

Effectiveness of locking compression plate in wedge fracture of diaphysis of radius and ulna in adults: A descriptive case series

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Abstract

The aim of the study was to see the effectiveness of locking compression plate (LCP) in wedge fracture of diaphysis of radius and ulna in adults. This prospective descriptive case series study inducted total 45 patients presenting with wedge fracture (AO Type, 22-B) of radius and/or ulna. The treatment outcome of these patients were monitored for 24 weeks in 8 visits. Presence or absence of radiological union was noted. The functional outcome was evaluated in terms of Disability of Arm, Shoulder and hand (DASH) score and Grace and Eversmann criteria. Mean age of the patients included in this study was 28.76 ± 6.16 years (range 18-47 years). Among them 28 (62.2%) were male while 17 (37.8%) were females. Union was achieved in all the patients at mean time of 12.62 ± 2.24 weeks (range 8-16 weeks). Mean DASH score was 12.20 ± 4.3 (range 5-19). According to Grace and Eversmann criteria, 41 (91.1%) had excellent result, 3 (6.7%) had good result, 1 (2.2%) had satisfactory results while there was no patient with unsatisfactory result. High rate of union along with good functional outcome and minimal complication can be achieved in patients with diaphyseal wedge fracture of radius and/ or ulna when managed with locking compression plate.

Keywords: Locking compression plate, Union, DASH, Grace and Eversmann, Wedge diaphyseal fracture.

Introduction

The upper extremity is the most commonly injured limb, hence it is very important that emergency management team must be well aware of the evaluation and management of upper extremity injuries.¹

Diaphyseal fractures of radius and/or ulna have special consideration as compared to other long bones fractures. Not only the exact reduction has to be achieved but proper length apposition is required and rotational alignment is also compulsory. Compromise to the rotational alignment leads to the impaired supination and

pronation movements at radioulnar joints. The surgical treatment, which is open reduction and internal fixation (ORIF) of radius fractures are widely accepted treatment protocols. These are followed by early range of motion and rehabilitation.¹⁻⁴

In 1957, Smith and Sage analyzed fractures of the forearm treated with a variety of intramedullary appliances. The results from this series of internal fixation are also discouraging with the nonunion rate reaching 20%.⁵⁻⁷

Knight and Purvis reported 71% unsatisfactory results in those forearm diaphysis fracture treated conservatively.⁸

Owing to all these facts, Open Reduction Internal Fixation (ORIF) is considered as the best mode of treatment for the fractures of shaft of Radius and Ulna, even if fractures are reduced closely

The locking compression plate (LCP) is developed by combining the inherent properties of Low Contact Dynamic Compression Plate (LC-DCP) and Point contact fixator (PC-Fix). Theoretically locking compression plates (LCP) have advantage over conventional plates but still clinical trials and documentation is required to prove their superiority.⁹

Through this study we want to establish the outcome of LCP in diaphyseal wedge fracture of radius and/ or ulna.

Methodology

This prospective descriptive case series was conducted in Department of Orthopaedic Surgery and Traumatology, Unit-I of King Edward Medical University (KEMU)/ Mayo Hospital, Lahore of Pakistan from April 30, 2013 till April 22, 2014. Patient with age more than 16 with wedge fracture of diaphysis of radius and/ or ulna were included in this study. All the pathological fracture, open fracture, infection at the incision site, fracture older than a month and patients with chronic diseases like diabetes, hypertension were excluded from this study. After ethical approval from institutional review board, informed consent were obtained from all the patients involved in this study. The prognosis of the treatment was explained before enrolling the patient in the study. Demographic details were obtained.

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All the patients were operated by the same surgeon under general anaesthesia under strict aseptic conditions in operation theatre under prophylactic antibiotic coverage.

The treatment outcome of these patients were monitored for 24 weeks in 8 visits. Follow up was done every two weeks for first two months and every four weeks for next four months. Presence or absence of radiological union was noted. Radiologically union was present if there would be no fracture line visible and bridging of both cortices as suggested by Whelan.¹⁰ The functional outcome was evaluated in terms of Disability of Arm, Shoulder and hand (DASH) score and Grace and Eversmann criteria. DASH score results are interpreted as higher scores (maximum = 100) representing a greater disability and the lower scores occurring in a good functioning arm.¹¹ In Grace and Eversmann criteria, the outcome was classified as excellent, good, satisfactory and unsatisfactory based on presence/absence of union and movement in percentage of normal forearm rotation arc.⁶ The data was analysed by SPSS 20.0. Quantitative data (Age, DASH score, time to union) was presented by using mean $\pm$ SD. Qualitative variables (Gender, Radiological Union and outcome according to Grace and Eversmann criteria Failure, complications) was presented as frequency, percentage. The p-value was also calculated where value less than 0.05 was considered to be statistically significant.

Fracture of radius was opened through Henry's approach where bone was exposed and then after reduction Locking Compression Plate (LCP) was applied.¹²

Fracture of the Ulna was exposed through the sub-cutaneous ulnar approach where after appropriate exposure of the bone, reduction and application of LCP was done.¹²

Results

Mean age of the patients included in this study was 28.76 $\pm$ 6.16 years (range 18-47 years). Among them 28 (62.2%) were male while 17 (37.8%) were females. Thirty-one (68.9%) had their right forearm involved while 14 (31.1%) had fracture of left forearm. Road traffic accident (RTA) was the main cause of injury (68.9%) followed by fall from height (24.4%) and assault (6.7%). Union was achieved in all the patients at mean time of 12.62 $\pm$ 2.24 weeks (range 8-16 weeks). Only 4 (8.9%) patients achieved union at 8th week postoperatively while 34 (75.6%) patients achieved union by 12th week and 45 (100%) at the end of 16th week. Mean DASH score was 12.20 $\pm$ 4.3 (range 5-19). According to Grace and Eversmann criteria, 41 (91.1%) had excellent results, 3 (6.7%) had good results, 1 (2.2%) had satisfactory result

Table: Grace and Eversmann outcome.

Outcome	Frequency	Percent
Excellent	41	91.1
Good	3	6.7
Satisfactory	1	2.2
Total	45	100



Figure: Superficial infection.

while there was no patient with unsatisfactory result (Table). There were total 4 cases of superficial infection (Figure) that were managed with intravenous antibiotics according to culture and sensitivity.

Other complications like deep infection, synostosis, plate fracture, compartment syndrome, or iatrogenic neurological or vascular damage were not found.

Discussion

In the present industrial era we encounter a large number of forearm fractures. The treatment of these fractures has gone through an evolutionary process and different treatment modalities were introduced from time to time. The principles of LC-DCP and PC-Fix are used to develop the locking compression plate (LCP). The stability of fixation is not dependent upon the bone plate interface rather it depends upon the screw plate interface.¹³

This study was conducted to see the effectiveness of locking compression plate in diaphyseal fractures of forearm, AO type 22-B.

Sushil Sharma conducted a study on the forearm shaft fractures and his results revealed mean time of 12.6 weeks for union ranging from 8 to 24 weeks. In his study delayed union was seen in 2 cases and 1 (13.3%) case developed infection of both bones. Infection was treated conservatively with intravenous antibiotics which later on settled. Stiffness of the elbow and wrist joint was seen in

the four cases which were treated by physiotherapy. All cases recovered full range of motion after physiotherapy. Sharma in his results obtained 93.3% union rate with 90% satisfactory results.¹³

According to the results of this study union was achieved in 100% patients by 16th week however mean time to union was 12.62 ± 2.24 weeks. We had superficial infection in 4 cases which were managed with debridement and intravenous antibiotics according to culture-sensitivity.

KC Saikia¹⁴ in his prospective comparative study compared the LCP with limited contact dynamic compression plate (LC-DCP) for the management of fractures of shaft of forearm of both bones. The LC-DCP group took 16.27 weeks (10-29 weeks range) for union as compared to LCP group which took 14.16 (8-21 weeks Range) for union. This difference was statistically not significant ($p > 0.09$). We achieved union using LCP earlier than that achieved by KC Saikia.¹⁴

Leung et al.¹⁵ in their case series of LCP achieved 100% union in a mean time of 20 weeks. The more recent study of Stevens et al.¹⁶ had 100% union rates in both LCP and DCP groups. They even found the consolidation time favouring the DCP. Results of this study regarding union with the use of LCP was consistent with the results reported by Leung, Stevens and our study.

Ibrahim Azboy¹⁷ in his study compared the results of the locking compression plate (LCP) and the dynamic compression plate (DCP) for the treatment of shaft of Radius and Ulna fractures. Mean time to union was 15 weeks (range, 12-25 weeks) in the LCP group and 17 weeks (range, 13-24 weeks) in the DCP group. Mean time to union in our case was shorter than their study. According to the Grace-Eversmann criteria, in the LCP group, 16 (72.72%) patients had excellent results, 4 (18.18%) patients had good results, and 2 (9.1%) patients had acceptable results. We had better results where 41 (91.1%) had excellent result, 3 (6.7%) had good results and 1 (2.2%) had satisfactory results. Better outcome might be due to selection of a specific fracture pattern (22-B) while they had wide variety of fracture pattern in their study. Mean DASH score in their LCP group was 14 (range 5-34) whereas in our study mean DASH score was 12.20 ± 4.3 (range 5-19).

In a study by Angadi et al.,¹⁸ where they compared the outcome diaphyseal fracture of radius ulna fixation with dynamic compression plate (DCP) (group A) with LCP (group B), found that LCP was superior to DCP in terms of time to union and Anderson et al criteria. This was probably due to more periosteum stripping required in

DCP as compared to LCP.

In a study by Chaudhary et al.¹⁹ where management of diaphyseal fracture of radius and ulna in 20 adults with intramedullary rods showed 70% patients with excellent results, 20% patients with good results and 10% patients with satisfactory results according to Grace and Eversmann criteria. This study concluded that good functional outcome could be achieved with intramedullary rods when used for the management of diaphyseal fracture of forearm bones. It has the disadvantage of high non-union rate and loss of range of motion.

Our study has advantage of accessing outcome of LCP in specific fracture pattern. This increases the predictability of outcome with LCP in that specific fracture pattern. However, it has inherent limitation of lack of comparison especially with conventional pattern.

Conclusion

Based upon the results of this research it was concluded that LCP is an effective method for treating diaphyseal wedge fracture (AO-Type, 22-B) of radius and ulna in terms of union and clinical outcome however long term study with greater sample size is still required.

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Conflict of Interest: The authors have no conflict of interest to declare.

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