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Research Article

The Efficiency of Locking Compression Plates versus Dynamic Compression Plates in the Treatment of Low Distal Fibula Fracture: A Randomized Clinical Trial

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Abstract

Background: Uncertainties remain as to which type of plate [locking compression plate (LCP) or dynamic compression plate (DCP)] is more efficient and cost-effective in fixing and stabilizing the fractures. We aimed to compare the clinical utility of the two types of plates including LCPs and 3.5-mm DCPs in the treatment of low distal fibula fracture (distal lateral malleolus fractures).
Methods: This randomized single-blinded clinical trial was performed on 54 patients with distal fibula fractures who were candidates for surgical treatment using compression plate fixation. The patients were randomly assigned into two groups scheduled for treatment with fixation of LCPs or with 3.5-mm T-plates (DCPs). The patients were finally followed-up for two years to assess the clinical outcome of the procedures.
Results: No difference was revealed between the two groups in the prevalence of postoperative infection, nonunion, wound dehiscence, skin reactions, and local surgical pain. The mean functional score [Olerud-Molander Ankle Score (OMAS)] in the DCP and LCP groups was 85.33 ± 4.92 and 84.85 ± 5.12, respectively, indicating no difference between the groups (P = 0.726).
Conclusion: In the treatment of low distal fibula fractures, the use of LCPs and 3.5mm DCPs can similarly result in improving functional status with minimal postoperative complications. Due to the similarity of the consequences of using both plates and the fact that the DCP type is more cost-effective and available in remote and deprived areas, this type seems to be preferred.

Keywords: Fibula; Fracture Fixation; Clinical Trial

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Background

About 15% of body weight is tolerated by fibula (1). Since Percival Pott in 1768 described the various aspects of ankle fractures, numerous cases of this type of fracture and its surgical treatment protocols have been presented (2). This type of fracture has been compromised about nine percent of all orthopedic fractures and about up to 20% to 25% of all lower extremity fractures in the world (3, 4). Due to the development of osteoporosis and advancing the age of affected patients as well as traumatic events, the prevalence of this fracture has been raising (5). According to recent literature, isolated distal fibular or lateral malleolus fractures occurred in two-thirds of patients that almost all needed surgical therapeutic approaches (6). The main goal of the treatment in these types of fracture is to reduce displaced fractures along with maintaining anatomic alignment of the ankle mortise and limb rotation and achieving bony union followed by weight bearing and physiotherapy (7).

Besides, an unstable fracture requires mostly open reduction and internal fixation (ORIF) approach by using compression screws and a neutralization plate. In osteoporotic bones, using precontoured locking plates can help to improve fixation, but the application of lateral plating may result in some potential complications such as infection around the distal fibula, posttraumatic osteoarthritis, malunion, and wound dehiscence (8-10). ORIF is a satisfying surgical option for ankle fractures (11). Studies have shown a low rate of complications and a good union rate when using a plate for distal fibular fixation (12). Nowadays by developing minimally invasive techniques, the use of locking compression plates (LCPs) helps to stabilize the fracture zone and also minimize surgical complications (13); however, sometimes the cost of using this type of plate is high and also it is not available in deprived and remote areas. Recently, special attention has been paid to the use of plate types leading to more rigidity of fixation, early limb mobilization, better maintenance of reduction, and ultimately accelerating bone-healing phase. In this regard, the use of T-plates or dynamic compression plates (DCPs) seems to be a step forward in this direction (14); T-plates are also less expensive and more available than LCPs. However, there is little evidence of its benefits compared to conventional plates. In the present trial, we aimed to compare the clinical utility of the two types of plates including LCPs and 3.5mm DCPs in the treatment of low distal fibula fracture (distal lateral malleolus fractures).

Methods

In this study, the fracture was so distal that it was not possible to insert three screws distally with the usual plates (the fracture was in the joint line area and distal to

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it). Patients with type A and B fractures based on Weber classification (the Danis-Weber classification is a method for classifying ankle fractures; type A: distal to syndesmosis, type B: at the level of syndesmosis, type C: proximal to the syndesmosis) were selected. The exclusion criteria were the presence of bilateral fractures, lack of the ability to ambulate without assistance before injury, or history of osteoarthritis before operation. The patients over the age of 55 were excluded to control for the osteoporosis effect.. All subjects gave written informed consent before participation in the study and the study details were ethically approved by the Ethical Committee at the Shahid Beheshti University of Medical Sciences, Tehran, Iran. Patients were completely unaware of the technique used. Using the computerized random number table, the patients were assigned into two groups scheduling for treatment with fixation of LCPs or with 3.5-mm T-plates (DCPs). All the surgeries were performed by the same surgical team in the same laminar air flow operating room. Patients were given 1 gram of cefazolin intravenously within 30 minutes prior to skin incision, and general anesthesia was administered in all cases with a similar protocol (Figures 1, 2).

Figure 1. A 15-year-old boy with a motor-car accident and bimalleolar fracture

The patients were finally followed-up for two years to assess the clinical outcome of the procedures with respect to 1) postsurgical complications including infection, nonunion, wound dehiscence, skin reactions, and local surgical pain and 2) the functional state of ankle using the Olerud-Molander Ankle Scoring (OMAS) system. This is a functional rating scale including nine different items of pain, stiffness, swelling, stair climbing, running, jumping, squatting, supports, and activities of daily living that the total score ranges from 0 (totally impaired) to 100 (completely unimpaired). The researcher who was investigating the above items in the follow-up was not aware of the type of applied plates, so that the study was done as a single-blinded study.

Figure 2. A 17-year-old boy with a motor-car accident and distal tibiofibular fracture

For statistical analysis, results were presented as mean ± standard deviation (SD) for quantitative variables and were summarized by frequency (percentage) for categorical variables. Continuous variables were compared using t-test or Mann-Whitney test whenever the data did not appear to have normal distribution or when the assumption of equal variances was violated across the study groups. If required, the categorical items were compared using chi-square test or Fisher's exact test. P-values ≤ 0.05 were considered statistically significant. For the statistical analysis, the SPSS statistical software (version 23.0, IBM Corporation, Armonk, NY, USA) was used.

Results

This randomized single-blinded clinical trial was performed on 54 patients with distal fibula fractures that referred to our hospital in 2022 and were candidates for surgical treatment using compression plate fixation. Two people from anatomical plate group and one person from T-plate group were removed from the follow-up due to lack of cooperation. In total, 51 patients were included into the study and randomly planned to receive LCPs (n = 25) or DCPs (n = 26). Of these patients, 45 had simultaneous medial malleolus fracture. The DCP and LCP groups were matched for male gender (59.3% versus 63.0%, P = 0.780) and average age (35.11 ± 11.81 years versus 33.15 ± 10.26 years, P = 0.517). Regarding the postoperative complications (Table 1), no difference was revealed between the two groups in the prevalence of infection, nonunion, wound dehiscence, skin reactions, and local surgical pain.

Table 1. Post-surgical complications in the two dynamic compression plate (DCP) and locking compression plate (LCP) techniques

Item	DCP group (n = 26) [n (%)]	LCP group (n = 25) [n (%)]	P-value
Infection	1 (3.7)	1 (3.7)	> 0.999
Wound dehiscence	4 (14.7)	2 (7.4)	0.669
Local pain	7 (25.9)	6 (22.2)	0.750
Skin reaction	1 (3.7)	5 (18.5)	0.192
Nonunion	0 (0)	1 (3.7)	0.999

DCP: Dynamic compression plate; LCP: Locking compression plate

The mean OMAS score in the DCP and LCP groups was 85.33 ± 4.92 and 84.85 ± 5.12, respectively, indicating no difference between the groups (P = 0.726). According to the multivariate linear regression modeling (Table 2) and with the presence of age and sex variables, no difference was ultimately found between the use of DCPs and LCPs in functional status based on the OMAS score.

Table 2. The multivariate linear regression analysis in determining the difference between dynamic compression plate (DCP) and locking compression plate (LCP) techniques regarding functional score [Olerud-Molander Ankle Score (OMAS)]

Item	Unstandardized coefficients		P-value	95% CI for beta	
	Beta	SE		Lower bound	Upper bound
Group	-0.729	1.347	0.591	-3.435	1.976
Gender	-1.099	1.397	0.435	-3.904	1.706
Age	-0.106	0.063	0.098	-0.231	0.020

CI: Confidence interval; SE: Standard error

Discussion

The locking plate can be applied in various ways, commonly as a compression plate for fracture fixation of the lateral malleolus of the ankle. In this regard, assessing the early and long-term outcomes of this procedure has shown it to be acceptable with minimized complications. In fact, employing treatment with fixation of LCPs could lead to high radiographic bone union rate of fibula, improving patients' long-term quality of life, rapid

resolution of pain and tenderness at the fracture site as well as low complications (15). Moreover, comparing locking to non-lacking plates concerning post-procedural consequences could result in similar outcomes. In a randomized clinical trial conducted by Koshimune et al. treatment using locking and non-lacking plates led to similar outcomes regarding bone union rate, range of motion, and complications (16).

Takemoto et al. also assessed biomechanical parameters in the locking and non-locking plate techniques and found similar procedural outcomes (17). Similarly, Schepers et al. showed similar postoperative outcomes regarding wound complications after the two pointed techniques (18). In a recent review of the literature conducted by Hasami et al. on 11 studies, it was finally concluded that using two locking and non-lacking plates could result in similar functional outcomes (19).

However, researchers are always looking for techniques that, in addition to being as effective as conventional methods, are also more cost-effective. In this regard and in the field of surgical treatment of malleolus fractures and using new plates, DCPs were introduced, leading to same efficacy compared to locking techniques but with more cost-effectiveness. As indicated in the present study and with the aim of achieving minimized postoperative complications along with proper functional state, LCPs and DCPs were found to be completely comparable. DCPs use friction generated by screws to compress the plate to the bone, acting as a conduit to transfer loads between the bone ends. Recent researches expressed that choosing appropriate plates for such fractures should be based on the nature and mechanism of bone fracturing as well as the nature of fractured bone such as the osteoporotic status. It has been shown by MacLeod et al. that DCPs were inferior to LCPs in osteoporotic bone. In their description, the DCPs produce much larger strains in osteoporotic bone as compared to LCPs and thus, locking plates are superior to dynamic compression types in poorer bone quality state (20). Contrarily, in another experiment by Manoharan et al. DCP conferred the best stability in lateral bending and torsion as compared to locking types for fixation of distal fibula oblique fracture (21). However, according to our study and in non-osteoporotic bones, DCPs are as effective as LCPs in stabilizing and fixing distal lateral malleolus fractures.

Conclusion

It can be finally concluded that in the treatment of low distal fibula fractures, the use of LCPs and 3.5 mm DCPs can similarly result in improving functional status based on the OMAS score with minimal postoperative complications. Due to the similarity of the consequences of using both plates and the fact that the DCP type is more cost-effective and available in remote and deprived areas, this type seems to be preferred. In order to achieve more reliable results concerning the efficiency of both types of plates, especially the DCP type in fracture fixation, it is necessary to evaluate its efficiency at older ages (osteoporotic status) and in the types of non-traumatic and pathological fractures.

Conflict of Interest

The authors declare no conflict of interest in this study.

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