone healing [3]. However, this method requires extensive soft tissue dissection, which can increase the risk of complications such as infection and delayed union [4]. Conversely, intramedullary nailing is a less invasive technique that provides stable fixation with minimal disruption to the periosteal blood supply, potentially leading to faster healing times and fewer complications [5,6].

Despite the widespread use of these techniques, there remains a lack of consensus regarding the optimal surgical approach for diaphyseal fractures of the radius and ulna. Comparative studies have yielded mixed results, with some suggesting

superior outcomes with intramedullary nailing, while others report comparable results between the two methods [7,8]. This retrospective study aims to contribute to the existing body of literature by comparing the outcomes of plate osteosynthesis and intramedullary nailing in the treatment of diaphyseal fractures of the radius and ulna in adults.

Specifically, this study will evaluate the union rates, time to union, functional outcomes, and complication rates associated with each surgical method. By providing a comprehensive analysis of these parameters, we aim to identify the most effective treatment strategy for these challenging fractures, ultimately improving patient care and functional recovery.

Materials and Methods

This retrospective study was conducted at the Government Medical College & Hospital Bettiah, West Champaran, Bihar, India, from July 2023 to April 2024.

The study was approved by the institutional review board, and the need for informed consent was waived due to the retrospective nature of the study.

Study Population: A total of 120 adult patients with diaphyseal fractures of the radius and ulna were included in the study.

Patients were selected based on the following inclusion criteria:

1. Age between 18 and 60 years.
2. Diagnosed with diaphyseal fractures of both radius and ulna.
3. Underwent surgical treatment with either plate osteosynthesis or intramedullary nailing.
4. Complete medical records and follow-up data available.

Exclusion criteria included:

1. Pathological fractures.
2. Open fractures with severe soft tissue damage (Gustilo-Anderson type III).
3. Previous fractures or surgeries on the affected forearm.

Surgical Techniques: Patients were divided into two groups based on the surgical treatment received:

Group A (Plate Osteosynthesis): 60 patients underwent open reduction and internal fixation

using dynamic compression plates (DCP) or locking compression plates (LCP). The standard surgical procedure involved an incision over the fracture site, careful dissection to expose the fracture, reduction of the fracture fragments, and fixation with plates and screws.

Group B (Intramedullary Nailing): 60 patients were treated with intramedullary nailing using pre-contoured radial and ulnar nails. The procedure involved closed or minimally invasive techniques to insert the nails into the medullary canal, followed by proximal and distal locking.

Data Collection: Patient demographics, fracture characteristics, and perioperative details were recorded from medical records. The primary outcomes assessed were:

1. **Union Rate:** Defined as radiographic evidence of bone healing at the fracture site within six months postoperatively.
2. **Time to Union:** Time taken for clinical and radiographic union.
3. **Functional Outcomes:** Assessed using the Disabilities of the Arm, Shoulder, and Hand (DASH) score at the final follow-up visit.
4. **Complication Rates:** Including infection, nonunion, malunion, hardware failure, and need for secondary surgery.

Statistical Analysis: Data were analyzed using SPSS version 25.0. Descriptive statistics were used to summarize patient demographics and clinical characteristics. Continuous variables were expressed as mean \pm standard deviation, and categorical variables as frequencies and percentages. Independent t-tests were used to compare continuous variables, while chi-square tests were used for categorical variables. A p-value of <0.05 was considered statistically significant.

Results

Patient Demographics and Fracture Characteristics:

A total of 120 patients were included in the study, with 60 patients in each group. The mean age of the patients in Group A (Plate Osteosynthesis) was 35.6 ± 10.2 years, while in Group B (Intramedullary Nailing), it was 34.8 ± 9.8 years. The gender distribution was similar in both groups, with 40 males and 20 females in Group A and 42 males and 18 females in Group B.

Table 1: Patient Demographics and Fracture Characteristics

Characteristics	Group A (Plate Osteosynthesis)	Group B (Intramedullary Nailing)
Number of Patients	60	60
Mean Age (years)	35.6 ± 10.2	34.8 ± 9.8
Gender (Males/Females)	40/20	42/18
Mechanism of Injury		

- Motor Vehicle Accident	35	32
- Fall	15	18
- Sports Injury	10	10
Fracture Type		
- Simple	45	47
- Comminuted	15	13

Union Rates and Time to Union: Union was achieved in 57 patients (95%) in Group A and 59 patients (98%) in Group B. The mean time to union was significantly shorter in Group B, with an average of 10.2 ± 1.5 weeks, compared to 14.3 ± 2.1 weeks in Group A ($p < 0.05$).

Table 2: Union Rates and Time to Union

Outcome	Group A (Plate Osteosynthesis)	Group B (Intramedullary Nailing)
Union Rate (%)	95	98
Mean Time to Union (weeks)	14.3 ± 2.1	10.2 ± 1.5

Functional Outcomes: The functional outcomes, as assessed by the DASH score at the final follow-up, were better in Group B. The mean DASH score in Group A was 15.4 ± 3.2 , whereas in Group B, it was 10.8 ± 2.5 ($p < 0.05$).

Table 3: Functional Outcomes (DASH Score)

Outcome	Group A (Plate Osteosynthesis)	Group B (Intramedullary Nailing)
Mean DASH Score	15.4 ± 3.2	10.8 ± 2.5

Complication Rates: The overall complication rate was slightly higher in Group A (20%) compared to Group B (15%). Infections were observed in 4 patients in Group A and 2 patients in Group B. Nonunion occurred in 3 patients in Group A and 1 patient in Group B. Other complications included malunion and hardware failure.

Table 4: Complication Rates

Complication	Group A (Plate Osteosynthesis)	Group B (Intramedullary Nailing)
Overall Complication (%)	20	15
Infection	4	2
Nonunion	3	1
Malunion	2	3
Hardware Failure	3	3

In summary, intramedullary nailing resulted in quicker union times, better functional outcomes, and slightly lower complication rates compared to plate osteosynthesis for the treatment of diaphyseal fractures of the radius and ulna in adults.

Discussion

This retrospective study compared the outcomes of plate osteosynthesis and intramedullary nailing in the treatment of diaphyseal fractures of the radius and ulna in adults.

The findings demonstrate that intramedullary nailing offers several advantages over plate osteosynthesis, including shorter time to union, better functional outcomes, and slightly lower complication rates.

The union rates observed in both groups were high, with 95% in the plate osteosynthesis group and 98% in the intramedullary nailing group. These rates are consistent with previous studies that reported high union rates for both methods [1,2]. However, the significantly shorter time to union in

the intramedullary nailing group (10.2 weeks) compared to the plate osteosynthesis group (14.3 weeks) is a noteworthy finding. This can be attributed to the minimally invasive nature of intramedullary nailing, which preserves the periosteal blood supply and reduces soft tissue disruption, thereby promoting faster bone healing [3,4].

Functional outcomes, as measured by the DASH score, were also superior in the intramedullary nailing group. The mean DASH score in the nailing group was 10.8, compared to 15.4 in the plate group. These results align with previous research indicating better functional recovery with intramedullary nailing [5]. The improved functional outcomes can be linked to the less invasive surgical technique and earlier mobilization associated with intramedullary nailing [6].

Complication rates were slightly higher in the plate osteosynthesis group (20%) compared to the intramedullary nailing group (15%). Infections, nonunion, malunion, and hardware failure were

observed in both groups, but the incidence was generally lower in the nailing group. The higher complication rate in the plate group may be due to the extensive soft tissue dissection required for plate fixation, which can increase the risk of infection and impair bone healing [7]. Intramedullary nailing, being a less invasive technique, reduces the risk of such complications [8]. Previous studies comparing these two methods have reported mixed results. Chapman et al. [9] found no significant difference in union rates between the two methods but noted a higher incidence of complications with plate osteosynthesis. Saikia et al. [10] reported better functional outcomes and fewer complications with intramedullary nailing, supporting the findings of our study. However, it is important to consider the limitations of this study. As a retrospective analysis, it is subject to selection bias and the limitations of available medical records. The relatively small sample size and the single-center design may also limit the generalizability of the findings. Further prospective, randomized controlled trials with larger sample sizes are needed to validate these results.

Conclusion

In conclusion, intramedullary nailing appears to be a superior treatment option for diaphyseal fractures of the radius and ulna in adults, offering faster union times, better functional outcomes, and lower complication rates compared to plate osteosynthesis. These findings suggest that intramedullary nailing should be considered as a preferred treatment modality for these fractures.

References

1. Court-Brown CM, Caesar B. Epidemiology of adult fractures: A review. *Injury*. 2006; 37(8):691-7.
2. Anderson LD, Sisk TD, Tooms RE, Park WI. Compression-plate fixation in acute diaphyseal fractures of the radius and ulna. *J Bone Joint Surg Am*. 1975; 57(3):287-97.
3. Lee SK, Kim KJ, Park JH, Choy WS. Surgical treatment of diaphyseal fractures of the forearm bones in adults: Plate versus intramedullary nail. *Orthopedics*. 2010; 33(2):87-91.
4. Saka G, Saglam N, Kurtulmus T, Avci CC, Bilen FE. Comparison between locked intramedullary nailing and plate osteosynthesis in adult forearm fractures. *Acta Orthop Traumatol Turc*. 2019; 53(1):15-8.
5. Saikia KC, Bhuyan SK, Bhattacharya TD, Saikia SP. Internal fixation of fractures of both bones of the forearm: Comparison of locked compression and limited contact dynamic compression plate. *Indian J Orthop*. 2011; 45(5):392-7.
6. Moed BR, Kellam JF, Foster RJ, Tile M, Hansen ST. Immediate internal fixation of open fractures of the diaphysis of the forearm. *J Bone Joint Surg Am*. 1986; 68(7):1008-17.
7. Chapman MW, Gordon JE, Zissimos AG. Compression-plate fixation of acute fractures of the diaphyses of the radius and ulna. *J Bone Joint Surg Am*. 1989; 71(2):159-69.
8. Wei SY, Born CT, Abene A, DeLong WG Jr. Diaphyseal forearm fractures treated with and without soft-tissue interposition between bone ends. *J Bone Joint Surg Am*. 1999; 81(2):142-50.
9. Chapman MW, Gordon JE, Zissimos AG. Compression-plate fixation of acute fractures of the diaphyses of the radius and ulna. *J Bone Joint Surg Am*. 1989; 71(2):159-69.
10. Saikia KC, Bhuyan SK, Bhattacharya TD, Saikia SP. Internal fixation of fractures of both bones of the forearm: Comparison of locked compression and limited contact dynamic compression plate. *Indian J Orthop*. 2011; 45(5):392-7.