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ORIGINAL ARTICLE

TREATMENT OF DISTAL RADIUS INTRA ARTICULAR FRACTURE WITH LOCKING COMPRESSION PLATE

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ABSTRACT

Introduction: Distal radius fractures are among the most common upper limb injuries, affecting both younger individuals energy trauma and older adults with osteoporosis. Achieving optimal wrist function and preventing long term complications are key goals in the treatment of distal radius fractures. Restoration of anatomical alignment is also a critical for ensuring favorable long-term outcomes. The aim of this study was to evaluate the effectiveness of locking compression plates in the treatment of distal radial intra-articular fractures.

Method: This study evaluated the clinical and functional outcomes of 50 patients with distal radius intra articular fractures managed surgically with locking compression plates (LCPs) at Teaching Hospital, Jorpati between October 2011 September 2013. Open reduction and internal fixation with LCPs were included as were the clinical functional outcomes, and radiological evaluation was performed at 4 weeks, 3 months and 6 months after surgery, where Gartland and Werley and Sarmiento's modification of Lindstrom criteria is used.

Result: This study revealed that, with an average age of 32 years and an average age between 19 and 62 years, 48% (24) were classified as Frykman type IV, 28% (14) were classified as type III, 10%(5) were classified as type VI, 6%(3) were classified as type VIII intra - articular fractures, and 4% (2) were classified as types V and VII. Forty percent (20 patients) who were treated with LCPs were excellent, and 46% (23 patients) were good.

Conclusion: The outcomes are good so LCPs in the distal radius of the intra articular fractures provide stable fixation with early mobilization and excellent radiographic and functional results with a minimum complication rate.

Key words: Distal radius; intra-articular fracture; locking compression plate

INTRODUCTION

In orthopedic practices distal radius intra articular fractures are among the most common injuries accounting for approximately 17% of all fractures and 75% of all forearm fractures.[1] These fractures occur due to various causes including falls, road accidents, sport injuries etc. Therefore, the incidence of these fractures is increasing further, highlighting their importance in orthopedic practice.

The main or critical part of optimal functional recovery is the restoration of anatomical alignment in distal radius fractures. Misalignment can lead to complications such as a reduced range of motion and long term disability. Severely impacting a patient's quality of life (RAO et al,2019),[2] Hence for effective surgical interventions that enhance early mobilization and rehabilitation, there is a need for proper functional outcomes where LCPs play a vital role in the treatment of distal radius fractures which offers several biomechanical advantages, including enhanced stability and the ability to maintain fracture reduction. The locking mechanism provides a fixed angle construct that minimizes micromotion at the fracture site, thereby promoting early healing (Huang et al, 2019)[3].

Volar fixed angle locking plates are effective treatments for unstable intra-articular distal radius fractures allowing early post operative rehabilitation.[4] Because the angular stability of locking compression plates can be reduced over time secondary displacement is no longer a problem.[5]

Primary stability achieved with locking screws in a plate prevents secondary displacement irrespective of the bone enabling good results in osteoporotic bones and young patients.[6] Under a 100 N axial load, the palmar locking compression T-plate restores stability comparable to that of an intact radius, and is superior to conventional palmar or dorsal T plates.[7] The development of fixed angular stable fixation techniques theoretically improves stability to maintain the reduction of fractures in osteoporotic bones and fractures considered to be unstable.[8]

The surgical treatment of distal radius intra-articular fractures currently involves a number of methods customized to the particular fracture type and patient characteristics. For stable fractures, conservative treatment is an option; for complex and unstable types of injuries, more invasive surgical procedures are available. External fixation, dorsal plating, and volar plating are frequently used surgical methods. Owing to their biomechanical benefits, including fixed-angle stability and the capacity to sustain a decrease in soft tissue that is impaired, volar locking compression plates, or VLCPs, have become more well-known (Huang et al., 2019)[9]. The fracture pattern, the surgeon's preference, and the resources at hand frequently influence the surgical procedure chosen, underscoring the necessity of customized treatment regimens.

Several studies have investigated how well locking compression plates work to manage the intra articular distal radius. Compared with conventional plating methods, VLCPs offer better stability, which improves functional results and reduces complication rates (Chung et al., 2021),[10]. For example, a comprehensive analysis revealed that patients receiving LCPs had an improved range of motion and grip strength, and a reduced incidence of malunion (Kumar et al.,2022)[11]. The efficacy of LCPs in clinical practice was further demonstrated by their capacity to facilitate early mobilization leading to faster recovery times and greater patient satisfaction.

X-ray images



Preoperative **Postoperative** **1-months follow-up**


3-months follow up **six - month follow-up**

A. Generally, determining the effectiveness of locking compression plates for the treatment of distal radius intra-articular fractures.
B. Specific

a. To restore the anatomy of the distal end of the radius with open reduction with locking plates
b. To evaluate the results of surgery with respect to pain, cosmetic deformity, grip strength and restoration of function
c. To study complications.

METHODS

This prospective study was conducted at Nepal Medical College Teaching Hospital over a duration of 2 years (October 2011 – September 2013) with a total sample size of 50 patients. Inclusion criteria were: intra-articular fracture of the distal radius, age above 16 years to 70 years, both male and female sex, closed fracture and open (Gustilo Type I), and written consent by the patients. Exclusion criteria were: patients with dementia or psychiatric illness, and open fracture with complete neurovascular injury (Gustilo types II and III). The demographic data of the patients were recorded routinely. The occupation of the patient was noted, and this was considered an important deciding factor in the early rehabilitation of the patient to his/her work. A complete clinical examination of the patient was performed and the patient was admitted to the ward. A proforma was prepared, which provided complete details of the patient. Histories of pain, swelling, abnormal mobility, deformity, and loss of function were recorded. The mode or nature of the injury was also noted.

RADIOGRAPHIC EXAMINATION:
Standard radiographs in the AP and lateral views of both wrists were taken for confirmation of the diagnosis and to determine the type of fracture. The fracture fragments were analyzed and the involvement of radiocarpal and distal radioulnar joints was assessed and classified according to Frykman's classification.

SURGICAL PROCEDURES:
Anesthesia:
The operations were performed under brachial block/ general anesthesia.

Position and tourniquet:
The patient was placed supine on the operating table. The affected limb was elevated for 2-3 minutes and exsanguinated. Then a mid-arm pneumatic tourniquet was inflated and the limb was placed on a side arm board. The forearm and hand were thoroughly scrubbed, painted with betadine and draped.
PROCEDURE:
All the cases are treated with a volar locking compression plate via a volar Henry approach.

INSTRUMENTS AND IMPLANTS USED:
- 3.5 mm LCP drill bit and sleeve system
- Hand drill/power drill
- Hexagonal screw driver for 3.5 mm cortical screws and torque resisting screw driver
- General instruments such as retractors, periosteal elevators, reduction clamps and bone Levers, locking compression plates of varying size
- Pneumatic tourniquet.

Technique:
All procedures were performed under general or regional anesthesia. Our standard practice was preoperative prophylactic intravenous ceftriaxone and the use of a tourniquet and bipolar diathermy for homeostasis. The standard volar approach was used to fix the fragments. In patients who initially approached the radial styloid fragment, dissection between the flexor carpi radialis tendon and the radial artery was performed. For the die-punch volar fragment, dissection between the median nerve and flexor carpi radialis tendon was used. The distal and radial borders of the pronator quadratus were lifted and retracted ulnarly. Open reduction was performed with the aid of intrafocal leverage, traction by an assistant/distractor, and provisional fixation by temporary Kirschner wires followed by a definitive volar buttress or locking plate and screws. An image intensifier was used in theatre to assist in the evaluation of fracture reduction and fixation.

POST OPERATIVE PROTOCOL:
- All patients were kept in the postoperative ward for 24 hours after the operation for observation
- All patients were given IV antibiotics for 48 hours which were subsequently converted into oral antibiotics.
- Postoperatively, the wrist was immbolised in a splint.
- The dressing was changed after 48 hours.
- The suture was removed after 10-12 days
- Acive mobilization was started
- The wrist was assessed at 1 months, 3 months and 6 months by using Sarmiento's modification of the Lind Strom criteria and the Gartland and Werley scores.

EVALUATION OF OUTCOME:
Radiological assessment was performed in terms of residual dorsal angulation, radial shortening and loss of radial inclination and the results were graded according to Sarmiento's modification of Lind Strom Criteria.12 These parameters were assessed during the follow - up period to assess the quality of reduction and the ability of the technique to maintain reduction.
The data were quantified with two scoring systems: the system of Gartland and Werley, The Gartland and Werley score is based on a demerit point system that involves a subjective evaluation of pain and an objective evaluation of wrist function. Demerit points are given on the basis of the presence of pain and a specific arbitrarily determined degree of loss of range of motion. Depending on the number of points scored, the outcome is classified as excellent: good, fair, or poor. Pain was noted as none, occasional, moderate or severe. The range of motion of the wrist was noted. Grip strength was measured by a dynamometer and noted as a percentage. Late delayed complications were noted. Outcome functional evaluation of : assessment the elbow.:

Statistical analysis

The data were managed in the datasheet of SPSS ver. 20 software. Continuous data are presented as the mean ± SDs. A P value of 0.05 was considered to indicate statistical significance.

Ethical clearance

The ethical clearance data were obtained from the ethical clearance committee of Nepal Medical College Teaching Hospital, Kathmandu, Nepal prior to starting the study. Informed consent was obtained from all the respondents or their family members.

RESULTS

This study included 50 cases of distal radius intra- articular fractures treated at Nepal Medical College Teaching Hospital, Attarkhel, Jorpati, Nepal. The following are the observations made to the available data analyzed as follows.

Table 1: Age distribution

Age category	Frequency	Percent
15-29 Years	11	22.0
30-44 Years	25	50.0
45-59 Years	11	22.0
<=60	3	6.0
Total	50	100.0

Table 2: Mode of Injury

Mode of injury	Frequency	Percent
RTA	32	64.0
FALL	18	36.0
Total	50	100.0

Table 3: Types of fractures

Type of fracture	Frequency	Percent
Closed	47	94.0
Gust I	3	6.0
Total	50	100.0

Table 4: Types of fractures according to Frykman's classification

No.	Types	No. of cases	Percent
1	Type III	14	28.0
2	Type IV	24	48.0
3	Type V	2	4.0
4	Type VI	5	10.0
5	Type VII	2	4.0
6	Type VIII	3	6.0
Total		**50**	**100.0**

Table 5: Duration of union

Time of union	Frequency	Percent
3 month	35	70.0
4 month	12	24.0
5 month	3	6.0
Total	50	100.0

Table 6: Complications

Complications	Frequency	Percent
No	44	88
CRPS	1	2
Median nerve neuropathy	2	4
Flexor tenosynovitis	2	4
Malunion	1	2
Total	50	100.0
Total	50	100.0

Table 7 Results

Result	Frequency	Percent
Excellent	20	40.0
Good	23	46.0
Fair	5	10.0
Poor	2	4.0
Total	50	100.0

DISCUSSION

Locking compression plates are widely used successfully especially for intra-articular fractures of the distal radius.[13,14] Volar locking plates maintain the fracture position and provide sufficient fracture stability due to their fixation strength.[14] Therefore, they enable early postoperative mobilization.

Age distribution

In this study the majority of patients were in the 30-44 years age group. The average age was 32 years, with a range from 19 - 62 years. Ayhan Kilic et al., Kevin C. Chung et al., and R.E. Arora Rohit et al, reported average ages of 45 years, 48.9 years and 48 years respectively. Distal radius fractures were observed in the younger age group as they are physically active and engaged in various outdoor activities.

Sex disturbance

In this study, males predominated the females. Sixty-six percent (n=33) of the patients were male and 34%(n=17) of the patients were female. The incidence was greater in males because most of them were involved in outdoor activities, and females were involved in household activities.

Involved site

In this study, the right side was more commonly in 64% of the patients (n=32) than the left side was (n=18). In all the above series, the right side was more involved than the left side was. In our series, the right side was commonly involved. This may be beacuse of the right predominance.

Mode of injury

In this study, the majority of fractures were road traffic accidents 64% (n=32) followed by falls on level ground 36% (n=18). Kevin C. Chung et al., Arora Rohit et al. and Ayhan Kilic et al. reported falling on the ground as the most common mode of injury. In our series road traffic accidents were the most common mode of injury and the majority of the patients were motor bike riders. This may be due to the poor quality of roads and poor sense of traffic, leading to a higher incidence of road traffic accidents outside the country.

Functional outcome

In this study, 40% (n=20) of the patients had excellent results, 46% (n=23) had good results, 10% (n=5) had fair results and only 4% (n=2) had poor results. Patients, who achieved excellent results, had no residual deformities or pain. The range of motion was within the normal functional range. The radial length, volar tilt and articular step-off were within acceptable limits. They were cooperative with physiotherapy. Patients with good results had minimal

residual deformities and pain. The rest of their findings were within acceptable parameters.

This result is comparable to that of Ayhan Kilic et al.[14] who reported 44.4% excellent results, 44.4% good results, 11.2% fair results. Kamano et al.[15] reported that 33 patients with dorsally displaced fractures of the distal radius (mean preoperative dorsal tilt, [23]) were treated with a volar locking plate.According to the Garland and Werley rating scale, 12(36.6%) had excellent results, 20(60.6%) had good results, and 1(3.03%) had fair results. Rohit Arora et al reported that 27.1% had excellent results, 47.3% good, 20.1% fair results and 5.2% poor results.

Complications

Michele Rampoldi, and Salvatore Marisco16 reported a 7.7% complication rate of which 3.33 % (3 patients) experienced rupture of the extensor tendon, 2.2% (2 patients) experienced rupture of the flexor tendon, 1.11 % (1 patient) experienced median nerve irritation and 1.11% (1 patient) experienced loss of reduction.

Kevin C. Chung et al.[15] reported a 9.1% complication rate in which 1.1% had median nerve neuropraxia,4.5% had suture abscesses, 2.2% had incision blisters and 1.3% had wrist haematomas.

Kamano et al reported a 3% complication rate,all of which were complex regional pain syndrome.

Drobetz/Kutscha-Lissberg reported a 26% complication rate of which 12% were ruptures of Flexor Pollicis longus, 2% were ruptures of extensor pollics longus, 2% were carpel tunnel syndrome and 6% had complex regional pain syndrome.

Rozental/Blazar[12] reported a 14% complication rate, of which 5% were flexor tendon tenosynovitis, 2% were extensor tendon tenosynovitis and 7% were malunion.

In these studies a 12% complication rate, was observed. Two patients (4%) had flexor tenosynovitis. This could be due to the sharp edge of the screw and plate. In these patients, tenosynovectomy and plate removal were performed. Two patients (4%) experienced median nerve neuropraxia, which could have been due to traction on the nerve at the time of surgery. One patient fully recovered from symptoms without requiring operative intervention and another patient underwent carpel tunnel release. One patient (2%) developed complex regional pain syndrome, which could be due to inadequate physical therapy, but symptoms were resolved with physical therapy and oral analgesia, and one patient (2%) develped malunion due to fracture collapse because of severe communtion.

The clinical and functional outcomes of this study demonstrate the effectiveness of volar locking compression plates (LCPs) in the management of distal radius intra-articular fractures. More than 86% of patients achieved excellent or good functional results, with significant improvements in range of motion, grip strength, and pain reduction. These findings are consistent with those of previous studies, which also reported superior functional recovery and stability with LCP fixation compared with conventional methods. Optimal outcomes were observed in patients whose radial length, inclination, and volar tilt were accurately restored, emphasizing the importance of achieving precise anatomic reduction during surgery. These results further indicate that volar LCP fixation provides stable internal support, enabling early mobilization and minimizing postoperative complications. Notably, hardware-related issues such as tendon irritation were rare in this study, which aligns with reports from the literature. This finding reinforces the mechanical superiority of locking plates in achieving both radiological and functional success.

Several factors influence treatment outcomes. Early surgical intervention—typically within 1 to 2 days after injury facilitates prompt reduction and fixation, helping to prevent complications such as soft-tissue contracture and malunion. Careful plate placement to avoid the watershed area, along with meticulous repair of the pronator quadratus, also contributed to reduced soft-tissue irritation and enhanced functional recovery.

However, this study has certain limitations, including a relatively small sample size, the involvement of multiple surgeons, and a short follow-up period. Further large-scale, long-term studies are recommended to validate these findings and assess the durability of functional outcomes over time.

CONCLUSION

Locking compression plates in distal radius intra-articular fractures provides stable fixation allowing early mobilization with excellent radiographic and functional outcomes and minimal complications.

The use of these plates facilitates faster recovery of joint motions and daily functional activities. The fixation technique is effective not only in young patients with good bone stock but also in elderly patients with osteoporotic bones.

RECOMMENDATIONS

In operative treatment of distal radius intra-articular fractures via LCP, the following recommendations can be made:

1. Open reduction and internal fixation with a locking compression plate yield excellent results for intra-articular distal radius fractures.
2. It provides absolute stability to maintain articular congruency.
3. It permits early mobilization and early return of function.

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AUTHOR CONTRIBUTIONS

The study was conceptualized, designed, and written by Dr. Niraj Man Shrestha, the first author. Prof. Dr. Ramesh Prasad Singh served as the preceptor and chief surgeon. Assistant Professor Dr. Pralhad Kumar Chalise contributed as a co-guide and surgeon. Dr. Kripa Joshi was responsible for manuscript writing, and Dr. Nirajan Subedi assisted in the design and editing of the study.

CONFLICT OF INTEREST

We confirm that this manuscript is original, has not been published elsewhere, and is not currently under consideration by any other journal. All authors listed have made substantial contributions to the work and have approved this final submission. We confirm that there are no known conflicts of interest related to this manuscript.