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Original Article

Comparative Study on Fixation Techniques and Functional Outcome between Plate Osteosynthesis, Interlocking Nailing, and Titanium Elastic Nailing in both Bones of Forearm Fractures

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Abstract

Introduction: The goal of treatment of fractures of both bones of forearm in adults is to regain length, axial, and rotational stability. Open reduction and internal fixation with compression plates achieve a high percentage of union in about 96-98% of cases.

Aim: Aim of this study is to compare the results of treating diaphyseal fractures of both bones in adult forearm using plate osteosynthesis with that of titanium elastic nail fixation and interlocking nail fixation.

Materials and Methods: This is a prospective study of 30 cases of diaphyseal fractures of both bone of forearm in adults treated by surgical fixation with various implants.

Results: Diaphyseal fractures of both bones of forearm in adults are one of the most common fractures being reported to orthopedic emergency. Early fixation of fracture followed by intense physiotherapy produced excellent results (70%). Fixation with plate osteosynthesis has stood the test of time and provides excellent fixation (80%).

Conclusion: Titanium elastic nail fixation is particularly useful in fractures involving middle third of radius and ulna. Providing for 3 point fixation leads to stable fixation and proper alignment of fracture fragments. Being newer techniques, these intramedullary devices require further evaluation and there is a steep learning curve.

Key words: Forearm fractures, Intramedullary, Radius and ulna

INTRODUCTION

Recent advances in fracture management in humans have focused on minimally invasive fracture stabilization techniques. Over the last 40 years, anatomic reduction with plate stabilization has become the standard in adult patients with diaphyseal fractures of the radius and ulna. When operative fixation has been indicated in skeletally immature patients with these fractures, a variety of techniques has been reported, with intramedullary fixation becoming increasingly accepted.[1] There is currently significant variability in the treatment of adolescents with forearm fractures.[1] Fractures of forearm are classified according to the level of fracture, the pattern of fracture, the degree of displacement, the presence or absence of comminution or segmental bone loss and whether they are open or closed. Each of these factors may have some bearing on the type of treatment to be selected and the ultimate prognosis.[2] For descriptive purposes, it is useful to divide the forearm into thirds, based on the linear dimensions of radius and ulna. Disruption of proximal or distal radioulnar joints is of great significance to the treatment and prognosis. It is imperative to determine whether the fracture is associated with joint injury because effective treatment demands that both the fracture and joint injuries are treated in an integrated fashion.[3]

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Aim

Aim of this study is to compare the results of treating diaphyseal fractures of both bones in adult forearm using plate osteosynthesis with that of titanium elastic nail fixation and interlocking nail fixation.

MATERIALS AND METHODS

This is a prospective study of 30 cases of diaphyseal fractures of both bone of forearm in adults treated by surgical fixation with various implants. It includes all diaphyseal fractures of both bones of forearm in adults. Comminuted, segmental fractures are included in this study. All compound fractures, malunited fractures, bones with medullary canal diameter of <2 mm, and fractures in children are excluded from this study.

RESULTS

The age group varied from 20 to 70 years with the mean age of 45 years. The incidence of fracture was observed maximum between 30 and 50 years of age. Among the 30 cases, males were predominant. Right side fracture was common in our series. The most common mode of injury had been road traffic accident. 80% of patients are in Muller type A3 (Table 1). 88% of patients presents after 2 days of injury (Table 2).

Intramedullary fixation provides for short operating time, short hospital stay and early rehabilitation (Table 3). Average time of fracture healing was 8 weeks. In patients who had undergone plate osteosynthesis, it was 9 weeks whereas in patients who had undergone nail fixation it was 6 weeks. Muller type 22 C1 fracture was united by 11 weeks. Other fracture patterns healed between 6 and 9 weeks. One patient, who had undergone interlocking nail fixation, developed nonunion of fracture of radius. After a period of 15 weeks, since there was angulation of the distal fragment with no callus response at the fracture site, the nail was removed and open reduction and internal fixation with plate osteosynthesis and bone grafting was done. The fracture went on to unite after a period of further 10 weeks. 2 patients had restricted pronation and supination and both of them eventually recovered. All these patients were treated with plate osteosynthesis. 8 patients treated with plate osteosynthesis gave excellent results with regard to pronation and supination. 4 patients developed post-operative stiffness of elbow joint. All of them were treated with plate osteosynthesis. However, all these patients eventually had fair range of motion (ROM) by the end of 12 weeks following intense physiotherapy. The patient who had sustained fracture of radial styloid process during titanium nail fixation following far lateral entry point developed stiffness of wrist joint. With active exercises, the ROMrange of motion was increased. Restoration of pronation and supination activities was possible by the end of 6th week using intramedullary nailing whereas they were possible by the end of 9th week using plate osteosynthesis. Fixation with plate osteosynthesis has stood the test of time and provides excellent fixation (80%). Overall results are 73.3% of cases are graded as excellent (Table 4).

DISCUSSION

The patients who had simple Muller's A3 fracture pattern were fixed with intramedullary nail fixation and the fractures with comminution and segmental pattern were fixed with plate osteosynthesis. Compound fractures were excluded from our study. A satisfactory device for internal fixation must hold the fracture rigidly, eliminating as completely as possible angular and rotatory motion. This can be accomplished by either a strong intramedullary nail or AO dynamic compression plate.[1] During plate osteosynthesis, further injury to blood supply of the bone, the periosteum was stripped sparingly with a periosteal elevator and only sufficiently for applying a plate. The fragments were carefully reduced with interdigitating bone spicules being

Table 1: Classification of fracture

Muller's sub type	Number of cases (%)
A3	24 (80)
B1	4 (13.3)
B2	1 (3.3)
B3	-
C1	1 (3.3)

Table 2: Time interval between injury and surgery

Time interval (days)	Number of cases (%)
<2	4 (13.3)
2-5	20 (66.67)
5-7	6 (20)

Table 3: Duration of hospital stay postoperatively

Procedure	Duration of stay (days)
Plate osteosynthesis	12
Intramedullary nail	5

Table 4: Overall results

Grading	Number of cases (%)
Excellent	22 (73.3)
Good	4 (13.3)
Fair	2 (6.6)
Poor	2 (6.6)

fitted properly. Our study has showed good fracture union occurred in 80% of cases. Earlier studies have reported an alarming refracture rate of 40% when the plates were removed before 1 year.[3] It is well established that the cortex beneath a rigid plate weakens because of stress shielding, becoming thin, atrophic, and almost cancellous in nature. If soft tissue stripping has been extensive, osteonecrosis, and revascularization weakens the cortex further. In our series involving 10 cases treated with plate osteosynthesis, we did not have refracture in any of our patients.[4] While using intramedullary device for fixing the adult forearm fractures involving both bones, rotational control in fractures near the metaphyseo-diaphyseal junction was difficult because of wide medullary canal. Interference fit nails do not maintain bone length if associated with bone loss. When an intramedullary fixation is used, errors in selecting the proper diameter or length of the nail and operative technique contributed to poor results. In case of the titanium elastic nail, the distal end of nail must abut subchondral bone to prevent shortening.[5] The lower modulus of elasticity of titanium nails allow easier insertion and provide more load sharing with the bone. Titanium elastic nails produced interference fit which was responsible for the return of forearm rotation and grip strength. Our study had showed that good to excellent union occurred with 90% of fractures fixed with titanium elastic nail and excellent union in 70% with interlocking nail fixation. We compared the results of plate fixation with that of intramedullary fixation. Apart from the incidence of infection, we did not have any complications while treating forearm fractures with plate osteosynthesis.[6] Three out of the 4 cases healed well on controlling the infection and one went in for eventual replacement of ulnar plate with a "K" wire. We had technical difficulties while using both titanium elastic nail and interlocking nail. While fixing fractures of radius involving distal 3rd shaft, the titanium elastic nail did not provide with adequate stability of fracture fragments because of wide medullary canal. Furthermore, if the medullary canal diameter is narrow (3 mm) the size of the nail is used is also thin, hence, it was very difficult to manipulate the proximal fragment with the nail.[7] That was one of the reasons for performing open reduction at the fracture site in one case. Earlier, intramedullary devices such as K-wires, square nails, and rush nails were used for fixing radius and ulna. These implants did not provide with rotational stability at the fracture site. This lead to higher incidence of nonunion.[8] But both interlocking nail and titanium elastic nail, provided with excellent rotational stability of fracture fragments. We used tourniquet in fractures fixed with plate osteosynthesis. One case of tourniquet palsy occurred but recovered eventually. Since tourniquet was not used during intramedullary fixation, the chance for occurrence of this neurological complication was totally eliminated. In our study, the rehabilitation time was much shorter for fractures fixed with intramedullary nail when compared with that of plate osteosynthesis. The average time required for functional recovery is more than 9 weeks when plates are used, and about 6 weeks when intramedullary nails are used. The duration of hospital stay postoperatively was also less (on an average of 5 days for intramedullary devices and 12 days for plate osteosynthesis).[9]

CONCLUSION

Even though plate osteosynthesis is still the most commonly used form of fixation in adult both bone forearm fractures, both titanium elastic nail and interlocking nail fixation are relatively newer techniques which offer a viable and more efficient alternative especially in fixation of fractures involving shafts of radius and ulna.

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