Functional Outcome of Isolated Middle to Distal Third Ulnar Shaft Fracture in Adults with Square Nail Fixation

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ABSTRACT

Introduction: Isolated ulnar shaft are uncommon injuries with most of the fractures occurring following direct trauma. Open reduction and internal fixation with plating is the gold standard treatment but is associated with complications. Treatment with square nail provides rotational stability, is cheaper, safer with minimum complications of plating. **Aims:** To evaluate the functional outcome of isolated fracture of middle third to distal third ulna treated with square nail. **Methods:** This prospective observational study was conducted in the Department of Orthopedics at Nepalgunj Medical College Teaching Hospital Kohalpur from September 2018 to August 2022. Patients aged above 18 and below 60 years who had displaced isolated fracture of middle third or distal third of ulna were evaluated for demographic details, union, functional outcome and associated complications. All of the fractures of ulna were treated by square nail and outcomes were evaluated using disability of arm, shoulder and hand (DASH) score and Grace and Eversmann scoring system. **Results:** In this study of 39 patients with the mean age of 30.84±8.12 years, 56.4% of the patients were in age group 18-30 years, 27 (69.2%) were males and 12 (30.8%) were females. The right limb was fractured in majority, distal third was more commonly involved, physical assault was the most common mode of injury, transverse was the most common fracture pattern. The average time to union was 11.61±2.74 weeks. Most (74.4%) of the patients had good result in DASH score and most (94.9%) had good to excellent result in Grace and Eversmannscoring at final follow-up. The most common complication noted was olecranon bursitis (17.94%) followed by skin irritation (12.82%). **Conclusion:** Square nail fixation of isolated middle third to distal third ulna is safe procedure with few complications, produces excellent to good results.

***Keywords*:** Disability of arm, Shoulder and hand (DASH) score, Grace and Eversmann scoring, Square nail, Ulna fracture

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INTRODUCTION

Isolated fractures of ulnar shaft are a relatively uncommon injuries, but significant, injury with an estimated incidence of 0.2 cases per 1000 population.[1] Most of these fractures occurs following direct trauma to the ulna as the defendant raises arm to protect head from an impact, and are so commonly known as nightstick fractures.[2] Most of the isolated ulna fractures can be broadly classified as stable or unstable, dependent on intactness of interosseous membrane (IOM), contact between fragments and injury to periosteum.[2,3] There has been a paradigm shift in the treatment of these fractures from conservative to operative. Open reduction and internal fixation (ORIF) with plate osteosynthesis usually maintains axial and rotational alignment and high union rates.[4,5] There has been evidence that ORIF with plating leads to periosteal stripping and excessive cortical contact that may disrupt the blood supply[6], in addition to that evacuation of the fracture hematoma may result in delayed fracture union, nonunion and infection.[7,8] Other complications quoted in literature related to plating are longer incisions, hardware prominence and refracture following implant removal.[10,11] Studies have shown that intramedullary (IM) nailing as Kirschner wires (K-wires), Steinmann pins, or Rush rods resulted in high nonunion rates due to a lack of rotational control.[11,12] Square nails provide rotational stability [13] require minimal instruments for insertion, are cheaper than plates, take less time during surgery and are easier to remove. The purpose of this study is to evaluate the functional outcome of isolated ulnar mid to distal third

diaphyseal fractures using disability of arm, shoulder and hand DASH score[14] and Grace and Eversmannscoring system.[15]

METHODS

This prospective observational study was conducted in the Department of Orthopedics at Nepalgunj Medical CollegeTeaching Hospital Kohalpur, Banke, Nepal over the period of 48 months from September 2018 to August 2022. All adult patients aged above 18 and below 60 years who had displaced isolated fracture of middle third or distal third of ulna who gave informed consent were included in the study. The ethical clearance was obtained from institutional review committee. Inclusion criteria were (i) age between 16 and 60 years, (ii) fracture age less than or equal to 14 days (iii) closed or Gustilo and Anderson Type I compound fracture (iv) with good function of shoulder, elbow, wrist and finger joints and (v) without any otherassociated ipsilateral or contralateral major limb injury. The exclusion criteria were (i) open fractures above Gustilo and Anderson and grade I (ii) pre-existing fracture aroundthe wrist or arthrosis of the wrist, (iii) pathological fracture (iv) preexisting forearm fractures or fresh fracture with associated proximal or distal radio-ulnar joint injury or fracture associated with metaphyseal fracture (v) fracture old than 14 days (vi) fractures with associated injury of ipsilateral upper limb (vii) segmental fractures and comminuted fractures (viii) ulna fractures with associated osteoporosis requiring other implants for fixation (ix) fracture with narrow medullary cavityand (x) patients unwilling to participate. All patients with suspected ulna fracture were hospitalized from the emergency, outpatient department (OPD). After general condition of the patient was established, detailed history was taken to determine the demographic details, mode of injury and clinical evaluation was done to determine status of soft tissue, fracture pattern, and neurovascular status. The diagnosis and displacement of isolated ulna fracture was confirmed by appropriate X-rays. After diagnosis was confirmed, patients meeting inclusion criteria underwent preoperative investigations and put on the next possible operation list. All the fractures were approached via bony portal from the radial side of olecranontip after maintaining aseptic precaution, painting and draping. The fracture was stabilized with square nail of predetermined diameter (80 percentage of the narrowest canal diameter) and length (tip of olecranon to the ulnar styloid minus 1 cm). All the fractures were initially attempted to be stabilized by closed technique under C arm guidance, limited open method was used if closed method failed. Above elbow posterior slab in 90 degrees of flexion of elbow was applied for 2 weeks duration. All the patients were administered intravenous antibiotics for at least of 48 hours and then converted to oral antibiotics for 5 days duration. The dressing was changed after 48 hours of surgery and the patients were generally discharged from the hospital after 48 hours and second look dressing was advised to the patient on 5th to 7th day. On 14th post-operative day sutures and slab were removed and converted to above elbow cast for next 4 weeks. At 6th week the cast was removed, patients were observed for union and complications and physiotherapy was started, thereafter patient were followed regularly at 2 to 4 weeks interval till union was achieved and then at 8-12 weeks interval for a total of 1 year both radiographically and clinically. At all follow up patients were observed for fracture union, range of movement, arthrosis, implant position and stability of the DRUJ. Union was defined as bridging of at least 3 out of 4 cortices on two radiograph views. Patients were given a questionnaire at the end of follow up to assess their functional disability. This was done using DASH score[14] and Grace and Eversmann rating system[15] and tabulated for analysis. In this study, the score result was divided into 4 categories as follows 75-100 indicated severe disability, 50-74 indicated poor, 25-49 showed fair and 0-25 showed good function in DASH score and 10 indicated excellent, 8-9 indicated good, 6-7 indicated fair and <5 indicated poor result in Grace and Eversmann[15] scoring.

Statistical method: All the data were recorded as per the proforma attached. Microsoft word 2016 was used. Descriptive statistical method (mean, standard deviation, frequency) were applied using the SPSS 25.0 for windows 10 package program.

RESULTS

Total number of patients were 39 patients. The mean age was 30.84±8.12 years(ranged from 19 to 54 years). The age wise distribution is shown in figure 1.

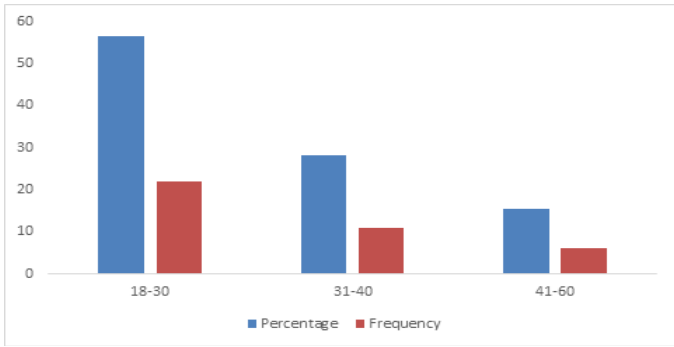

Figure 1: Age distribution of patients

The most common age group was 18-30 years at 56.4%.

There were27(69.2%) males and 12(30.8%) females. The male to female ratio was 2.25:1. The right limb was fractured in 25 (64.1%) and the left limb was fractured in 14(35.9%) subjects.

Most of the fractures 25(61.5%)were in the distal third area of ulna followed by middle third14(38.5%). The most common mode of injury was physical assault seen in 56.41%(22), followed by fall 25.64%(10) and road traffic accidents 17.95% (7). The most common fracture geometry was transverse seen in 61.53%(24) followed by oblique 30.76%(12) followed by comminuted 7.71%(3) The average operative time was 26.15±6.65 minutes with range from 15 to 35 minutes. Most of the nails were inserted by closed technique 84.62%(33), while mini open technique was required in 15.38%(6) patients. The most common problem encountered during intraoperative period was exchange of nails due to shorter length and diameter, 6 patients (15.38%) had to undergo exchanging intraoperatively. The average time to union was 11.61±2.74 weeks. The final outcome as per Grace and Eversmann scoring

is shown in figure 2.

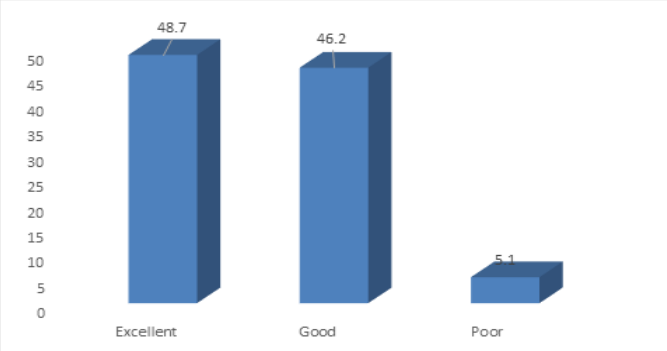

Figure 2: Distribution of patients at final follow-up in Grace and Eversmann score

Most of the patients had excellent (48.7%) result followed by good (46.2%) and only 5.1 % had poor result. The Dash score at the final follow up is shown in figure 3.

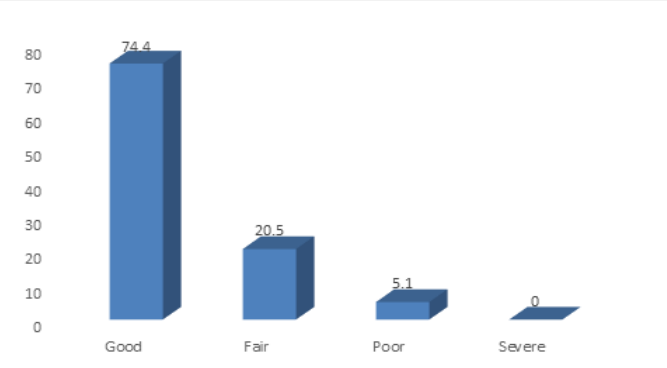

Figure 3: DASH score at final follow-up

Most (74.4%) of the patients had good result followed by fair (20.5%) and only 5.1 % had poor result at final follow-up.

The most common complication encountered was olecranon bursitis in 7 patients (17.94%) followed by skin irritation in 5 patients (12.82%), and nonunion in 2 patients (5.1%). Both of the non-union was found in patients who had undergone limited open method, one patient was diabetic and another patient had grade I open fracture.

DISCUSSION

Open reduction and internal fixation with plating has been considered the gold standard method of treating forearm injuries which has been supported by multiple studies.[16] Nevertheless there are a lot of minor to serious complications associated with plating as longer duration of surgery, compartment syndrome[17], delayed union or nonunion[18] and refracture following removal of plate.[16] There are a number of advantages to closed square nail fixation as smaller incision, early union, low rate of infection, decreased cost of implants, shorter duration of surgery, easier removal and less soft tissue damage. In addition to that healing takes place by periosteal callus formation which is more desirable in fracture healing.

There are a limited number of publications in literature using square nail fixation for isolated ulna fracture, most of the studies have focused on elastic nails and both bone fractures of the forearm. Most of the patients 22(56.4%) were in the age group 18 to 30 with mean age of 30.84±8.12 years which was similar to study done by Lil NA et al[19] where mean age in males was 36.2 and 39.9 years in females and Kandel PR et al[20] where the mean age was 29.53±10.59 and 60% of the patients were in the age group 18-28. Most of the injuries of forearm is seen in young people because of the activity they pursue.

This study showed most of the patients 27(69.2%) were males and right limb was fractured in 25(64.1%) majority which corelates with study done by Kandel PR et al[20], Lil NA et al[19] where most of the patients were males and study by Kandel PR et al and Chouhan VP et al[21] where right limb was involved in 73.3% and 58% of cases respectively. Right limb is more commonly involved as it is dominant limb in most of the patients and is frequently used during fall, protection of body during physical assault and other injuries.

Most of the fractures 25(61.5%) were in the distal third area of ulna and the most common mode of injury was physical assault 56.41%(22). Isolated fracture of distal ulna is most frequently caused by physical assault. The most common fracture was transverse 61.53%(24) which can be corelated to fact that physical assault being the most common mode of injury. Majority of the patients (94.9%) had good or excellent result at final follow-up as per Grace and Eversmann scoring which is comparable to the study done by Kandel et al where 76.6 % had good or excellent results and study by Azboy I et al[22] where 87.5 % had good or excellent result.

LIMITATIONS

The main limitation of this study is sample size, study design and duration of follow-up. The results of this study would have more valid if the sample size was larger, duration of follow-up was for longer period and comparison with other modalities of surgical treatment were made.

CONCLUSION

This study showed that square nail fixation of isolated middle third to distal third ulna is easy to perform, is safe, associated with fewer complications, can be done in short duration with minimum instruments and yields excellent to good results in most of the patients. It can be a good alternative to plating in patients opting smaller incision and cheaper cost albeit with some trivial complications as skin irritation and olecranon bursitis.

REFERENCES

1. Handoll, H.H.; Pearce, P.K. Interventions for isolated diaphyseal fractures of the ulna in adults. Cochrane Database Syst. Rev. 2004, CD000523.

2. Dymond IW. The treatment of isolated fractures of the distal ulna. The Journal of Bone and Joint Surgery. British volume. 1984 May;66(3):408-10.

3. Sauder DJ, Athwal GS. Management of isolated ulnar shaft fractures. Hand clinics. 2007 May 1;23(2):179-84.

4. Anderson LD, Sisk D, Tooms RE, Park 3rd WI. Compression-plate fixation in acute diaphyseal fractures of the radius and ulna. The Journal of Bone and Joint surgery. American Volume. 1975 Apr 1;57(3):287-97.

5. Chapman MW, Gordon JE, Zissimos AG. Compression-plate fixation of acute fractures of the diaphyses of the radius and ulna. JBJS. 1989 Feb 1;71(2):159-69.

6. Perren SM, Cordey J, Rahn BA, Gautier E, Schneider E. Early temporary porosis of bone induced by internal fixation implants A reaction to necrosis, not to stress protection?. Clinical Orthopaedics and Related Research®. 1988 Jul 1;232:139-51.

7. Saikia KC, Bhuyan SK, Bhattacharya TD, Borgohain M, Jitesh P, Ahmed F. Internal fixation of fractures of both bones forearm: Comparison of locked compression and limited contact dynamic compression plate. Indian journal of orthopaedics. 2011 Oct;45(5):417-21.

8. Azboy İ, Demirtas A, Uçar BY, Bulut M, Alemdar C, Özkul E. Effectiveness of locking versus dynamic compression plates for diaphyseal forearm fractures. Orthopedics. 2013 Jul 1;36(7):e917-22.

9. Leung F, Chow SP. Locking compression plate in the treatment of forearm fractures: a prospective study. Journal of orthopaedic surgery. 2006 Dec;14(3):291-4.

10. Henle P, Ortlieb K, Kuminack K, Mueller CA, Suedkamp NP. Problems of bridging plate fixation for the treatment of forearm shaft fractures with the locking compression plate. Archives of orthopaedic and trauma surgery. 2011 Jan;131(1):85-91.

11. Knight RA, Purvis GD. Fractures of both bones of the forearm in adults. JBJS. 1949 Oct 1;31(4):755-64.

12. Sage FP. Medullary fixation of fractures of the forearm: a study of the medullary canal of the radius and a report of fifty fractures of the radius treated with a prebent triangular nail. JBJS. 1959 Dec 1;41(8):1489-525.

13. Street DM. Intramedullary forearm nailing. Clinical Orthopaedics and Related Research®. 1986 Nov 1;212:219-30.

14. Hudak PL, Amadio PC, Bombardier C, Beaton D, Cole D, Davis A, Hawker G, Katz JN, Makela M, Marx RG, Punnett L. Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder, and head). American journal of industrial medicine. 1996 Jun; 29(6):602-8.

15. Grace TG, Eversmann Jr WW. Forearm fractures: treatment by rigid fixation with early motion. JBJS. 1980 Apr 1;62(3):433-8.

16. Hadden WA, Reschauer R, Seggl W. Results of AO plate fixation of forearm shaft fractures in adults. Injury. 1983 Jul 1;15(1):44-52.

17. Moed BR, Kellam JF, Foster RJ, Tile M, Hansen ST. Immediate internal fixation of open fractures of the diaphysis of the. J Bone Joint Surg Am. 1986;68:1008-7.

18. Anderson LD, Sisk D, Tooms RE, Park 3rd WI. Compression-plate fixation in acute diaphyseal fractures of the radius and ulna. The Journal of Bone and Joint surgery. American Volume. 1975 Apr 1;57(3):287-97.

19. Lil NA, Makkar DS. Results of closed intramedullary nailing using Talwarkar square nail in adult forearm fractures. Malaysian orthopaedic journal. 2012 Nov;6(3):7.

20. Kandel PR. Surgical Outcome of Forearm Fractures Treated With Titanium Elastic Nailing System (TENS). International Journal of Orthopaedics. 2022 Feb 28;9(1):1591-6.

21. Chouhan VP, Ojha AK. Functional outcome of closed diaphyseal fractures of both bone forearm in adults treated by small dynamic compression plate fixation in radius & intramedullary nail fixation in ulna. International Journal of Orthopaedics Sciences. 2019;5(2):991-5.

22. Azboy I, Demirtaş A, Alemdar C, Gem M, Uzel K, Arslan H. A newly designed intramedullary nail for the treatment of diaphyseal forearm fractures in adults. Indian journal of orthopaedics. 2017 Dec;51(6):697-703.

FIGURES

Case series 1

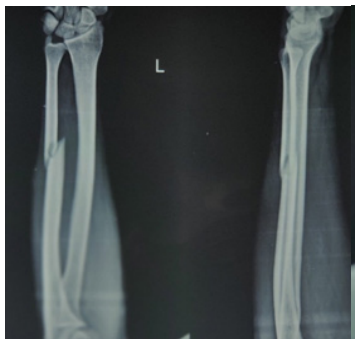

Figure 4: At the time of injury

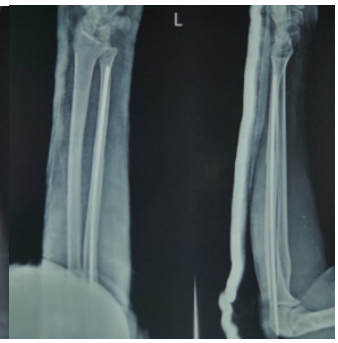

Figure 5 : Immediate post operative picture

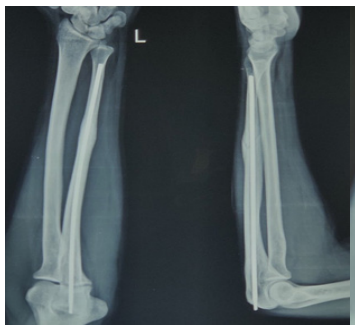

Figure 6 : Follow-up at 10 weeks

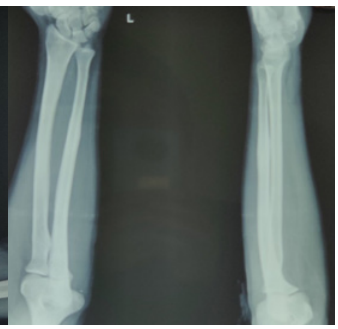

Figure 7 : Following implant removal

Case series 2

Figure 8 : fracture at the time of injury

Figure 9 : follow-up at 14 days

Figure 10 : follow-up at 6 weeks

Figure 11 : follow-up at 1 year

Figure 12 : follow-up after implant removal