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Treatment of diaphyseal forearm bone fractures by Locking Compression Plate (LCP)

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Abstract

Purpose:-
To evaluate the use of locking compression plates in the treatment of diaphyseal fractures of forearm.
Methods:-
30 patients of forearm fractures were included in the study with 26 males and 4 females having mean age of 34 years. Follow up was done at 3, 6 and 12 months. Clinical assessment was done for the functional outcome according to Anderson criteria.
Results:-
All the fractures united with mean union time 12.6 weeks. There was not a single case of nonunion with only 2 cases of delayed union. There was a single case of infection which was managed conservatively. None of the cases required bone grafting.
Conclusion:-
Locking compression plate is no doubt an effective bridging device used for treating comminuted fractures, but its superiority over conventional plating in the treatment of simple factures is yet to be proven.

Study Conducted at Postgraduate Department of Orthopaedics, Government Medical College, Jammu, India.

INTRODUCTION

Forearm bone fractures are commonly encountered in today's industrial era. Various treatment modalities were introduced from time to time and each of them had some edge over the previous one. Continuing this process of revolution and based on many years of experience with compression plating and promising results obtained with so called internal fixation, an implant system has been developed which combines the two treatment modalities. Despite the combination of these different treatment techniques no compromises were made with regard to application as a compression plate or as a bridging device in the form of an internal fixation. LCP (Locking compression plate) is a product of these combinations and is in line with the latest plating techniques, the aim of which is to achieve the smallest surgical incision and to preserve the blood supply to the bone and adjacent soft tissues. LCP has got features of both LC-DCP and a PC-Fix as it uses screw heads that are conically threaded on the undersurface and create an angular stable plate screw device. This type of plate fixation relies on the threaded plate-screw interface to lock the bone fragments in position and do not require friction between the plate and bone as in conventional plating. The present study was undertaken to evaluate the use of LCPs in diaphyseal fractures of forearm bones.

MATERIALS AND METHODS

A prospective study was conducted from May 2006 to August 2007 including 30 adult patients. There were 26 males and 4 females and mean age of the patient was 34 with range being 15-60. Our study included diaphyseal fractures of forearm less than 3 weeks old where as type II and type III compound fractures, pathological fractures and segmental diaphyseal fractures were excluded.

High energy trauma was responsible for the 19 cases (63.3%) and 11 cases (36.7%) occurred as a result of low energy trauma. 26 (86.7%) were closed type and 4(13.3%) were open type I fractures. 23 cases (76.7%) were type A fractures and 7 cases (23.3%) were type B fractures. 20 cases (76.7%) were isolated injuries where as 10 cases (33.3%) had multiple injuries. In 17 cases (56.6%) both radius and ulna were involved where as isolated cases of radius and ulna fractures were 8(26.7%) and 5(16.7%) respectively. All the cases were initially given a trial of closed reduction.

After the failure of closed reduction cases were prepared for open reduction and internal fixation with 3.5mm stainless steel LCPs.

Fractures were exposed through the usual surgical approaches, fragments were reduced and a conventional screw was inserted to secure the plate on to the bone temporarily. Based on the configuration of fractures second screw inserted was either a conventional or locking screw to achieve interfragmentary compression or bridging of fragments respectively. Then the plate was secured finally to the bone with the help of locking screws through rest of the holes. Follow up at the monthly interval was done for all the operated patient and radiographs were taken at 3 , 6 and 12 months. Following parameters were considered in follow up:-

CLINICAL PARAMETERS

- Condition of scar
- Fracture site tenderness
- Any clinical deformity

RADIOLOGICAL PARAMETERS

- Position of fracture fragments.
- Amount of bridging callus.
- Fracture line.
- Hardware failure.

Fracture was considered to be united when there was obliteration of fracture gap or the presence of bridging periosteal callus in three of the four cortices on AP and Lateral radiographs. Fracture union was considered as delayed when there was presence of fracture gap or absence of progressive callus formation in the first 6 postoperative months. The results were graded according to Anderson et al criteria as given below:-

Excellent : Results were considered excellent when:-

- There was union of fracture
- Loss of flexion and extension at the wrist or elbow of less than 10 degrees
- Loss of pronation and supination of less than 25%

Satisfactory: Results were satisfactory when:-

- There was union of fracture
- Loss of flexion and extension at the wrist or elbow of less than 20 degrees.
- Loss of pronation and supination of less than 50%

Unsatisfactory: Results were unsatisfactory when:-

- There was union of fracture
- Loss of flexion and extension at the wrist or elbow of more than 20 degrees
- Loss of pronation and supination of more than 50%

Failure: Failure was considered when:-

- There was nonunion
- Unresolved chronic osteomyelitis

RESULTS

All the thirty cases showed union of fracture. The mean union time was 12.6 weeks with range being 8-24 weeks. There were 2 cases of delayed union. One was 35 yrs old male with type A closed fracture of forearm bones that united after 24 weeks. The second one was a 59 yrs old male having type B closed fracture of both bones of forearm that also united after 24 weeks. Bone grafting was required in none of the cases. There was one case (13.3%) of infection developing in patient of both bones forearm fracture which subsided following antibiotic treatment. Four patients developed stiffness of elbow and wrist joints, which was managed by physiotherapy and all four subsequently recovered full range of motion. Functional assessment of the cases has been done according to Anderson et al criteria as given in the table. Overall rate of union was 93.3% with satisfactory results being 90% in the present study (Table 1).

Figure 1

Table 1: Functional Outcome of the Patients

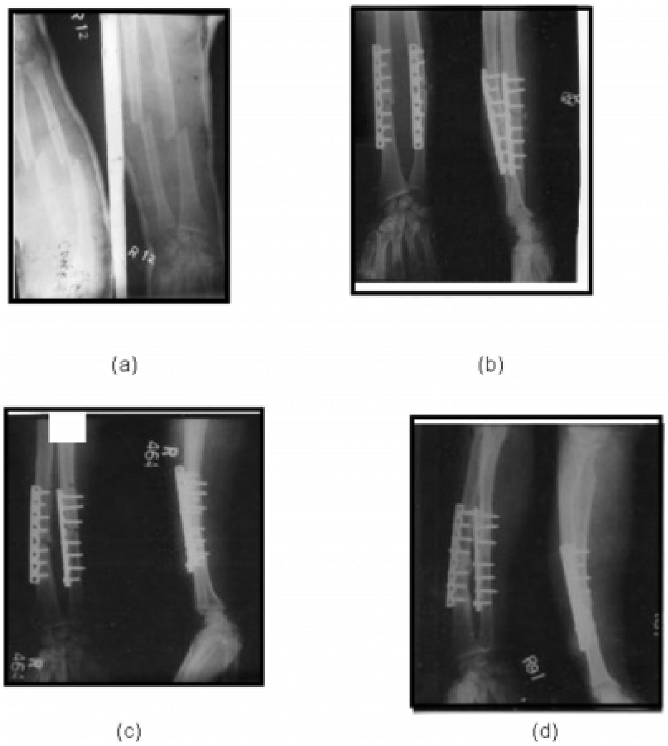
Outcome	Percentage
Excellent	16.7%
Satisfactory	73.3%
Unsatisfactory	10.0%
Failure	0.0%

DISCUSSION

Although there is no marked difference in the use of LCP as compared to conventional plating but LCP has a slight edge over the conventional plating (DCP and LCDCP). LCP is a stronger construct and by preventing primary and secondary loss of reduction it does not alter the natural course of healing of fracture, which is not possible with the use of DCP and LCDCP. Being a rigid construct, it allows early rehabilitation and thereby preventing secondary complications like elbow and wrist stiffness. LCP does not involve stripping of periosteum and cause minimal damage to soft tissues around fracture and thus by minimal disturbance of local biology of fracture it allows fracture healing to proceed its natural course. Also minimal soft tissue stripping decreases the incidence of infection. Because of locking screw heads in the holes of LCP, loosening of screws and failure of implant is markedly reduced.

Open reduction and internal fixation has been the standard treatment of forearm fractures. There have been numerous studies on conventional plating of diaphyseal forearm fractures. In 1972 Dodge and Cady (1) reported 84% union rate in forearm fractures using DCP, 5.1% infection rate with 78% satisfactory results. In 1975 Anderson et al reported 84% union rate, 2.9% infection rate with 85% satisfactory results (2). In 1980, Grace and Eversmann reported 80% satisfactory results. (3) In 1989, Ross et al reported 94.7% rate of union, 5.4% infection rate and 89% satisfactory results (4). Chapman et al reported an infection rate of 2.3%, 98% union rate with 92% satisfactory results. (5) The results of the present study are almost comparable to the above mentioned series. However fixation using an LCP is an effective treatment method in terms of union rate, pain and functional outcomes.

Figure 2



Radiographs of a 44 year old man showing (a) Simple Fracture of Both radius and ulna (b) Immediate post operative radiographs (c) Callus formation at 8 weeks (d) Union at 16 weeks.

There have been no randomized controlled trials till date comparing the efficacy of LCP and conventional plates (DCP & LCDCP). However Stevns et al in a comparative study between DCP and LCP in simple forearm fractures found that time to union depended not on the type of plate used, but on the application of inter fragmentary compression (6). Leung et al in a series of 45 forearm bone fractures concluded that LCP was an effective modality of treatment in comminuted and segmental forearm fractures, but the efficacy was similar to conventional plates in case of simple fractures (7).

Ling et al in their series of three radial and six ulnar non unions reported 100% union and satisfactory functional results (8). Snow et al conducted a biomechanical study in an osteoporotic bone model and found that LCP was superior to conventional plating when used as a bridging plate and tested in axial compression (9).

Although the combination of interfragmentary compression with a superimposed locking internal fixator can produce a very stable construct, though it may not be promoting spontaneous fracture healing including callus formation. In

LCP we can use variety of standard and locking head screws to achieve fixed angle construct but it results in difficulty in terms of clinical evaluation as the sequence and type of screw to be inserted varies from one case to another case. Mechanism of fracture healing varies according to the number of screws inserted, choices of standard or locking head screws and the manner in which the screws are inserted whether monocortical or bicortical. Roberts et al conducted a biomechanical study in a saw bone model and concluded that replacing a single set of unicortical locked screws with locked or unlocked bicortical screws distant from the fracture site improved torsional stability of the construct by more than 50%, giving stability equal to standard unlocked plating. Hybrid fixation with locked bicortical end screws had the best stability in AP bending ([10]).

CONCLUSION

It can be concluded that the superiority of LCP over conventional plating systems in the treatment of simple diaphyseal forearm fractures is yet to be proven but the LCP is an effective device for use as a bridging device in treatment of comminuted fractures, especially when the bone is osteoporotic.

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