

EFFECTIVENESS OF LOCKING VERSUS DYNAMIC COMPRESSION PLATES FOR DIAPHYSEAL HUMERUS FRACTURES

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HOW TO CITE THIS ARTICLE:

Penugonda Ravi Shankar, Muni Srikanth Iytha, Archana Pusarla, Seethamraju Vidya Sagar, Suresh Katakam. "Effectiveness of Locking Versus Dynamic Compression Plates for Diaphyseal Humerus Fractures". Journal of Evidence based Medicine and Healthcare; Volume 2, Issue 6, February 9, 2015; Page: 693-698.

ABSTRACT: The aim of this study was to compare the effectiveness of locking compression plate (LCP) over dynamic compression plate (DCP) in the management of diaphyseal fractures of the humerus. 38 patients with diaphyseal fracture of the shaft of the humerus were randomized prospectively and treated by open reduction and internal fixation with LCP or DCP. 11 patients underwent internal fixation by LCP and 27 by DCP. Fixation was done through an anterolateral or posterior approach. The outcome was assessed in terms of the union time, union rate, functional outcome, ROM and the incidence of complications. Functional outcome was assessed using the Romen's et al series grading system. On comparing the results by tests of significance like Chi-square test, there was no significant difference in Romen's et al scores between the two groups ($P>0.05$). Though the average union time and recovery of ROM was found to be better for LCP as compared to DCP, it is not statistically significant. Complications such as infection were found to be higher with DCP as compared to LCP. This study proves that LCP can be considered a better surgical option for the management of diaphyseal fractures of the humerus as it offers a short union time and lower incidence of serious complications like infection. However, there appears to be no difference between the two groups in terms of the rate of union and functional outcome.

KEYWORDS: Locking compression plate(LCP), Dynamic compression plate(DCP), Diaphyseal fractures.

INTRODUCTION: Most uncomplicated humeral shaft fractures can be managed non-operatively, with an expected union rate of more than 90%. The methods include the hanging cast, functional brace, Velpau dressing and shoulder spica cast.^{1,2,3} The indications for operative treatment are open fractures, segmental fractures, pathological fractures, those with associated vascular injuries, bilateral humerus fractures, humerus fractures in polytrauma patients, radial nerve palsy after fracture manipulation, neurological loss after penetrating injuries, fractures with unacceptable alignment and failed conservative treatment.^{4,5,6}

With the emphasis on biological fixation by the AO group of surgeons, there has been a continuous invention of implants and instrumentation facilitating stable fixation and early mobilization reducing the number of man hours lost. Dynamic compression plate has been a time tested implant in the armamentarium of the orthopaedic surgeons in the management of long bone fractures. Though they are very effective, they have inherent disadvantage by virtue of their size and fixation technique especially in osteoporotic bones. The recent introduction of locking compression plate has revolutionized the management of juxta articular fractures and osteoporotic bone. Many studies have shown the superiority of LCP over traditional implants on

osteoporotic fractures. We made an attempt to compare the results of humerus fracture fixation by DCP and LCP in SVRRGGH during the period 2008 - 2010.

MATERIALS AND METHODS: We conducted a prospective comparative study on 38 consecutive patients with fracture of the shaft of the humerus requiring surgical stabilization were randomized using a sealed envelope to undergo fixation with either DCP or LCP. In this study, 27 patients (22 men and 5 women; mean age, 37 years [range, 18-55 years]) of fracture shaft of humerus fixed by open reduction and internal fixation using dynamic compression plate were compared with 11 patients (9 men and 2 women; mean age, 43 years [range, 26-54 years]) treated by locking compression plate. The operating surgeons were experienced with both procedures.

The aims and objectives of our study was to study the role of dynamic compression plate and locking compression plate in the management of fracture shaft of humerus and to study the advantages of locking compression plate over dynamic compression plate (conventional plate).

On admission of patient, a thorough clinical examination was done including systemic examination to rule out any associated any injury. The AO/ASIF classification was used for fracture classification⁷ (Table 1). In the LCP group, 1 patients had Gustilo-Anderson grade 1 fractures and 2 patients had grade 2 fractures, and in the DCP group, 1 patient had a Gustilo-Anderson grade 1 open fracture and 1 patients had grade 2 fractures.⁸ In the LCP group, 4 (36%) patients experienced low-energy trauma and 7 (64%) experienced high-energy trauma. In the DCP group, 12 (44%) patients experienced low-energy trauma and 15 (56%) experienced high-energy trauma.

All patients were administered 1 g of a first-generation cephalosporin 30 minutes preoperatively as a prophylactic measure (continued for 24 hours). Average time from injury to surgery was 3 days (range, 1-8 days) in the LCP group and 4 days (range, 1-6 days) in the DCP group.

Anterolateral approach with lateral plating was the most preferred surgical approach. Posterior approach was used in seven cases due to the fracture being in the distal third. A broad and narrow 4.5mm DCP or LCP made of 316L stainless steel was used and a minimum of 6 cortices were engaged with screw fixation in each fragment.

Post operatively suction drain was removed after 24 to 48 hours. Sutures are removed on 9th to 12th post-operative day and check x-rays were taken in antero-posterior and lateral views. Appropriate analgesics and antibiotics were given till the time of suture removal. After suture removal, patients were discharged with an arm pouch and advised to perform shoulder, elbow wrist and finger movements.

All the patients were followed up at monthly intervals with a mean period of follow up of 6 months. One patient who developed non-union required follow up for 9 months until fracture get united with bone grafting. Functional evaluation was done using the Romen's et al series grading system (table 2).

STATISTICS: Data was analysed using MS – excel 2007 software. Relevant descriptive statistics like proportions means etc. and tests of significance like Chi-square test were applied.

RESULTS: Union was achieved in all patients in both groups. All patients were followed up until fracture union was achieved. In our study we did not have any intra-operative complications. Post-operatively we had 4 radial nerve palsies, 5 delayed union, 1 non-union and 6 cases of superficial and deep infections.

Most of the fractures were healed by the 18th week. In the DCP group out of the 27 patients, 21 (78%) patients had fracture union by the 18th week. 5 patients (18.5%) had delayed union which was united spontaneously without any intervention by 22 weeks, while 1 patient (3.7%) had a non-union which required bone grafting to achieve union. The cause for non-union was deep infection and patient's early weight loading against our advice. In the LCP group 11 patients had fracture union by the 18th week. Out of the 4 radial nerve palsies, 3 palsies developed after surgery and 1 patient had palsy prior to the surgery. All of them recovered spontaneously recovered by 3 to 4 months. Of the 2 cases of superficial infection in patients treated by LCP, 1 had preoperatively type 1 compound injury. In both the cases, infection was controlled by one week course of antibiotics which was started after culture and sensitivity report. Of the four cases of deep infection, one patient developed non-union which was united after debridement and bone grafting by 8 weeks. 2 patients had implant removal once the fracture is united for the control of infection and one patient of deep infection had control after culture and sensitivity and a course of antibiotics with debridement of wound.

In our study, we had 17 cases (44.73%) of excellent result, 20 cases (52.63%) of good result and one case (2.63%) of poor result as per Romen's et al series grading. In the patients treated by dynamic compression plate 11 patients (40.74%) had excellent result, 15 patients (55.55%) had good results, 1 patient (3.70%) had poor result. In patients treated by LCP, 6 patients (54.54%) had excellent result and 5 patients (45.45%) had good results. None of the patients treated by LCP had poor results. ($\chi^2 = 0.89$; d.f = 2; p = 0.64; NS).

DISCUSSION: Concepts in the management of trauma in Orthopaedics are very rapidly changing to keep pace with the increasing severity and complexities of the fractures. Patients with osteoporosis are at a greater risk for delayed union or non-union following plate fixation of a humeral diaphyseal or meta-diaphyseal fracture because of poor screw purchase or loosening. Many studies have shown the mechanical advantage of LCP over the conventional fixation. Many lab studies using saw bones and cadaveric models have tried various permutations and combinations of screw fixation and found that after cyclic loading, the unlocked screw constructs had significantly lower stability compared with both the locked and hybrid constructs.⁹ Our study was done to evaluate the efficacy of locking compression plate (LCP) over the dynamic compression plate (DCP) in the treatment of the shaft of humerus.

Different authors used different criteria to label union. Healing or union has been variously defined by the presence of bridging callus on x-ray, the absence of pain on deformation at fracture site, the ability of the patient to load full weight without external support. In our study we considered the fracture as united when there was no pain clinically and without any subjective symptoms and the patient had full function. Most of the studies show 8-15 % delayed union and 3% non-union with DCP and 8% delayed union and no non-union with LCP.^{10,11,12} In our study 19% delayed union and 4% non-union with DCP and no cases of delayed and non-union.

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Excellent to good overall result in previous studies ranges from 86-95%. In our study overall functional outcome was excellent to good in 96% with DCP and 99.9% with LCP.^{13,14,15}

We are aware of the limitations in our study. First, study comprises a relatively small number of patients. Second, a comparison could not be made between subgroups of the diaphyseal humerus fractures (e.g., comminuted or osteoporotic fractures). Future studies consisting of homogeneous subgroup types with similar degrees of osteoporotic bone may reveal more accurate results for the indications and effectiveness of LCP and DCP. Though the total number of patients treated by LCP was small in number, all the patients had excellent to good results. None of the patients who were treated by LCP had poor results. As per biomechanics, the screws of LCP virtually act as pegs resisting axial, rotational, translational and bending forces. Because of more stability of implant and intact periosteum producing early callus and primary fracture union producing visible callus allows early mobilization of joints around the fracture. The only limiting factor with usage of LCP regularly is cost of the implant.

CONCLUSION: Locking compression plates and DCPs have similar functional and radiological results in the treatment of adult diaphyseal humerus fractures. However, LCP produces visible callus and allows for early mobilization of fracture because of stability of the plate – bone construct. Limiting factor for regular use of LCP is its cost. Large volume of work is required to comprehensively prove the advantages of LCP over DCP in the overall population at large.

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G. A. Classification	Number of patients	
	DCP	LCP
Type I	1	1
Type II	1	2
Total	2	3

Table 1

ROMEN' S ET AL SERIES GRADING
EXCELLENT Solid union – anatomic reconstitution Less than 10% loss of range of motion No significant subjective complaints
GOOD Solid union – anatomic reconstitution 10-30% loss of range of motion Minimal subjective complaints
POOR Non anatomic results or nonunion Greater than 30 degree loss of range of motion, Moderate subjective complaints

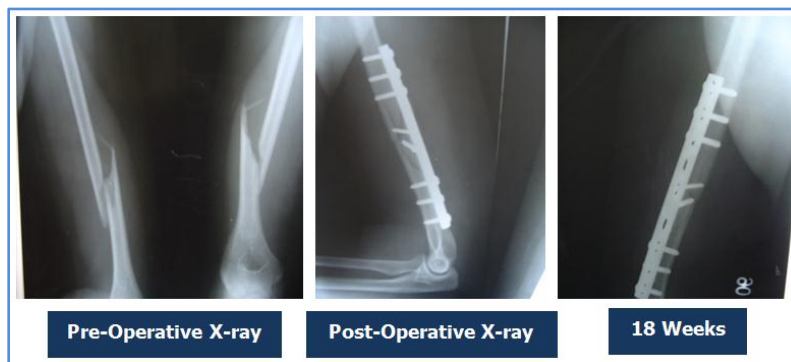
Table 2

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HUMERAL SHAFT FRACTURE STABILIZED WITH LCP:



HUMERAL SHAFT FRACTURE STABILIZED WITH DCP:



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Date of Submission: 20/01/2015.
Date of Peer Review: 21/01/2015.
Date of Acceptance: 30/01/2015.
Date of Publishing: 04/02/2015.