Cost Effectiveness of a New Ankle Fracture System

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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 costs of operative treatment of a lateral malleolus fracture between a novel plate design and a neutralization plate and lag screw approach.

Materials and Methods

A retrospective chart review was performed with institutional review board approval. All patients operatively treated for a Weber B lateral malleolus 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. Costs 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$). The average time to healing was significantly less in the experimental group (75 days) than in the control group (97 days) ($p<0.04$).

Conclusion

The decreased operating room costs likely result from attributes of the novel plate design that assist in fracture reduction and eliminate the need for a separate lag screw. The decreased dissection required to apply the novel plate could explain the quicker healing observed. The additional cost of new implant designs may be justified by quicker, simpler operative techniques and enhanced healing.

Introduction

Ankle fractures are among the most common injuries treated by orthopaedic surgeons, and the annual incidence of ankle fractures is rising.[1,4] The indications for operative treatment of ankle fractures are well described.[5,6,7] A displaced fracture of the lateral malleolus adjacent to the syndesmosis is one of the most common indications for operative treatment.[5,6,7] This fracture can be described as a Weber B fracture in accordance with the classification described in 1977.[12]

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[5]. After reduction of the fracture, an interfragmentary compression screw is applied using 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 applied to the distal fibula.[5,7] An accepted alternative to this technique is the application of an anti-glide 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.[9] Both of these techniques result in predictable healing in the vast majority of cases.[2,5]

Newer techniques and innovations in plate and screw design have emerged in recent years, and a number of these are specific to the treatment of displaced lateral malleolus fractures. The Sidewinder plate from the Trimed (Valencia, CA) ankle fixation system is one of these novel plate designs (Fig. 1). 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, the operative time can be shortened since there is no need to place a lag screw separately from the plate.

The purpose of this study is to compare the costs associated with operative treatment of a displaced lateral malleolus fracture with the novel Sidewinder plate to treatment with a traditional lag screw and neutralization plate. We hypothesize that there is no significant difference between the two treatment methods with respect to the combined cost of the implants and operating room time.

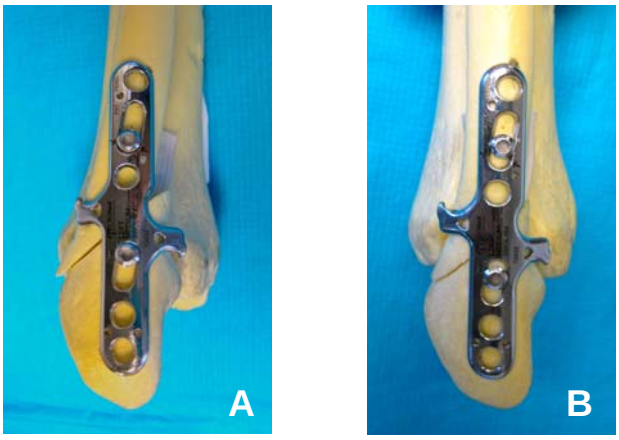

Fig. 1: Photo A shows the plate applied to the lateral fibula centered over the unreduced fracture and secured proximal and distally. Photo B shows the plate after the fracture has been reduced with the assistance of the angled hole in the proximal end of the plate. The anterior and posterior tabs have not been crimped.

Materials and Methods

Our Institutional Review Board approved this retrospective chart review. All operative procedures performed by the senior author (SGP) between September 1, 2006 and December 31, 2008 were reviewed for current procedural terminology (CPT) codes 27792, 27814, 27822 and 27823. All of these codes include open treatment of a lateral malleolus fracture. For each patient identified, the anesthesia record, operative report, perioperative supporting documentation and clinic notes were reviewed. The following data were abstracted from the records: age, gender, procedure, lateral malleolus implants used, cost of implants, operative time and time to radiographic healing. Operating room costs were calculated by multiplying the surgical time by the room cost of $90 per minute. This room cost includes 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 malleolus fracture, B. lateral malleolus fracture with a syndesmosis injury, C. bimalleolar fractures, D. bimalleolar fractures with a syndesmosis injury, E. trimalleolar fractures and F. trimalleolar fractures with a syndesmosis injury.

JMP software (SAS Inc., Cary, NC) was used for the statistical analysis. An α-value of 0.05 was considered significant. Analysis of variance was used to compare continuous variables between groups.

Results

For the time period specified, 35 patients were identified that had been treated with open reduction and internal fixation of the lateral malleolus alone or in conjunction with surgical treatment of medial malleolus, posterior malleolus and / or syndesmosis injuries. For fixation of the lateral malleolus 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 with an interfragmentary screw and a one-third tubular neutralization plate. These patients made up 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 was treated with the Sidewinder, 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 and five patients treated with the conventional construct. Subgroups E and F had no patients treated with the Sidewinder and seven and two patients respectively treated with the lag screw and plate.

The average age of the experimental group was significantly less at 37 years (range 18 to 61) than that of the control group at 52 years (range 21 to

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 twenty 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, and 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, and the average cost of the operating room was $4,401±$1,886. The average total cost for the experimental group was $5,542±$1,885 (Figure 2). The cost of lateral fixation implants was significantly less in the control group ($p<0.0001$). The cost of the operating room was significantly less in the experimental group ($p<0.01$). With the numbers available, we did not detect a significant difference between the groups with respect to the total cost of the procedure.

The average total cost for subgroup A (lateral malleolus fracture) was significantly more at $5,846±$872 for the control group than for the experimental group at $3,155 ($p<0.05$) (Fig. 3). For subgroup B (lateral malleolus fracture with a syndesmosis injury), the average total cost was $7,404±$1,306 in the control group and $9,550 in the experimental group (Fig. 3). In subgroup C (bimalleolar fractures), the control group had an average total cost of $4,619±$1,483, and the

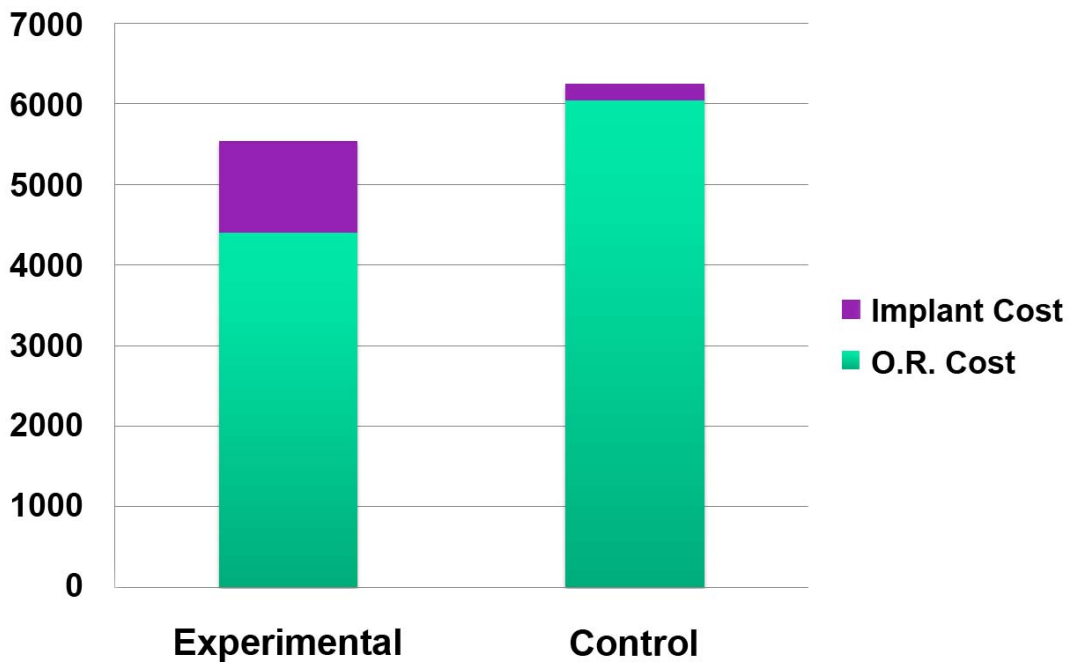

Fig. 2: Comparison of implant, operating room and total costs for the experimental and control groups. The implant costs were significantly less for the control group ($p<0.0001$) while the O. R. costs were significantly less for the experimental group ($p<0.01$). With the numbers available, we were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

experimental group cost $$6,272±$1,150 (Fig. 3). Subgroup D (bimalleolar fractures with a syndesmosis injury) on average cost a total of $5,831±$1,730 for the controls and $4,780±$875 for the experimental group (Fig. 3). With the numbers available, we did not detect 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 syndesmosis injury) cost on average $7,584±$2,164 (Fig. 3). There were no experimental members of subgroup E or F to which to compare.

In the control group, the fractures healed radiographically on average in 97±30 days. In the experimental group, the fractures healed in an average of 75±12 days. This difference was statistically significant ($p<0.04$)

Discussion

With the data presented above, we are unable to reject the null hypothesis that there is no significant difference in total operative costs for the use of a novel lateral malleolus fixation plate as compared to conventional fixation with a lag screw and neutralization plate. Our results indicate that the average cost of implants to fix the lateral malleolus is greater when using the novel implant system than when using traditional lag screw and one-third tubular plate fixation. The overall costs of the operation are not increased because the increased implant cost is offset by a decrease in operating room costs.

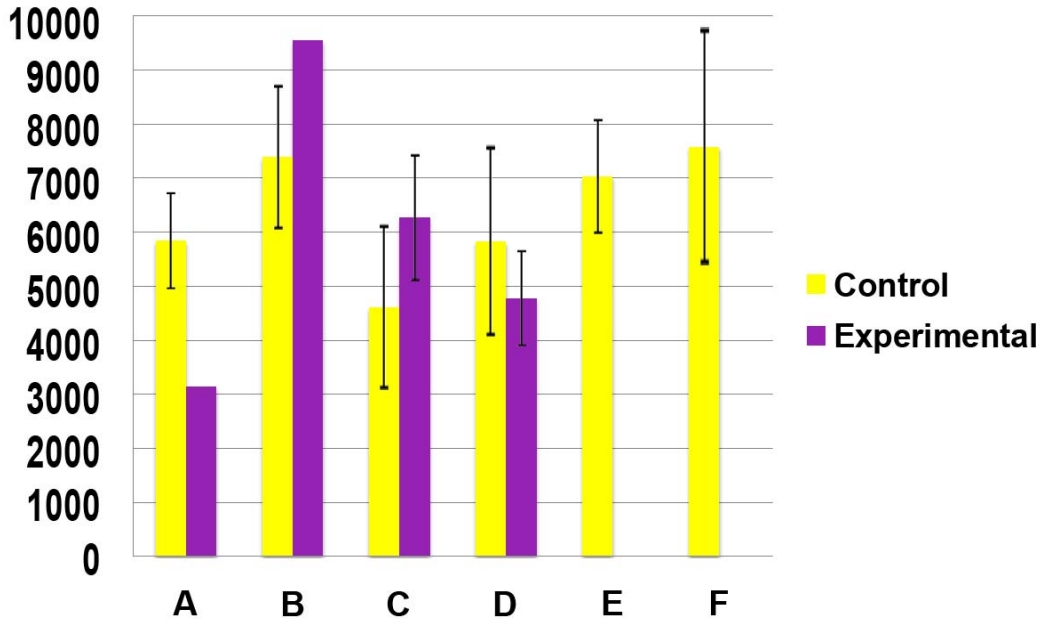

Fig. 3 Comparison of total costs for the experimental and control subgroups:

A. lateral malleolus fracture ($p<0.05$)
B. lateral malleolus fracture with a syndesmosis injury
C. bimalleolar fractures
D. bimalleolar fractures with a syndesmosis injury
E. trimalleolar fractures
F. trimalleolar fractures with a syndesmosis injury.

Error bars = std. dev.

The decrease in operating room time could come from the 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 speeding the fracture reduction and surgical process. Bending the tabs into place anteriorly and posteriorly compresses the fracture, so it's not necessary to place a lag screw separately. This decreases the amount of dissection needed possibly further reducing the operative time.

Limiting the dissection anterior and posterior to the fibula also decreases the soft tissue trauma around the fracture site. Preserving the soft tissue envelope has the potential to enhance healing of the fracture.[10] We observed a decrease in the time to healing with the novel plate compared to the conventional treatment by 22 days. The average of the experimental group was less than that of the control group. The younger age of the experimental group could have had a positive effect on the rate of that group's healing. However, it seems unlikely that the age difference alone could account for the substantial difference we observed.

In both the experimental and control groups, we observed that all of the fractures healed. For both groups this outcome is consistent with the reported observation that Weber B ankle fractures typically heal without incident.[2,11] Two additional clinical studies recently reported uncomplicated healing in all patients using the Sidewinder plate for treatment of Weber B lateral malleolus fractures.[3,8]

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's 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 OR time and the time to healing shorter than if the same technique were applied to a more difficult fracture.

Another possible limitation to the study would be inadequate sample size. It is possible that there were not enough cases performed to detect a small difference between the groups.

In general orthopaedic surgeons play an integral role in the implementation of new surgical technologies, but often the innovative designs are more expensive than older hardware options. Currently the indications for the usage of these new designs are not well researched in the orthopaedic literature. As a result, it can sometimes be difficult to justify the use of newer technology when it's more expensive and there is no increase in benefit with respect to patient outcomes. Cost effectiveness studies like this one will be critical to justify the use of new technologies in this era of increased scrutiny on healthcare expenditures.

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