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Original Research

Comparison of Locking Versus Nonlocking Plates for Distal Fibula Fractures

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ABSTRACT

Locking plates might offer a biomechanical fixation advantage for distal fibula fractures with comminution or osteoporotic bone. In January 2011, our unit introduced a bone-specific locking plate for the distal fibula. The aim of the present study was to compare it against more conventional plating system implants for lateral malleolar fixation in terms of outcomes, crude costs, and complications. We retrospectively reviewed a consecutive cohort of patients with closed ankle fractures who presented within a 24-month period. The clinical and radiographic outcomes were compared among conventional plating using a one-third semitubular plate, a 3.5-mm limited-contact dynamic compression plate, and a 2.7-mm/3.5-mm locking compression distal fibula plate. A total of 145 patients with ankle fractures underwent surgical fixation: 87 (60.0%) with the semitubular plate, 22 (15.2%) with the limited-contact dynamic compression plate, and 36 (24.8%) with the locking compression distal fibula plate. A greater proportion of patients with established osteoporosis or osteoporosis risk factors were in the locking compression distal fibula plate group (27.8% versus 2.3% and 0%). Four patients (2.8%) required washout for infection. No significant differences were found between the sex distribution within the 3 groups ($p = .432$). No significant difference was found in the complication rate ($p = .914$) or the reoperation rate ($p = .291$) among the 3 groups. Although costing >6 times more than a standard fibula fixation construct (implant cost), bone-specific locking compression distal fibula plates add to the portfolio of implants available, especially for unstable fractures with poor bone quality.

Ankle malleolar fractures are common injuries, constituting approximately 9% of all fractures (1). The incidence of ankle fractures in the United Kingdom is estimated to be 7.5 per 10,000 annually, increasing to 10.4 per 10,000 annually in those aged >50 years (1,2). This is comparable to that of other northern European countries, with the incidence in Denmark reported to be 10.7 per 10,000 annually (3). 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 (4–6).

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 (6). 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 (7). However, locking plates can have greater rigidity compared with conventional plates, which can impair fracture healing (8).

In January 2011, a bone-specific locking plate for the distal fibula with a cluster of 2.4- and 2.7-mm distal screws and 3.5-mm proximal screws was made available to our institution. This implant is contoured and provides a unicortical locking system in the distal part to allow fixation in metaphyseal bone. It also has 2 plate types, dependent on the position of the fracture, a lateral and a posterolateral distal fibula plate.

The purpose of the present study was to review the use of the bone-specific distal fibula locking plate and compare implant selection for all lateral malleolus fixation using 3 different plates. We retrospectively examined a consecutive cohort of patients with malleolar ankle

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fractures. This service evaluation assessed the cost (implant cost) and incidence of complications of bone-specific locking versus more conventional lateral nonlocking plating systems for closed displaced fibular fractures.

Patients and Methods

We retrospectively reviewed a consecutive cohort of patients admitted within the 24-month period from January 2011 for fixation of closed malleolar fractures of the ankle. 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. The implant costs were calculated using the price to our institution. (Our aim was to simply look at the crude cost of the implants, and not to analyze cost effectiveness, which would require identification of quality-adjusted life years, incremental cost differences, and the perspective of the analyses.)

Statistical analysis was performed using SPSS, version 22 (IBM, Armonk, NY). Data were tested for normality using a Kolmogorov-Smirnov test. Nonparametric data were analyzed using a Kruskal-Wallis test, and differences were tested using pair-wise Mann-Whitney *U* tests between groups. Parametric data were analyzed using a 1-way analysis of variance, and differences were examined with a post hoc analysis with Bonferroni correction. Categorical data were analyzed using the Pearson χ^2 test. The results were considered statistically significant at $p \leq .05$.

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 semitubular 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

All radiographs of the pre- and postoperative ankles were assessed by 2 independent observers (S.L., C.M.), and the interval to radiographic union was noted. If no consensus was reached, the senior author (M.J.O.) determined the case. Data on osteoporotic risk factors were collected, including established osteoporosis, previous fragility fracture, glucocorticoid usage, cigarette smoking, alcohol excess, rheumatoid arthritis, and diabetes mellitus.

Results

From January 2011 to December 2012, 145 patients with ankle fractures underwent surgical fixation with a distal fibular plate. Of the 145 patients, 87 (60.0%) received an STP, 22 (15.2%) an LC-DCP, and 36 (24.8%) an LCP-F. The descriptive characteristics of the 3 groups stratified by plate and fracture type are listed in Table 1. The age of the patients in the LCP-F group was significantly older than that in the LC-DCP and STP groups ($p < .001$; Fig. 1). No significant differences were found in the sex distribution among the 3 groups ($p = .432$). A significantly greater number ($p < .001$) of patients had known osteoporosis or osteoporosis risk factors in the LCP-F group (10 patients [27.8%] versus 2 [2.3%] and 0 [0%] in the STP and LC-DCP groups, respectively). Lag screws were used in conjunction with 104 of the plates (71.7%).

The mean hardware costs are listed in Table 2. The mean cost of the LCP-F and screws (£673.83) was significantly greater ($p < .001$) than that of the STP and screws (£104.82). Most of the locking plates used were the lateral distal fibula plates (23 [63.9%]); 13 (36.1%) were posterolateral distal fibula plates. Of the lateral plates, 9 (60.1%) were used with lag screws. Also, 23.1% of the posterolateral plates were used with a lag screw.

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). The interval to full weightbearing was not signifi-

Table 1
Patent and clinical characteristics (n = 145)

Characteristic	Semitubular Plate (n = 87)	Limited-Contact Dynamic Compression Plate (n = 22)	Locking Compression Distal Fibula Plate (n = 36)
Age (y)			
Mean ± SD	39 ± 14.7	38 ± 15.1	56 ± 14.8
95% CI	35.5 to 41.8	31.3 to 44.7	51.2 to 61.2
Range	15 to 83	19 to 71	23 to 82
Gender			
Male	46 (52.9)	13 (59.1)	15 (41.7)
Female	41 (47.1)	9 (40.9)	21 (58.3)
Diabetes mellitus	1 (1.1)	0 (0.0)	5 (13.9)
Fracture type			
Lateral malleolus	34 (39.1)	6 (27.3)	5 (13.9)
Bimalleolar	39 (44.8)	10 (45.4)	17 (47.2)
Trimalleolar	14 (16.1)	6 (27.3)	14 (38.9)
Classification			
Weber A	1 (1.2)	0 (0.0)	0 (0.0)
Weber B	73 (83.9)	9 (40.9)	35 (97.2)
Weber C	13 (14.9)	13 (59.1)	1 (2.8)
Lag screw fixation	78 (89.7)	9 (31.8)	17 (47.2)

Data presented as n (%), unless noted otherwise.
Abbreviations: CI, confidence interval; SD, standard deviation.

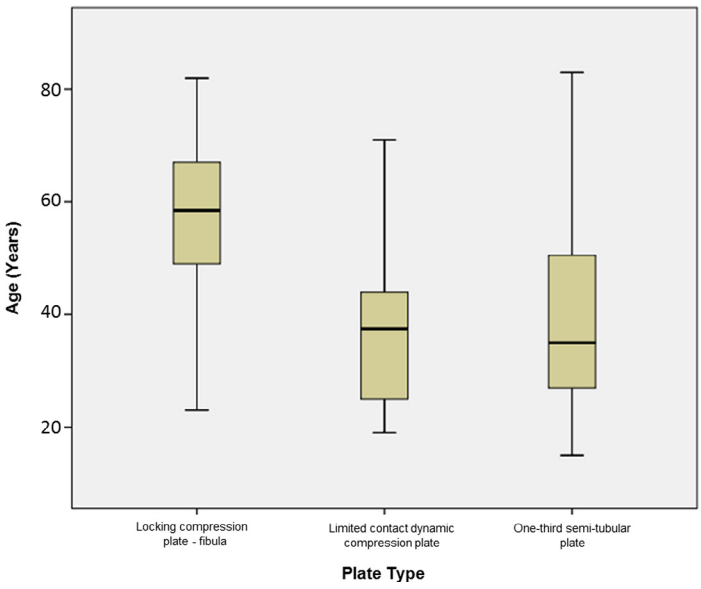

Fig. 1. Box plot showing patient age stratified by fixation type.

Table 2
Mean hardware costs

Variable	Semitubular Plate (n = 87)	Limited-Contact Dynamic Compression Plate (n = 22)	Locking Compression Distal Fibula Plate (n = 36)
Total cost (£)	104.82	142.47	673.83
95% CI (£)	103.25 to 106.38	132.88 to 152.06	649.92 to 697.74
Price range (£)	82.45 to 110.74	123.47 to 172.97	581.29 to 854.34

Abbreviation: CI, confidence interval.