

COMPARATIVE OUTCOMES OF DYNAMIC COMPRESSION PLATE FIXATION VERSUS SQUARE NAILING IN ADULT BOTH BONE FOREARM FRACTURES: A PROSPECTIVE STUDY

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ABSTRACT

Background: Fractures involving both bones of the forearm in adults are commonly associated with high to intermediate energy trauma and require precise anatomical restoration to achieve optimal functional outcomes. Open reduction and internal fixation with dynamic compression plates is considered the standard treatment, while intramedullary fixation methods such as square nailing offer a less invasive alternative. This study aims to compare the radiological and functional outcomes of these two treatment modalities. **Materials and Methods:** This prospective comparative study was conducted on 50 adult patients with both bone forearm fractures where they were divided equally into two groups: dynamic compression plate (DCP) fixation (n=25) and square intramedullary nailing (n=25) based on the modality of the fixation. Patients were followed up for a minimum period of six months. Outcomes assessed included time to radiological union, range of motion, functional outcome using Grace–Eversmann criteria, Disabilities of the Arm, Shoulder and Hand (DASH) score, and complications. Statistical analysis was performed using independent t-test and Chi-square test with a p-value <0.05 considered significant. **Result:** The mean time to union was significantly shorter in the DCP group (12.6 ± 2.5 weeks) compared to the square nailing group (15.1 ± 2.8 weeks) (p < 0.01). A higher proportion of patients in the DCP group achieved near-normal range of motion (84% vs 56%, p < 0.05). The mean DASH score was significantly lower in the DCP group (14.8 ± 7.2) compared to the nailing group (24.8 ± 8.6) (p < 0.001), indicating better functional outcomes. Although the DCP group demonstrated a higher percentage of excellent and good results based on Grace–Eversmann criteria (76% vs 56%), this difference was not statistically significant (p > 0.05). **Conclusion:** Complication rates were comparable between the groups, with a slightly higher incidence of non-union and loss of forearm rotation in the nailing group.

INTRODUCTION

Fractures involving both bones of the forearm are among the more common injuries encountered in adult orthopaedic practices and are frequently associated with high to intermediate energy mechanisms such as road traffic accidents, falls and direct trauma. The functional role of the upper limb is largely dependent on the ability to position the hand in space, a function significantly contributed by the forearm through coordinated rotational movements.^[1,2]

The radius and ulna together form a complex anatomical and biomechanical unit that facilitates pronation and supination movements. These

movements occur through the coordinated action of the proximal and distal radioulnar joints, allowing the radius to rotate around the relatively stable ulna. In the supinated position both bones lie parallel, whereas during pronation the radius crosses over the ulna. Preservation of this intricate relationship is essential for normal forearm function and even minimal malalignment, shortening or disruption of the radial bow can result in significant functional impairment to greater extent.^[3,4]

In adult patients non-operative management of both-bone forearm fractures is often associated with unsatisfactory outcomes such as malunion, non-union and restriction of forearm rotation which primarily due to the difficulty in maintaining

anatomical alignment. In contrast to it pediatric fractures show better remodeling potential because of the bone property, making conservative treatment more reliable in that population.^[5,6]

Open reduction and internal fixation is one of the approach in adults with plate osteosynthesis for achieving anatomical reduction and stable fixation. Dynamic compression plate (DCP) fixation allows for axial compression at the fracture site promoting primary bone healing and providing rigid stability. This facilitates early mobilization and improves functional recovery by restoring length, alignment and the radial bow.^[7,8]

Intramedullary fixation techniques including square nailing is also been utilized as alternative treatment options. These methods offer advantages such as smaller incisions, reduced soft tissue dissection and shorter operative time. However limitations include relatively less rotational stability, difficulty in maintaining the radial bow and reliance on secondary bone healing, which may influence functional outcomes.^[9]

Despite the widespread use of both techniques there remains ongoing debate regarding their comparative effectiveness in terms of fracture union, restoration of motion, and complication rates. Functional outcome assessment often performed using validated scoring systems such as the Grace–Eversmann criteria and the Disabilities of the Arm, Shoulder and Hand (DASH) score, which plays a crucial role in determining the success of these interventions.^[10]

The present study was undertaken to evaluate and compare the radiological and functional outcomes as well as the associated complications in adult patients with both-bone forearm fractures treated with dynamic compression plate fixation and square nailing.

Aims

To evaluate and compare the radiological union and functional outcomes, efficacy and reliability in adult patients with both bone forearm fractures treated with dynamic compression plate fixation and square nailing.

To assess the time to fracture union and postoperative range of motion at the elbow and forearm and to analyze their association with variables such as fracture pattern and timing of surgery.

To compare complications associated with both treatment modalities such as non-union, infection rate, implant failure association and difficulty in obtaining the proper forearm rotation.

MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of Orthopaedics at Government Cuddalore Medical College and Hospital over a period of two years from January 2024 to January 2026. A total of 50 adult patients presenting with fractures of both bones of the forearm were enrolled in the study. A convenience sampling method was employed. Patients were divided into two equal

groups based on the method of surgical fixation: 25 patients underwent open reduction and internal fixation using dynamic compression plates (DCP group), while the remaining 25 patients were treated with square intramedullary nailing (nailing group). All procedures were performed under regional or general anesthesia following standard operative protocols.

Inclusion criteria comprised skeletally mature patients (as determined by age or radiological closure of epiphyses), patients with simple or comminuted diaphyseal fractures of both bones of the forearm and both closed fractures as well as open fractures classified as Type I and Type II according to the Gustilo–Anderson classification.

Exclusion criteria included isolated fractures of the radius or ulna, fracture-dislocations such as Monteggia and Galeazzi injuries, skeletally immature patients, pathological fractures, and fractures presenting more than 15 days after injury or those with established malunion.

Postoperatively, patients were immobilized for a short duration depending on fracture stability, followed by gradual initiation of mobilization exercises involving the elbow and forearm. Patients were followed up at regular intervals with clinical and radiographic evaluation until fracture union was achieved.

Outcome measures included time to radiological union, range of motion of the elbow and forearm and functional outcome. Functional assessment was performed using the Grace Eversmann scoring system and the Disabilities of the Arm, Shoulder and Hand (DASH) score. All patients were followed for a minimum period of six months.



Data obtained were entered into Microsoft Excel and analyzed using statistical software (SPSS version 30). Continuous variables, including age, time to union and DASH scores, were expressed as mean \pm standard deviation. Categorical variables such as gender distribution, mode of injury, fracture type, functional outcomes and complications were presented as frequencies and percentages. Comparison between the two groups (dynamic compression plate fixation and square nailing) was performed using the independent sample t-test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables as

appropriate. A p-value of less than 0.05 was considered statistically significant. Statistical comparison between groups was performed using independent t-test and Chi-square test.

Ethical clearance was obtained from the Institutional Ethic Committee of Government Cuddalore Medical college and Hospital. Written informed consent was obtained from all participants.

Case scenario: 27 years old male with RTA with both bone fracture right forearm treated with DCP.

RESULTS

A total of 50 patients were included in the study with 25 patients each in the dynamic compression plate (DCP) group and the square nailing group.

Demographic Profile: The mean age in the DCP group was 29.8 ± 6.2 years, while in the square nailing group it was 30.6 ± 6.8 years. Male

predominance was observed in both groups, with 64% males in the DCP group and 60% in the nailing group. The Demographic details are shown in [Table 1].

Road traffic accidents were the most common mode of injury in both groups (60% in DCP vs 56% in nailing) followed by assault and falls. Right-sided involvement was more frequent (68% in DCP vs 64% in nailing). The majority of fractures were closed injuries in both groups. Fractures were most commonly located in the middle third of the forearm in both groups. According to the AO classification, type 22B3 fractures were the most prevalent in both groups.

Radiological Union: The mean time to radiological union was shorter in the DCP group (12.6 ± 2.5 weeks) compared to the square nailing group (15.1 ± 2.8 weeks), indicating faster healing with plate fixation. Union Time comparison between the group is shown in [Table 2].

Table 1: Demographic profile of patients

Variable	DCP (n=25)	Nailing (n=25)
Mean Age	29.8 ± 6.2 years	30.6 ± 6.8 years
Male (%)	64%	60%
RTA (%)	60%	56%
Closed Fractures (%)	72%	68%
Right side (%)	68%	64%

Table 2: Union Time comparison

Group	Union time
DCP group	12.6 ± 2.5 weeks
Square nailing	15.1 ± 2.8 weeks

Functional outcome based on the Grace–Eversmann scoring system DCP plating had 12 patients (48%) had excellent outcomes, 7 (28%) had good results, 4 (16%) had fair outcomes, and 2 (8%) had poor results while Square nailing showed excellent results in 9 patients (36%), good in 5 (20%), fair in 8 (32%) and poor in 3 (12%). The DCP group showed superior functional outcomes, with 48% of patients achieving excellent results compared to 36% in the square nailing group. The proportion of fair and poor outcomes was higher in the square nailing group, indicating comparatively inferior functional recovery. Functional outcome comparison between the two groups shown in [Figure 1].

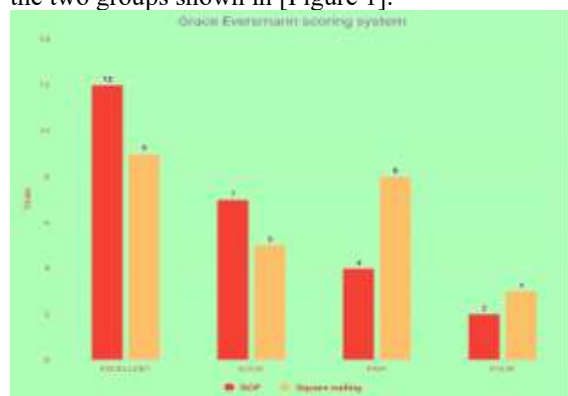


Figure 1: Bar diagram showing Functional outcome comparison.

The mean DASH score in the DCP group was 14.8 ± 7.2 whereas in Square nailing score was 24.8 ± 8.6 suggesting better functional status and lower disability following plate fixation.

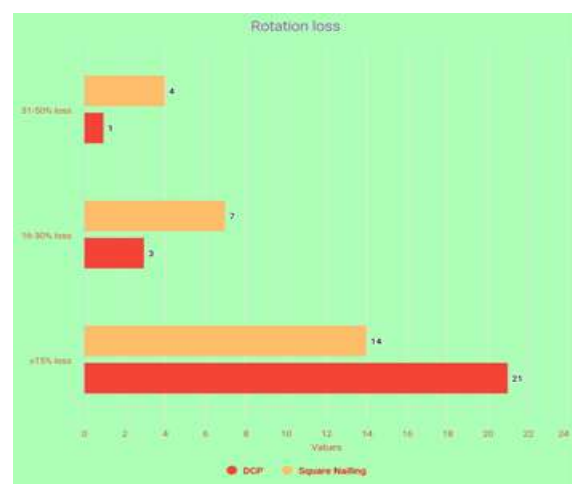


Figure 2: Horizontal Bar diagram showing Rotation loss comparison

Range of motion assessment in DCP group near normal range of motion (<15% loss) was observed in 21 patients (84%). 3 patients (12%) had 16-30% loss while 1 patients (4%) had 31-50% restriction. On assessment of range of motion in square nailing

group 14 patients (56%) achieved near normal motion (<15% loss) while 7 patients (28%) had 15-30% restriction and 4 patients 16% had 31-50% restriction. Rotation loss comparison between the two groups shown in the [Figure 2].

Complications that were noted in a DCP group were loss of forearm rotation was the most frequent complication 4 cases (16%), followed by delayed union 3 cases (12%), infection 2 cases (8%) and non-union 1 case (4%). As compared to the Complications noted in square nailing subset of patients were loss of forearm rotation was the most common complication 5 cases (20%), followed by delayed union 4 cases (16%), non-union 2 cases (8%) and superficial infection 1 case (4%).

DISCUSSION

The present study was conducted to evaluate and compare the outcomes of dynamic compression plate fixation and square intramedullary nailing in the management of these fractures. In the current study, the demographic profile of patients in both groups was comparable with no statistically significant difference in mean age, gender distribution or mode of injury. Road traffic accidents were identified as the most common mechanism of injury in both groups reflecting the high-energy nature of these fractures in the adult population. A key finding of this study was the significantly shorter time to radiological union observed in the dynamic compression plate group compared to the square nailing group. This can be attributed to the principle of absolute stability achieved with plate fixation which promotes primary bone healing. In contrast there is intramedullary fixation techniques gives relative stability and secondary bone healing which may prolong the time to union.

Functional outcomes as assessed by range of motion and standardized scoring systems were also superior in the plate fixation group. A significantly higher proportion of patients treated with dynamic compression plates achieved near normal range of motion. This is because that the ability of plate fixation to restore the radial bow and maintain anatomical alignment which are critical determinants of forearm rotation.

The mean DASH score was significantly lower in the plate fixation group, suggesting better functional recovery and less residual disability. Similarly, a higher percentage of patients in the DCP group achieved excellent and good outcomes based on the Grace-Eversmann criteria the overall trend favors plate fixation in terms of functional recovery.

The mean time to fracture union was significantly shorter in the DCP group compared to the square nailing group ($p < 0.01$). Functional outcome assessment using DASH score demonstrated significantly better results in the DCP group ($p < 0.001$). A significantly higher proportion of patients achieved near-normal range of motion in the DCP

group ($p < 0.05$). Although the DCP group showed better overall functional outcomes based on Grace-Eversmann criteria, the difference was not statistically significant ($p > 0.05$).

Complication rates were comparable between the two groups. Loss of forearm rotation was the most common complication observed in both groups with a slightly higher incidence in the square nailing group. Delayed union and non-union were also more frequently observed in the nailing group likely due to less rigid fixation and difficulty in maintaining rotational stability. On the other hand the incidence of infection was marginally higher in the plate fixation group which may be attributed to the more extensive soft tissue dissection required for open reduction.

The findings of this study are consistent with previously published literature, which suggests that plate osteosynthesis provides superior biomechanical stability and better functional outcomes compared to intramedullary fixation in adult forearm fractures. However, intramedullary techniques may still have a role in selected cases due to their minimally invasive nature and reduced operative time.

The present study has certain limitation that should be acknowledged. The sample size was relatively small, which may limit the generalizability of the findings. The study was conducted at a single centre using a convenience sampling method, which may introduce selection bias. Additionally the follow up period of six months may not be sufficient to evaluate long term functional outcome and late complications such as implant failure or refracture. Variability in fracture patterns and absence of randomization could also have influenced the outcomes. Further multicentric studies with larger sample size, longer follow up and randomized design are recommended to validate the findings of this study.

CONCLUSION

Dynamic compression plate (DCP) fixation provides superior radiological and functional outcomes compared to square intramedullary nailing for adult both-bone forearm fractures. DCP fixation achieved significantly faster union times (12.6 +/- 2.5 weeks vs. 15.1 +/- 2.8 weeks), better restoration of forearm rotation and superior functional recovery as evidenced by lower DASH scores and higher Grace-Eversmann ratings. While square nailing is less invasive, plate fixation remains the preferred treatment for achieving absolute stability and optimal anatomical alignment, despite a slightly higher risk of infection. Square nailing while less invasive is associated with inferior outcome in terms of stability and performance.

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