An Observational Assessment of the Factors Affecting Outcome of the Radius and Ulna in Adults

Dr. Pankaj Kumar[1]
[1]Assistant Professor, Department of Orthopedics, Vardhman Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India.
Corresponding Author: Dr. Pankaj Kumar

Abstract
Aim: To determine the relationship of different parameters to the method of treatment and type of fractures.
Methodology: 50 patients with fractures of the shafts of both the radius and ulna treated at the Vardhman Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India. Data collection and radiographic measurements were standardized for all patients. All patients were followed at least until bone union occurred or the diagnosis of nonunion was made. These methods of treatment were utilized: open reduction and internal fixation (ORIF), closed reduction with square nailing. End result ratings were made on a 14 point scale in four categories: (a) subjective, according the level of pain in the injured limb; (b) objective, by the range of forearm rotation; (c) radiographic, utilizing the criteria of union, synostosis and malunion.
Results: The mean follow-up was 36 months (Range: 3-60 months). Out of 50 patients, 26 were male and 24 were female, with an average age of 28 years (16-45 years). In 31 patients, the fracture involved the dominant limb. 28 of the fractures were open and 22 were closed fractures. Mode of trauma in maximum cases was due to road accidents (n=28), fall from height in 10 patients, Industrial accidents in 6 cases, direct blow in 3 cases and trivial trauma in 3 cases. Overall, 78 % of patients reported no pain, with no difference between patients with open and those with closed fractures. While 80% of patients treated with ORIF were pain free at their last examination, only 56% treated with CR and 48% treated with PIP were painless. There was no significant difference in the loss of forearm rotation between closed and open fractures: 66% of each group lost less than 30 degrees of forearm rotation. Union occurred in 94 percent of radius fractures and 98 percent of ulna fractures, with an average time to union of 18.2 weeks for the radius and 18.6 weeks for the ulna.
Conclusion: Treatments of fractures of the shaft of radius and ulna were good to excellent regardless of the method of treatment. Results with ORIF were also found better than CRIF.
Keywords: Malunion, Tibia, Ulnar, Malalignment.

Introduction

Radius and ulnar shaft fractures, also known as adult both bone forearm fractures, are common fractures of the forearm caused by either direct trauma or indirect trauma (fall). The radius and ulna exist in a delicate anatomical balance that allows for pronation and supination of the hand in a 180-degree arc of motion. The anatomical bow of the radius allows for rotation around a fixed ulna, and its structure is critical for this motion. Any disruption in the anatomy of the forearm can lead to a significant loss of the normal range of motion that allows for motions as

complex as a golf swing or as simple as turning the page in a book.[1] When both bones are fractured at different levels and there is a joint injury at the wrist or elbow, these are described as Galeazzi or Monteggia fractures. Galeazzi facture is a displaced fracture in the radius and a dislocation of the ulna at the wrist, where the radius and ulna come together. Monteggia fracture is a fracture in the ulna and the head of the radius is dislocated at the elbow joint.

Union with restoration of normal anatomy is particularly critical to achieve an optimal outcome for diaphyseal fractures of the shafts of the radius and ulna in adults. These goals have most often been met by open reduction and plate fixation [2-4]. For significantly displaced fracture, procedural sedation can be utilized to reduce the fracture and apply a splint properly. Open fractures should be reduced, thoroughly irrigated, and antibiotics started as soon as possible. Standard immobilization is achieved using a sugar-tong splint with the forearm in neutral rotation, and the elbow flexed to 90 degrees. Surgical treatment options include open reduction internal fixation (ORIF) and intramedullary nailing. Shorter intraoperative times and decreased scarring are observed benefits following fixation with intramedullary nailing [5]. However, achieving rotational stability as well as restoration of the radial bow is difficult with the use of intramedullary nailing. ORIF with plate and screw construct is generally accepted as the gold standard for treatment [6]. Comparison of ORIF and intramedullary nailing has been inconclusive [7, 8].

Treatment planning in both bone forearm fractures depends on many factors. Some of these factors include affected bones, mechanism of the injury, fracture pattern, soft tissue status, demographics, degree of initial displacement, etc. The outcome of treatment also depends on the above factors, as well as the accuracy of the reduction with regard to angulation, length, and rotation of the reduced fractures [9].

Materials and Methods

50 patients with fractures of the shafts of both the radius and ulna treated at the Vardhman Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India for 1 year. Data collection and radiographic measurements were standardized for all patients. All patients were followed at least until bone union occurred or the diagnosis of nonunion was made. The grade of soft tissue injury associated with open fractures was not recorded since many of these injuries preceded the advent of the rating system of Gustillo and Anderson [10].

Rating	Subjective	Objective	Radiographic
4	No pain	Combined loss of forearm rotation <300	Fracture united. combined malalignment (radius and ulna) <20
3	Mild pain, present with overuse	Combined loss of forearm rotation 31-600	Union, with combined malalignment 21-400
2	Moderate pain present with routine activities	Combined loss of forearm rotation 61-900	Union, with combined malalignment >400

1	Severe pain prevent routine activities	Combined loss of forearm rotation>900	Nonunion, synostosis or osteomyelitis

These methods of treatment were utilized: open reduction and internal fixation (ORIF), closed reduction with square nailing. The method of treatment was chosen by the attending surgeon based upon his experience and the type of injury. Minimal displacement of a closed fracture was the most frequent indication for closed reduction, and marked comminution was the primary reason for treatment with pins-in-plaster. All reductions were performed under I.V.R.A.

Union was defined as the presence of bridging bone or trabeculae spanning the fracture site. Non-union was identified by the absence of union within twenty-eight weeks following injury. Standards for alignment and measurement of radiographs were based on Sage's study, which defined normal as nine degrees of radial and six degrees of dorsal bowing of the radius and zero degrees in both planes for the ulna [11]. End result ratings were made on a 14 point scale in four categories: (a) subjective, according the level of pain in the injured limb; (b) objective, by the range of forearm rotation; (c) radiographic, utilizing the criteria of union, synostosis, and malunion.

Results

The mean follow-up was 36 months (Range: 3-60 months). Out of 50 patients, 26 were male and 24 were female, with an average age of 28 years (16-45 years). In 31 patients, the fracture involved the dominant limb. 28 of the fractures were open and 22 were closed fractures. Mode of trauma in maximum cases was due to road accidents (n=28), fall from height in 10 patients, Industrial accidents in 6 cases, direct blow in 3 cases and trivial trauma in 3 cases.

Subjective outcomes: Overall, 78 % of patients reported no pain, with no difference between patients with open and those with closed fractures. While 80% of patients treated with ORIF were pain free at their last examination, only 56% treated with CR and 48% treated with PIP were painless. Patients with isolated fractures were more often pain free than were those with associated injuries.

Objective outcomes: The average total decrease in forearm rotation, however, was 31 degrees, with loss of slightly more supination than pronation. There was no significant difference in the loss of forearm rotation between closed and open fractures: 66% of each group lost less than 30 degrees of forearm rotation .The method of treatment had a significant effect-on the loss of forearm rotation. 75% of patients treated with ORIF lost less than 30 degrees of forearm rotation, while only 52% treated by CR and 26% by PIP lost less than 30 degrees.

Radiographic outcomes: Union occurred in 94 percent of radius fractures and 98 percent of ulna fractures, with an average time to union of 18.2 weeks for the radius and 18.6 weeks for the ulna. Union was more frequent after closed than after open fractures. This difference was most apparent in radius fractures where 7 percent of open fractures developed non-unions, compared to only 2 % of closed injuries. Also, the average time to union was 22% longer for open than for closed fractures of the radius ($p = 0.027$), and 36% longer for open fractures of the ulna.

Complications: Infection rate was 9 percent in open fractures and 1.5 percent in closed fractures. Infections were not observed in open fractures treated by immediate ORIF. Infections resolved with surgical debridement and appropriate antibiotic therapy

Discussion

The operative method included in this comparative study was dynamic compression plating (3.5mm DCP) and intramedullary nailing by Talwalkar radius and ulna nail. The highest age incidence was found in the age group of 31 to 40 years and more common in males as compared to females. Right side forearm is more involved than the left as right side dominance is more as compared to left side. In this comparative study of 50 cases of fractures of both radius and ulna plating versus nailing excellent results in plating were 80.6% as compared to nailing which was 73.32%.

Following fixation of radius and ulna shaft fractures, the patient should be placed into a splint that immobilizes the elbow and forearm on the affected extremity. The fingers and thumb should be left free to encourage a range of motion and to prevent stiffness. Typically, the patient can begin range of motion exercises of the elbow and forearm 5 to 7 days post-surgery. The patient should be routinely followed postoperatively until the soft tissues have healed and bone union has been confirmed radiographically. This usually occurs around 2 to 3 months post-surgery. Once bone union has been confirmed, the patient can resume most activities using the affected limb [12].

Antibiotics should be administered for open fractures as quickly as possible, and a thorough neurovascular and soft tissue assessment should be completed. If compartment syndrome is suspected, surgical consultation should be made immediately.

Biologically, due to undisturbed soft tissues and hence the periosteal blood supply, the fracture healing is rapid, in a successful closed IM nailing [13]. If an open nailing is needed, then it would be little slow and after a plate fixation, it would be still slow due to some soft tissue disturbance. However, due to absolute stability achieved after a plate fixation, it is possible to use the forearm for some light activities (Except a Monteggia or a Galeazzi injury, where external immobilization is required for the adjacent joint injury). The nail is straight and an elastic implant, often taking the shape of the bone, in which it is inserted. In the fracture of upper/3 of radius, often the straight nail reduces the lateral radial bow [14]. However, in clinical appearance and in the final range of motion, this is not noticeable.

The presence of associated injuries was a strong predictor of a compromised end result. These patients had more pain, greater loss of forearm rotation, and longer times to 18 The Iowa Orthopaedic Journal Fractures of the Radius and Ulna in Adults union. Treatment with ORIF resulted in better out comes than treatment with either CR or PIP, largely because ORIF minimized malalignment and the resulting loss of forearm rotation [15].

Conclusion

Treatments of fractures of the shaft of radius and ulna were good to excellent regardless of the method of treatment. Results with ORIF were also found better than CRIF.

References

1. Matthews LS, Kaufer H, Garver DF, Sonstegard DA. The effect on supination-pronation of angular malalignment of fractures of both bones of the forearm. J Bone Joint Surg Am. 1982 Jan;64(1):14-7.
2. Anderson, L. D.; Sisk, T. D.; Tooms, R. E.; and Park III, W. I.: Compression plate fixation in acute diaphyseal fractures of the radius and ulna. J. Bone and Joint Surg., 1975. 57-A:287-297.
3. Burweli, H. N., and Charnley, A. D.: Treatment of forearm fractures in adults with particular reference to plate fixation. J. Bone and Joint Surg., 1964. 46- B:404-424.
4. Chapman, M. W.; Gordon, J. E.; and Zissimos, A. G.: Compression plate fixation of acute fractures of the diaphyses of the radius and ulna. J. Bone and Joint Surg., 1989. 71-A:159-169.
5. Zhao L, Wang B, Bai X, Liu Z, Gao H, Li Y. Plate Fixation Versus Intramedullary Nailing for Both-Bone Forearm Fractures: A Meta-analysis of Randomized Controlled Trials and Cohort Studies. World J Surg. 2017 Mar;41(3):722-733.
6. Iacobellis C, Biz C. Plating in diaphyseal fractures of the forearm. Acta Biomed. 2014 Jan 23;84(3):202-11.
7. Street DM. Intramedullary forearm nailing. ClinOrthopRelat Res. 1986 Nov;(212):219-30.
8. Jones DB, Kakar S. Adult diaphyseal forearm fractures: intramedullary nail versus plate fixation. J Hand Surg Am. 2011 Jul;36(7):1216-9.
9. Asadollahi S, Pourali M, Heidari K. Predictive factors for re-displacement in diaphyseal forearm fractures in children-role of radiographic indices. ActaOrthop. 2017 Feb;88(1):101-108
10. Hadden, W. A.; Reschauer, R.; and Seggl, W.: Results ofAO plate fixation offorearm shaft fractures in adults. Injury, 1983. 15:44-52.
11. Sage, F. P.: Medullary fixation of forearm fractures. J. Bone andJoint Surg., 1959. 41-A:1489-1516.
12. Schulte LM, Meals CG, Neviaser RJ. Management of adult diaphyseal both-bone forearm fractures. J Am AcadOrthop Surg. 2014 Jul;22(7):437-46.
13. Evans EM. Fractures of the radius and ulna. J Bone Joint Surg. 1951;p. 548–561.
14. Lee YH, Lee SK, Chung MS, Baek GH, Gong HS, et al. Interlocking contoured intramedullary nail fixation for selected diaphyseal fractures of forearm in adults. J Bone JonitSurg Am. 2008;90:1891–1898.
15. Stern, P. J., and Drury, W. J.: Complication of plate fixation of forearm fractures. Clin. Orthop., 1983. 175:25-29.