ORIGINAL ARTICLE

Comparison of Fixation between Dynamic Compression Plate Vs Locking Compression Plate in Lower Limb Diaphyseal Fractures by Bridge Plating Technique

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ABSTRACT

Background: Orthopedic surgeons often encounter diaphyseal femur fractures. Malunion and nonunion are most frequent complications because difficulty in reducing and keeping up the one reduction. A dynamic compression plate (DCP) is a metallic plate utilized in orthopedics for internal fixation of bone, normally after fractures. The Synthes Locking Compression Plate (LCP) system is a part of a treated steel and titanium plate and screw framework that merges locking screw technology with customary plating procedures.
Aim: To compare the outcome of using dynamic compression plate versus locking compression plate in diaphyseal fractures of lower limb via bridge plating technique.
Study design*:* Randomized Controlled Trial.
Place and Study Duration*:* Department of Orthopaedic Surgery, at M. Islam Teaching Hospital Gujranwala covering the period from December 2018 to May 2019.
Methods: This randomized control trial was conducted after taking ethical approval from board of studies. Ninety two patients were enrolled in this study from OPD and emergency. The non-probability purposive sampling technique was used in this study to include the patients. Patients were divided into two groups by using lottery method. In a group A, dynamic compression plate (DCP) was applied and its results were compared with group B, locking compression plate (LCP) was applied.
Results: The mean age of the patients was 46.55±15.03 years, 73.91% patients were males and the male to female ratio was 2.8:1. Statistically there is significant difference was found between the weight bearing, callus formation, alignment and different complications post-operatively with DCP but LCP showed little better results than DCP.
Conclusion: LCP technique is more effective and feasible for the treatment of diaphyseal fractures of lower limb in comparison with DCP technique.
Keywords: Dynamic compression plate, Locking compression plate, Diaphyseal fractures lower limb

INTRODUCTION

Malunion and nonunion are more frequent because difficulty in reducing and keeping the reduction of bones in the presence of muscles that exert various deform forces over to the fractured bony fragments. Generally in adults open reduction and internal fixation is a best method of treatment for diaphyseal fracture, even though closed reduction may be achieved.[1] Treatment by closed reduction and cast immobilization usually results in a poor functional outcome caused by prolong bed rest, malunion, nonunion and joint stiffness. Various types of plates are available for ORIF using plate and screws. For so long the dynamic compression plate (DCP) remains the best quality level for internal fixation of diaphysial fractures of long bones.[2] Treatment of diaphyseal fractures of long bone by ORIF is a well-accepted system. In various fracture localizations, the utilization of connecting plate fixation with locking compression plates (LCP) has been shown to improve biomechanical and biological characteristics. Only very limited clinical information are accessible on bridging plate fixation utilizing LCPs for the treatment of diaphyseal long bone fractures.[3] Recently developed LCPs combine the properties of both locking plates (LPs) and DCPs. With their joined hole, an unlocked compression screw and a locking screw may be used[4].

LCPs have been shown to furnish a stronger fixation compared with DCPs in biomechanical studies[5]. LCPs may be utilizing a bridging plate procedure, permitting biological fixation for the management of comminuted fractures.[4] These benefits of LCP have been considered to accelerate fracture healing and reduce the problems of delayed union and nonunion.[5] However, LCPs have a few disadvantages, including troubles during removal and higher cost.[6] A predetermined number of studies compare LCPs and traditional plates and have reported similar outcomes with both implants in the management of diaphyseal long bone fractures. Despite the fact that LCPs have some theoretical advantages, the prevalence of the LCP over conventional plates remains to be proven[7,8].

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MATERIAL AND METHODS

After taking ethical approval from board of studies, 92 patients who fulfill the inclusion and exclusion criteria was enrolled in the study from OPD and emergency. Informed consent was obtained from each patient. All basic demographic information of patients was also noted. Patients were divided into two groups by using lottery

method. In a group A, patient was managed with dynamic compression plate (DCP) and its results were compared with group B, in which patient was managed with locking compression plate (LCP). All surgeries were done by a surgical team. Then patients were shifted in ward and were discharged on 2nd postoperative day and were followed on 10th day, 1 month, 2 month, 3 month and 6 months postoperatively. Success was labeled when there was complete callus formation after 6 months of operation on x-ray, alignment was also measured by using radiographs. Patients were assessed for weight bearing.

Patient was thoroughly assessed in emergency for any associated injuries. Preoperative roentgenograms were taken to access the fracture geometry in two planes. Routine investigations were carried out. All the patients were given broad spectrum antibiotics before procedure to minimize the chances of infection. Patients were prepared and procedure was carried out in general or spinal anesthesia. Operated limb was prepared according to standard antiseptic method by painting and draping. Then incision was given above and below the fracture site without opening the fracture site and disturbing the fracture hematoma. Fracture is aligned and DCP or LCP of appropriate size was slide over the bone bridging the fracture and was fixed with screws. Postoperatively limb was protected in splint for 3 to 4 weeks and biological healing by callus formation and alignment of lower limb diaphyseal fracture was studied by taking AP and Lateral roentgenograms. Patient ability to bear weight and any complication was assessed on regular follow up.

RESULTS

The mean age of the patients was 46.55±15.03 years between 18-70 years. Out of 92 patients 73.91% patients were males whereas 26.09% patients were females. The male to female ratio was 2.8:1. After 10 days, no patient in any group showed callus formation after 2 months, 28 in DCP group and 24 in LCP group showed callus formation after 2 months, 34 in DCP group and 38 in LCP group showed callus formation, after 3 months, 35 in DCP group and 40 in LCP group showed callus formation and after 6 months, 36 in DCP group and 42 in LCP group showed callus formation. There was insignificant difference observed on all follow-ups except at last follow-up. From 10 days till 3 months, all patients had proper alignment. After 6 months, 39 patients in DCP while 43 patients in LCP group showed proper alignment. The difference was insignificant on all follow-ups. After 10 days, no patients in both groups had infection, but after 1 month, 1 case in DCP group and 2 cases in LCP groups had infection. After 2 months, 2 case in DCP group and 4 cases in LCP groups had infection. After 3 months, 2 case in DCP group and 2 cases in LCP groups had infection. After 6 months, 4 case in DCP group and 6 cases in LCP groups had infection (Table 1).

After 10 days, all patients in both groups showed no weight bearing and the difference between both groups was insignificant. After 1 month, 18 patients in DCP group showed no weight bearing, 27 showed touchdown, 1 had partial weight bearing. In LCP group, 13 cases had no weight bearing, 30 showed touch down while 3 cases showed partial weight bearing.

Table 1: Comparison of outcome in both groups (n=92)

		Group		p-value
		DCP (n=46)	LCP (n=46)	
Callus formation after	10 days	0	0	>0.999
	1 month	28	24	0.2001
	2 months	34	38	0.1570
	3 months	35	40	0.0897
	6 months	36	42	0.0408
Alignment after	10 days	46	46	>0.999
	1 month	46	46	>0.999
	2 months	46	46	>0.999
	3 months	46	46	>0.999
	6 months	39	43	0.1570
Infection After	10 days	0	0	>0.999
	1 month	1	2	0.2786
	2 months	2	4	0.1992
	3 months	2	2	>0.999
	6 months	4	6	0.2515

Table2: Comparison of weight bearing in both groups (n=92)

		Group		Total
		DCP	LCP	
Weight bearing at day 10	No	46	46	92
	Touch down	0	0	0
	Partial	0	0	0
	As tolerated	0	0	0
	Full	0	0	0
Weight bearing at 1 month	No	18	13	31
	Touch down	27	30	57
	Partial	1	3	4
	As tolerated	0	0	0
	Full	0	0	0
Weight bearing at 2 month	No	12	6	18
	Touch down	13	10	23
	Partial	18	26	44
	As tolerated	3	4	7
	Full	0	0	0
Weight bearing at 3 month	No	6	2	8
	Touch down	4	1	5
	Partial	14	4	18
	As tolerated	15	25	40
	Full	7	14	21
Weight bearing at 6 month	No	3	0	3
	Touch down	4	3	7
	Partial	8	4	12
	As tolerated	7	7	14
	Full	24	32	56

After 2 months, 12 patients in DCP group showed no weight bearing, 13 showed touchdown, 18 had partial weight bearing and 3 showed weight bearing as tolerated. In LCP group, 6 cases had no weight bearing, 10 showed touchdown while 26 cases showed partial weight bearing and 4 showed weight bearing as tolerated. After 3 months, 6 patients in DCP group showed no weight bearing, 4 showed touchdown, 14 had partial weight bearing, 15 showed weight bearing as tolerated and 7 had full weight bearing. In LCP group, 2 cases had no weight bearing, 1 had touchdown while 4 cases showed partial weight bearing, 25 showed weight bearing as tolerated and 14 had full weight bearing. After 6 months, 3 patients in DCP group showed no weight bearing, 4 showed touchdown, 8 had partial weight bearing, 7 showed weight bearing as tolerated and 24 had full weight bearing. In LCP group, 3

had touchdown, 4 cases showed partial weight bearing, 7 showed weight bearing as tolerated and 32 had full weight bearing. The difference was insignificant between both groups (Table 2).

Table3: Comparison of complication in both groups (n=92)

		Group		Total
		DCP	LCP	
Complications after 10 days	Implant Fracture	0	0	0
	Infection	0	0	0
	Mal-alignment	0	0	0
	Delayed union	0	0	0
	Non-union	0	0	0
	No	46	46	92
Complications after 1 month	Implant Fracture	0	0	NA
	Infection	1	2	0.5437
	Mal-alignment	0	0	NA
	Delayed union	0	0	NA
	Non-union	0	0	NA
	No	45	44	>0.999
Complications after 2 months	Implant Fracture	0	0	NA
	Infection	3	4	0.6693
	Mal-alignment	0	0	NA
	Delayed union	0	0	NA
	Non-union	0	0	NA
	No	43	42	>0.999
Complications after 3 months	Implant Fracture	0	0	NA
	Infection	3	2	0.6262
	Mal-alignment	0	0	NA
	Delayed union	0	0	NA
	Non-union	0	0	NA
	No	43	44	>0.999
Complications after 6 months	Implant Fracture	8	4	0.2160
	Infection	4	6	0.5029
	Mal-alignment	3	3	>0.999
	Delayed union	4	3	0.6942
	Non-union	3	2	0.6456

After 10 days, in both groups, no patient showed any post-operative complication, and the difference between both groups was insignificant. After 1 month, in infection was observed in 1 case of DCP while 2 cases of LCP group and the difference between both groups were insignificant. After 2 months, in infection was observed in 3 case of DCP while 4 cases of LCP group and the difference between both groups were insignificant. After 3 months, in infection was observed in 3 cases of DCP while 2 cases of LCP group and the difference between both groups was insignificant. After 6 months, implant failure was observed in 8 DCP cases while 4 LCP cases, in infection was observed in 4 cases of DCP while 6 cases of LCP group, mal-alignment was observed in 3 DCP and 3 LCP cases, delayed union in 4 DCP cases and 3 LCP cases while non-union was observed in 3 DCP cases and 2 LCP cases. The difference between both groups was insignificant (Table 3).

DISCUSSION

The primary locking plates were displayed around last two decades for use in spinal and maxillofacial surgery.[9-10] In the late 1980s and into the 1990s, experimentation with various sorts of internal fixation devices provoked the improvement of locking plates for fracture treatment.[11,12] In North America for general orthopedic applications just in the last 6 or 7 years have been accessible.[9,13] Displaced diaphyseal fractures of the forearm happen from high-energy trauma and may outcome in extreme loss of capacity except adequately treated. ORIF with DCP has been acknowledged as the best technique for treatment for these fractures[14].

In our study results the LCP group patients showed less complications in comparison with DCP group patients at different interval of months either that were related to weight bearing, alignment or callus formation. Statistically there is insignificant difference was found between the callus formation, alignment and different complications with study groups of the patients i.e. p >0.05. But still LCP had less number of complications as compared to DCP. Various researchers have noted union rates of 91-98% in A-type forearm fractures with DC plates which is accordance with our results.[15-16] Some studies showed the strength of a system may be compromised, particularly in cases of low bone quality just like the circumstance in osteoporotic fractures. In this sense, the logical literature has demonstrated the achievement of the LCP framework with locking screws and the failure of the DCP framework[17,18,19,20].

In a progression of 36 patients of long bone diaphyseal fractures, Saikia et al., thought about LCPs and DCPs (18 patients in each group). Total patients achieved union, which happened at an average of 16 weeks in LCP group and 14 weeks in DCP group. One case of deferred association happened in the DCP gathering and 1 instance of osteomyelitis happened in LCP group. The creators presumed that the LCP and LC-DCP gave comparative results[8]. Demirhan et al reasoned that the locking plate is altogether more steady than DCP and Ex-fix under torsional and bowing cyclic stacking in a dislodged break clavicle model. The mean disappointment minutes (Nmm) for bending were 7671.7 (LCP), 4370.3 (DCP) and 2999.7 (Ex-fix). The mean initial stiffness (Nmm) for bending were 32.6 (LCP), 23.4 (DCP) and 20.6. Mean failure loads for bowing were 213.2 (LCP), 131.1 (DCP) and 102.7.[21] In a study success rate of LCP (n=19) for treatment of long bone fracture was 15 (79%) while with DCP (n=6) was 4 (67%) cases. The difference was significant (p 0.003)[22].

Another study also reported that success rate of LCP (n=20) for management of long bone fracture was 10 (50%) while with DCP (n=20) was 5 (25%) cases. The difference was significant (p<0.05).[23] CT Stevens et al demonstrated that in their study no neurological or vascular injury was seen previously or after operation, no infection and non-unions were seen. In LCP group mean time to bony union was 33 weeks (11-72, SD:24), though in DC plate group it was 22 weeks (extend: 9-63, SD:15.8).[24] Saikia et al noted excellent function results of 32 patients (89%), satisfactory result in 3 patients (8%) and unacceptable result in 1% tolerant (3%) with no failure.[25] In Marya et al, reported the restricted contact dynamic compression plate for adult forearm fracture in 88% cases, good 7% cases, unsatisfactory 4% cases and failure in 1%[25]. Verset et al concluded that locking screws had no statistically impact on

the mechanical properties of LCP-plated bones in 4 point bending and torsion, contrasted to standard screws.[27] While in Raj demonstrated the normal age of patient in LCP group was 32.55±11.50 years from 18–64 years and in LC-DCP group, average age was 33.40±11.92 years between 18-60 years.23 Leung et al, the mean age was 35 years[28] and Sharma et al where the mean age was 34 years[26]. The findings from Saika et al demonstrated that males established (70%) and female (30%).[25] Manjappa et al reported 75% were male and 25% were females. While Sharma et al reported 24 patients were males in both group including 60% with male to female ratio being 1.5:1[26].

CONCLUSION

According to our study results we concluded that LCP is more effective and feasible for the treatment of diaphyseal fractures of lower limb in comparison with DCP when applied by bridge plating technique. Our study results showed statistically significant results between both the groups i.e. p value 0.001.

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