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ORIGINAL RESEARCH

The Cost-Effectiveness of the TriMed Sidewinder Plate for the Treatment of Weber B Ankle Fractures

[1]John D Hewitt MD, [1]Craig T Haytmanek MD, [2]Joshua N Tennant MD, [3]Ryan C May MS, [4]Selene G Parekh MD MBA

[1]Department of Orthopaedic Surgery, Duke University, Durham, NC, USA

[2]Department of Orthopaedic Surgery, University of North Carolina, Chapel Hill, NC, USA

[3]Department of Biostatistics, University of North Carolina, Chapel Hill, NC, USA

[4]Department of Orthopaedic Surgery, Duke University School of Medicine, Fuqua School of Business, Duke University, Durham, NC, USA

Correspondence: Selene G Parekh, Department of Orthopaedic Surgery, Duke University School of Medicine, 3609 Southwest Durham Drive, Durham, NC 27707, USA, Phone: 9194719622, e-mail: selene.parekh@gmail.com

ABSTRACT

Background: Ankle fractures are common injuries and many have indications for operative treatment. Newer plate designs have recently been introduced and have the potential to simplify and shorten the operative procedure. This study compares the cost of operative treatment of a lateral malleolar fracture between a novel plate design and a neutralization plate and lag screw approach.

Methods: A retrospective chart review was performed with institutional review board approval. All patients operatively treated for a Weber B lateral malleolar fracture were divided into two cohorts: an experimental group treated with a novel plate and a control group treated with a lag screw and neutralization plate. Cost of implants, operating room costs, and time to healing were compared between the two cohorts.

Results: The average implant cost for the novel plate design ($1,141) was significantly higher than that of the plate and lag screw construct ($208) ($p < 0.0001$). The average operating room costs were significantly lower for the experimental group ($4,410) compared to the control group ($6,037) ($p < 0.01$). The average time to union was significantly less in the experimental group (75 days) than in the control group (97 days) ($p < 0.04$).

Conclusions: Use of a novel plate design in this study was associated with decreased operating room costs and a quicker time to union compared to the use of a traditional construct. This may result from reduced amounts of dissection required to apply the novel plate and a more favorable biological environment for bone healing. The additional cost of new implant designs may be justified by quicker, simpler operative techniques, and enhanced healing.

Level of evidence: Therapeutic Level III.

Keywords: Ankle fractures, Cost-effectiveness, Sidewinder.

INTRODUCTION

Ankle fractures are among the most common injuries treated by orthopaedic surgeons, and the annual incidence of these fractures is rising.[1,2] Indications for operative treatment of ankle fractures are well described.[3-5] A displaced fracture of the lateral malleolus adjacent to the syndesmosis is one of the most common indications for operative treatment.[3-5] This fracture has been described as a Weber B fracture in accordance with the classification system described in 1977.[6]

Operative treatment of this fracture pattern requires anatomic reduction and rigid stabilization while the fracture heals. Generally, these requirements are accomplished in accordance with well-described AO fracture fixation principles.[3] After reduction of the fracture, an interfragmentary compression screw is applied with a lag screw technique. A neutralization plate is then applied to the lateral aspect of the fibula to protect the interfragmentary screw against rotational forces.[3,5] An accepted alternative to this technique is the application of an antiglide plate to the posterior aspect of the fibula with an interfragmentary compression screw placed through the plate and across the fracture from posterior to anterior.[7] Both of these techniques result in predictable healing in the vast majority of cases.[3,8]

Newer techniques and innovations in plate and screw design have emerged in recent years. Many of these are specific to the treatment of displaced lateral malleolar fractures. The Sidewinder plate from the TriMed (Valencia, CA) ankle fixation system is one of these novel plate designs (Figs 1A and B). It incorporates tabs protruding from the leading and trailing edges of the implant. These tabs initially aid in reduction and are then crimped to the anterior and posterior aspects of the fibula to compress across the fracture site, in lieu of an interfragmentary lag screw. The design of the plate has the potential to simplify the standard operative procedure by aiding in the reduction of the fracture. Furthermore, operative time can be shortened since there is no need to place a lag screw separate from the plate.

The purpose of this study was to compare the costs and outcomes associated with operative treatment of a displaced lateral malleolar fracture using the novel Sidewinder plate to treatment with a traditional lag screw and neutralization plate. We hypothesized that there would be no significant difference between the two treatment methods with respect to the combined cost of the implants, operating room time, and time to union.

MATERIALS AND METHODS

The Duke University Institutional Review Board approved this retrospective chart review of 35 patients requiring open reduction and internal fixation of lateral malleolar fractures. All operative procedures performed by the senior author (SGP) between 1 September 2006 and 31 December 2008, were reviewed for current procedural terminology (CPT) codes 27792, 27814, 27822 and 27823. All of these codes include open treatment of a lateral malleolar fracture. For each patient identified, the anesthesia record, operative report, perioperative supporting documentation, and clinic notes were reviewed. The following data were extracted from the records: age, gender, procedure, lateral malleolar implants used, cost implant, operative time, and time to radiographic healing (based on interpretation by a single observer). Operating room costs were calculated by multiplying the surgical time by the calculated operating room cost of $90 per minute. This room cost included the time charged for the surgical suite, the personnel, including the anesthesia team, the supplies, and the anesthetic agents.

Patients treated with the Sidewinder plate made up the experimental group, while patients treated with a one-third tubular plate and interfragmentary screw made up the control group. The two groups were further divided into subgroups based on their injuries: (A) lateral malleolar fracture, (B) lateral malleolar fracture with a syndesmotic injury, (C) bimalleolar fractures, (D) bimalleolar fractures with a syndesmotic injury, (E) trimalleolar fractures, and (F) trimalleolar fractures with a syndesmotic injury.

Analysis of variance was used to compare continuous variables between groups.

JMP software (SAS Inc., Cary, NC) was used for the statistical analysis. An α-value of 0.05 was considered significant.

RESULTS

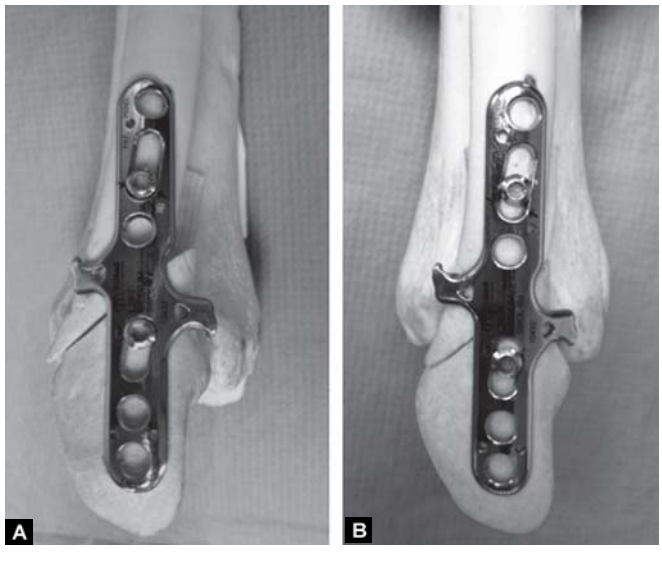
For the time period specified, 35 patients were identified that were treated with open reduction and internal fixation of the lateral malleolus alone, or in conjunction with surgical treatment of the medial malleolus, posterior malleolus and/or syndesmotic injuries. For fixation of a lateral malleolar fracture, ten of these patients were treated with open reduction and internal fixation with the Sidewinder plate and were included in the experimental group. The remaining 25 patients were treated with open reduction and internal fixation using an interfragmentary screw and a one-third tubular neutralization plate. These patients comprised the control group.

Of the patients in subgroup A, one was treated with the Sidewinder plate and five were treated with conventional fixation. For subgroup B, one patient was treated with the Sidewinder plate and two were treated conventionally. In subgroup C, three patients received the Sidewinder plate, while four received the interfragmentary screw and neutralization plate. Subgroup D was made up of five patients treated with the Sidewinder plate and five patients treated with the conventional construct. Subgroups E and F had no patients treated with the Sidewinder plate, but rather seven and two patients, respectively, treated with a lag screw and plate.

The average age of the experimental group was significantly less at 37 years (range 18-61) than that of the control group at 52 years (range 21-88) ($p < 0.02$). In the experimental group, four patients were male and six were female. In the control group, five patients were male and 20 were female.

The average operative time for the control group was 67 ± 17 minutes (standard deviation). For the experimental group, the average operative time was 49 ± 21 minutes. The average operative time in the experimental group was significantly less than that in the control group ($p < 0.01$).

The average cost of lateral fixation implants for the control group was $208 ± 19, while the average cost of the operating room was $6,037 ± 1,544. Thus, the average total cost for the control group was $6,245 ± 1,548 (Fig. 2). The average cost of lateral fixation implants for the experimental group was $1,141 ± 56, while the average cost of the operating room was $4,401 ± 1,886. The average total cost for the experimental group was $5,542 ± 1,885 (Fig. 2). The cost of lateral fixation implants was significantly less in the control group ($p < 0.0001$). The cost of the operating room was significantly less in the experimental group ($p < 0.01$). We did not detect a significant difference between the groups with respect to the total cost of the procedure.



Figs 1A and B: (A) The TriMed Sidewinder plate applied to the lateral fibula centered over a simulated unreduced fracture. (B) The construct after the fracture has been reduced. The anterior and posterior tabs have not been crimped.

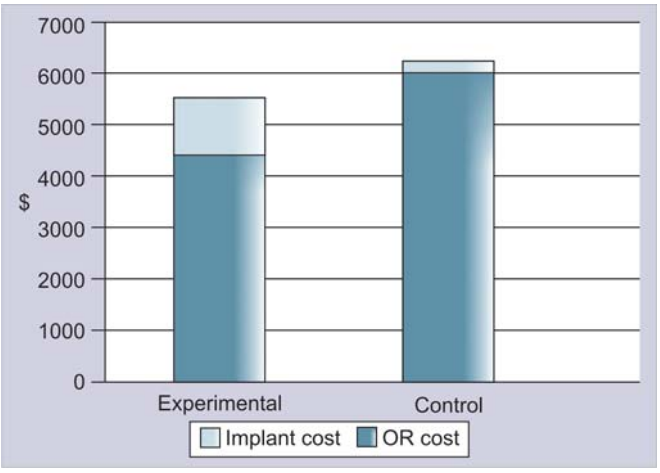


Fig. 2: Comparison of implant, operating room, and total costs for the experimental and control groups. The implant costs were significantly less for the control group ($p < 0.0001$), while the OR costs were significantly less for the experimental group ($p < 0.01$). With the numbers available, we were unable to detect a difference in total costs between groups.

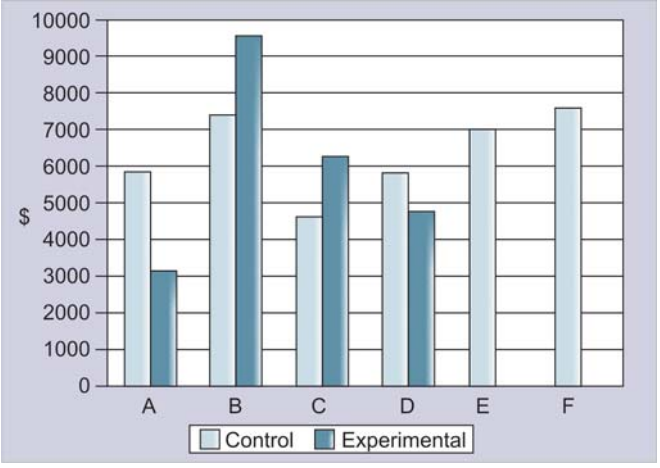


Fig. 3: Comparison of total costs for the experimental and control subgroups: (A) lateral malleolar fracture ($p < 0.05$), (B) lateral malleolar fracture with a syndesmotic injury, (C) bimalleolar fractures, (D) bimalleolar fractures with a syndesmotic injury, (E) trimalleolar fractures, and (F) trimalleolar fractures with a syndesmotic injury.

The average total cost (Fig. 3) for subgroup A (lateral malleolar fracture) was significantly more for the control group ($5,846 ± 872) than for the experimental group ($3,155) ($p < 0.05$). For subgroup B (lateral malleolar fracture with a syndesmotic injury), the average total cost was $7,404 ± 1,306 in the control group and $9,550 in the experimental group. In subgroup C (bimalleolar fractures), the control group had an average total cost of $4,619 ± 1,483 while the experimental group cost totaled $6,272 ± 1,150. In subgroup D (bimalleolar fractures with a syndesmotic injury), the control group had an average total cost of $5,831 ± 1,730 and the experimental group had an average total cost of $4,780 ± 875. There was not a significant difference between groups with respect to total cost for subgroups B, C and D. Subgroup E (trimalleolar fractures) cost an average of $7,041 ± 1,049, and subgroup F (trimalleolar fractures with a syndesmotic injury) cost on average $7,584 ± 2,164. There were no experimental members for subgroups E or F to compare.

In the control group, radiographic healing of the fractures was noted at an average of 97 ± 30 days. In the experimental group, radiographic healing was noted at an average of 75 ± 12 days. This difference was statistically significant ($p = 0.04$).

DISCUSSION

The data presented above indicate that the average cost of the lateral malleolus is greater when using the novel implant system *versus* using a traditional lag screw and one-third tubular plate constraint. The overall costs of the operation are not increased because the increased implant cost is offset by a decrease in operating room costs.

The decrease in operating room time could be attributed to innovations of the Sidewinder plate design. The tabs on the anterior and posterior aspects of the plate are designed to assist with fracture reduction, conceivably accelerating the process of fracture reduction. Bending the tabs into place anteriorly and posteriorly compresses the fracture, rendering it unnecessary to place a separate lag screw. This decreases the amount of dissection needed, possibly further reducing the operative time.

Because the tabs on the Sidewinder plate are compressed supraperiosteally, the surgeon is able to limit the soft tissue dissection anterior and posterior to the fibula. Soft tissue envelope preservation has the potential to accelerate the rate of osteosynthesis.[9] This finding is complicated by the significant age difference between the two treatment groups. The average age of the experimental group was significantly less than that of the control group. The younger age of the experimental group could have had a positive effect on the rate of healing.

In both the experimental and control groups, all fractures were observed to progress to union. For both groups, this outcome is consistent with the reported observation that Weber B ankle fractures typically heal without incident.[8,10] Two additional clinical studies recently reported uncomplicated healing in all patients using the Sidewinder plate for treatment of Weber B lateral malleolar fractures.[11,12]

There are potential limitations to this paper. The retrospective nature of the study makes it susceptible to selection bias. Since the 10 cases in the experimental group were the first 10 performed by the senior author using the TriMed plating system, it is possible that patients with simpler fracture patterns or less significant injuries were selected for the novel treatment. The simpler fracture pattern may have made both the operative time and the time to healing shorter than if the same techniques were applied to a more challenging fracture. Additionally, the unique radiographic appearance of the plate renders it impossible to have a blinded observer evaluating time to union. The tabs on the plate may obscure visualization of the fracture site and influence the perception of union.

Choices made by orthopaedic surgeons play an integral role in the implementation of new surgical technologies, but new

implant designs are frequently more expensive than traditional implants. The indications for the usage of these new implants are generally not well described in the orthopaedic literature until many years after their availability. As a result, it can be difficult to justify the use of newer technology when the initial cost is greater and there is no proven benefit with respect to patient outcomes. Cost effectiveness studies like this one will be critical in justifying the use of new technologies in this era of increased scrutiny on healthcare expenditures.

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