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Original Research Article

A Hospital-Based Assessment of Locked Versus Non-Locked Plating of Distal Fibula Fractures: An Observational Study

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Abstract

Aim: The aim of the present was to compare the locked versus non-locked Plating of distal fibula fractures.

Methods: The present study was conducted in the Department of Orthopaedics, ESICMCH, Bihta, Bihar, India and reviewed a consecutive cohort of patients admitted within the 24-month period for fixation of closed malleolar fractures of the ankle. 200 patients with ankle fractures underwent surgical fixation with a distal fibular plate.

Results: Of the 200 patients, 120 (60%) received an STP, 30 (15%) an LC-DCP, and 50 (25%) an LCP-F. The mean interval to full weightbearing was 6.9 weeks for the STP group, 7.2 weeks for the LC-DCP group, and 7.6 weeks for the LCP-F group. Of the 200 patients, 8 had wound issues, 4 patients returned to the operating room for wound washout, and 12 required antibiotics.

Conclusion: In conclusion, bone-specific LCP-Fs add to the portfolio of implants available. They provide rigid fixation with a stable construct and thus are particularly attractive for multifragmentary fractures and patients with poor bone quality. Their unit cost is significantly greater than that of STPs and LC-DCPs but they provide a satisfactory alter- native for those patients in whom and fracture patterns in which fixation is more likely to fail using non-locking techniques.

Keywords: ankle fracture, complications, locking plate trauma

Introduction

Less compression of the periosteum is an advantage of a locking plate. [1-3] A non-locking conventional plate obtains the fixation stability by the frictional force between the plate and bone.[1] This compression could cause disturbances in blood supply to the bone and introduce an unfavourable condition for bone union. Therefore, the reduction of periosteal compression may improve the rate of bone union. Although many types of plates were developed, which do not interfere with the cortical blood flow, no clinical effectiveness of these plates has been clearly proven. [4-6]

The locking plate can be used in various ways; it may serve as a bridging plate, a compression plate, a tension band plate or a neutralization plate. [7-11] The use of a locking plate as a neutralization device for lag screw fracture fixation is one of the most important techniques for locking plate. [7] Most displaced fractures of the lateral malleolus of ankle must be treated by anatomical reduction with absolute stability, and the fixation using a lag screw and neutralization plate is frequently performed.

In recent years, it has been pointed out that most of the comminuted fractures of distal fibula were caused by high-energy impact of pronation abduction. Moreover, high non-union rate of comminuted distal fibular fractures requires internal fixation for complete reduction. [12,13] To achieve a complete reduction in the comminuted fibula fractures, it is necessary to calibrate the length and rotation angle of the fibula. Clinically, common bone screws cannot fix the comminuted fractures of distal fibula, so it is imperative to discover a suitable treatment to cope with the difficult reduction.

Anatomical plate is a common material for fixation of fibular fractures. In terms of its mechanism of

action, the fracture site is compressed and fixed by the friction force generated when the bone surface is in close contact with anatomical plate so that the bone morphology is stably attached. [14] The double-hooked locking plate is a special deformation at the distal end of the locking plate. Owing to the double-hooked shape, the distal fibula fracture fragment can be pulled back for reduction. Moreover, the combination of the double-hooked locking plate and locking screws allows a firmer fixing of fibula fragments. Currently, double-hooked locking plates have been applied in external ankle fractures and achieved good clinical effect. [15,16]

The aim of the present was to compare the locked versus non-locked Plating of distal fibula fractures.

Materials and Methods

The present study was conducted in the Department of Orthopaedics, ESICMCH, Bihta, Bihar, India and reviewed a consecutive cohort of patients admitted within the 24-month period for fixation of closed malleolar fractures of the ankle. 200 patients with ankle fractures underwent surgical fixation with a distal fibular plate. Open ankle fractures, pilon fractures, injuries treated with an external fixator, fractures treated with syndesmotic screws only, and isolated medial malleolar fractures were excluded. Complications, including reoperation and subsequent removal of hardware, were recorded from the clinical data for the next 2 years.

Operative Technique

All patients received antibiotic prophylaxis with a single dose of a second-generation cephalosporin unless allergic to penicillin, in which case they received teicoplanin according to the hospital protocol. The choice of implant and use of lag screws was left to the discretion of the operating surgeon. The implants available during the study period were a one-third semi tubular plate (STP), a 3.5-mm limited-contact dynamic compression plate (LC-DCP), and a 2.7-mm/3.5-mm locking compression distal fibula plate (LCP-F). All 3 plates were manufactured by DePuy Synthes (West Chester, PA). Drains were not routinely used. All patients received low-molecular-weight heparin as thromboprophylaxis from 6 hours postoperatively for the duration of plaster cast immobilization. Radiographs were obtained at 6 weeks postoperatively and at further follow-up examinations, if deemed necessary, until clinical and radiographic union were achieved.

Analysis of Findings

Statistical analysis was performed using SPSS, version 22 (IBM, Armonk, NY). Data were tested for normality using a Kolmogorov-Smirnov test. The results were considered statistically significant at $p \leq .05$.

Results

Table 1: Patent and clinical characteristics

Characteristics	Semi tubular Plate (n = 120)	Limited-Contact Dynamic Compression Plate (n = 30)	Locking Compression Distal Fibula Plate (n = 50)
Age (y) Mean ± SD	40 ± 15.5	39 ± 16.4	58 ± 15.5
Gender Male	64	18	21
Female	56	12	29
Diabetes mellitus	2	0	7
Fracture type			
Lateral malleolus	48	8	7
Bimalleolar	54	16	24
Trimalleolar Weber A	18 1	6 0 (0.0)	19 0 (0.0)
Weber B	100	12	48
Weber C	19	18	2
Lag screw fixation	108	15	24

Of the 200 patients, 120 (60%) received an STP, 30 (15%) an LC-DCP, and 50 (25%) an LCP-F.

Table 2: Outcome measures

Outcomes	Semi tubular Plate (n = 120)	Limited-Contact Dynamic Compression Plate (n = 30)	Locking Compression Distal Fibula Plate (n = 50)
Radiographic union (wk)			
Mean	15.3	15.5	14.4
Median	12.0	12.0	12.0
95% CI	12.0 to 16.5	11.9 to 21.4	11.4 to 17.1
Full weight bearing (wk)			
Mean	6.9	7.2	7.6
Median	6.0	6.0	7.5
95% CI	6.5 to 7.4	6.3 to 8.1	6.6 to 8.5

The mean interval to full weightbearing was 6.9 weeks for the STP group, 7.2 weeks for the LC-DCP group, and 7.6 weeks for the LCP-F group.

Table 3: Complications and reoperations

Variables	Semi tubular Plate (n = 120)	Limited-Contact Dynamic Compression Plate (n = 30)	Locking Compression Distal Fibula Plate (n = 50)
Complications			
None identified	112	27	44
Infection requiring washout	3	1	2
Superficial infection requiring antibiotics	5	3	4
Wound issues not requiring antibiotics	7	0	1
Reoperation			
Washout with or without removal of metalwork	2	1	1
Planned removal of syndesmosis screw	6	2	0
Removal of symptomatic	15	3	1
metalwork Revision	5	0	2

Of the 200 patients, 8 had wound issues, 4 patients returned to the operating room for wound washout, and 12 required antibiotics.

Discussion

Ankle malleolar fractures are common injuries, constituting approximately 9% of all fractures. [17] With the incidence and severity of ankle fractures in the elderly population increasing, osteoporosis could increase the level of difficulty involved with surgical management of ankle fractures. [18-20]

The technique of surgical fixation used can be influenced by the fracture pattern, soft tissue injury, and bone quality. Conventional fracture plating systems depend on adequate bone quality to achieve sound fixation and maintain construct stability. Loosening or toggling of screws as a result of poor fixation, with resulting loss of friction between the plate and bone, can lead to failure of fixation.[20] Fixed- angle locking plates are useful with poor bone quality because they do not rely on screw–plate friction: rather, the threaded screw head locks into a threaded plate aperture. Precontoured plates also facilitate fixation, placement, and accuracy. [21] However, locking plates can have greater rigidity compared with conventional plates, which can impair fracture healing. [22] Of the 200 patients, 120 (60%) received an STP, 30 (15%) an LC-DCP, and 50 (25%) an LCP-F. The mean interval to full weightbearing was 6.9 weeks for the STP group, 7.2 weeks for the LC-DCP group, and 7.6 weeks for the LCP-F group. Of the 200 patients, 8 had wound issues, 4 patients returned to the operating room for wound washout, and 12 required antibiotics.

Biomechanical studies conducted on cadavers have shown that con- toured locking plates for distal fibular fractures in osteoporotic bone have greater torque and angle at failure compared with convention- al plates. [23] It was also found that a locking plate construct with 2 distal unicortical screws was mechanically equivalent to a standard plate with 3 distal screws in cadavers. [24] These biomechanical studies have shown that although fixation with standard plates is dependent on bone

mineral density, the locking plate is not, with the implication that these plates will be advantageous in osteoporotic bone. However, in patients with normal bone mineral density and no fracture comminution, locking plates do not offer a mechanical advantage compared with the nonlocking alternatives. [25]

Schepers et al [26], in a retrospective study of 165 patients, found increased wound complications in distal fibular fractures treated with locking compression plate compared with semi tubular plates and cautioned against their use. Although no difference was found between their groups in terms of removal of hardware, their overall wound complication rate was 17.5% with locking plates compared with 5.5% with semi tubular plates. Tsukada et al [27] conducted a randomized controlled trial of 52 patients and found no difference in complication rates or the time to radiographic bone union between locking and nonlocking plates; a finding also supported by our study. The LCP-F implant is more expensive (~£500) than a standard fibula fixation construct. However, this should be balanced against the cost of further intervention for patients in whom osteoporotic bone or un- stable fractures could be expected to increase the risk of displacement requiring further surgery. [28]

Conclusion

In conclusion, bone-specific LCP-Fs add to the portfolio of implants available. They provide rigid fixation with a stable construct and thus are particularly attractive for multifragmentary fractures and patients with poor bone quality. Their unit cost is significantly greater than that of STPs and LC-DCPs but they provide a satisfactory alter- native for those patients in whom and fracture patterns in which fixation is more likely to fail using non-locking techniques.

References

1. Wagner M. General principles for the clinical use of the LCP. Injury. 2003 Nov 1;34:B31-42.
2. Perren SM. Evolution of the internal fixation of long bone fractures: the scientific basis of biological internal fixation: choosing a new balance between stability and biology. The Journal of Bone & Joint Surgery British Volume. 2002 Nov 1;84(8):1093-110.
3. Jöckel JA, Erhardt J, Vincenti M, Reissig J, Hoffmann R, Husain B, Täger G, Partenheimer A, Lill H, Gebhard F, Röderer G. Minimally invasive and open surgical treatment of proximal tibia fractures using a polyaxial locking plate system: a prospective multi-centre study. International orthopaedics. 2013 Apr;37:701-8.
4. Uhthoff HK, Poitras P, Backman DS. Internal plate fixation of fractures: short history and recent developments. Journal of Orthopaedic Science. 2006 Mar;11:118-26.
5. Leung F, Chow SP. A prospective, randomized trial comparing the limited contact dynamic compression plate with the point contact fixator for forearm fractures. JBJS. 2003 Dec 1;85(12):2343-8.
6. Koshimune M, Kamano M, Takamatsu K, Ohashi H. A randomized comparison of locking and non-locking palmar plating for unstable Colles' fractures in the elderly. Journal of Hand Surgery. 2005 Oct;30(5):499-503.
7. Smith WR, Ziran BH, Anglen JO, Stahel PF. Locking plates: tips and tricks. JBJS. 2007 Oct 1;89(10):2298-307.
8. Fridberg M, Ban I, Issa Z, Krasheninnikoff M, Troelsen A. Locking plate osteosynthesis of clavicle fractures: complication and reoperation rates in one hundred and five consecutive cases. International orthopaedics. 2013 Apr;37:689-92.
9. Joeris A, Audigé L, Ziebarth K, Slongo T. The locking compression paediatric hip plate™: technical guide and critical analysis. Intern ational orthopaedics. 2012 Nov;36:2299-306.
10. Nikolaou VS, Tan HB, Haidukewych G, Kanakaris N, Giannoudis PV. Proximal tibial fractures: early experience using polyaxial locking-plate technology. International Orthopaedics. 2011 Aug;35:1215-21.
11. Gupta RK, Rohilla RK, Sangwan K, Singh V, Walia S. Locking plate fixation in distal metaphyseal tibial fractures: series of 79 patients. International orthopaedics. 2010 Dec; 34:1285-90.
12. Park YU, Kim SJ, Kim HN. Minimally invasive plate osteosynthesis using the oblong hole of a locking plate for comminuted distal fibular fractures. J Orthop Surg Res. 2021;16 (1):281.
13. Gu W, Shi Z, Mei G, Xue J, Zou J. Dual plating fixation for distal fibular comminuted fractures. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi. 2014;28:56–9 (Chinese).
14. Mai HQ. Open reduction and internal fixation of distal tibia with anatomical plate for Pilon fracture of tibia. J Pract Med. 2014;30:2256–7.
15. Ma ZF, Feng GY, Qi M. Treatment of Danis-Weber A, B external ankle fractures by internal fixation of distal fibular double hook locking plate. Chin J Bone Jt Injury. 2021;36:579–82.
16. Zhenhua F, Waizy H, Ming X, Wusheng K. Lateral malleolus hook plate for comminuted Weber A and B fractures: as retrospective study. Indian J Orthop. 2013;47:364–9.
17. Court-Brown CM, Caesar B. Epidemiology of adult fractures: a review. Injury. 2006 Aug 1; 3 7(8):691-7.
18. Strauss EJ, Egol KA. The management of ankle fractures in the elderly. Injury. 2007 Sep 1;38(3):2-9.

19. Zahn RK, Jakubietz M, Frey S, Doht S, Sauer A, Meffert RH. A locking contoured plate for distal fibular fractures: mechanical evaluation in an osteoporotic bone model using screws of different length. Journal of applied biomechanics. 2014 Feb 1;30(1):50-7.
20. Sommer C, Gautier E, Müller M, Helfet DL, Wagner M. First clinical results of the Locking Compression Plate (LCP). Injury. 2003 Nov 1; 34:B43-54.
21. Perren SM. Evolution of the internal fixation of long bone fractures: the scientific basis of biological internal fixation: choosing a new balance between stability and biology. The Journal of Bone & Joint Surgery British Volume. 2002 Nov 1;84(8):1093-110.
22. Dial DM, Ryan M. Locking plate technology and its use in foot and ankle surgery. Clinics in Podiatric Medicine and Surgery. 2011 Oct 1;28 (4):619-31.
23. Zahn RK, Frey S, Jakubietz RG, Jakubietz MG, Doht S, Schneider P, Waschke J, Meffert RH. A contoured locking plate for distal fibular fractures in osteoporotic bone: a biomechanical cadaver study. Injury. 2012 Jun 1;43(6):718-25.
24. Kim T, Ayturk UM, Haskell A, Miclau T, Puttlitz CM. Fixation of osteoporotic distal fibula fractures: a biomechanical comparison of locking versus conventional plates. The Journal of foot and ankle surgery. 2007 Jan 1; 46(1):2-6.
25. Nguyentat A, Camisa W, Patel S, Lagaay P. A biomechanical comparison of locking versus conventional plate fixation for distal fibula fractures in trimalleolar ankle injuries. The Journal of Foot and Ankle Surgery. 2016 Jan 1;55(1):132-5.
26. Schepers T, Van Lieshout EM, De Vries MR, Van der Elst M. Increased rates of wound complications with locking plates in distal fibular fractures. Injury. 2011 Oct 1;42(10):11 25-9.
27. Tsukada S, Otsuji M, Shiozaki A, Yamamoto A, Komatsu S, Yoshimura H, Ikeda H, Hoshino A. Locking versus non-locking neutralization plates for treatment of lateral malleolar fractures: a randomized controlled trial. International orthopaedics. 2013 Dec;37: 2451-6.
28. Murray AM, McDonald SE, Archbold P, Crealey GE. Cost description of inpatient treatment for ankle fracture. Injury. 2011 Nov 1;42(11):1226-9.