



Complications after fibula intramedullary nail fixation of pilon versus ankle fractures



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ABSTRACT

Background: Intramedullary nail (IMN) fixation of the fibula in malleolar ankle fractures has been shown to result in less wound complications than plate fixation. Therefore, IMN fibula fixation may also be associated with lower rates of wound complications when used for higher-risk pilon fractures. The purpose of this study was to compare complications of fibula IMN fixation in pilon versus malleolar ankle fractures.

Methods: A retrospective cohort comparison was performed at an urban level one trauma center involving fibula fractures in 47 patients with AO/Orthopaedic Trauma Association (OTA) type 43 fractures and 48 patients with AO/OTA type 44 fractures being treated with fibula IMN fixation. Complications, fibula-specific complications, revision surgeries, and implant removals were reviewed.

Results: There was no detectable difference in complications (27% vs. 23%, 95% confidence interval of the odds ratio (CIOR) 0.5 to 3.2), fibular-specific complications (6% vs. 10%, CIOR 0.1 to 3.5), revision surgeries (4% vs. 4%, CIOR 0.1 to 7.5), or symptomatic fibula implant removals (13% vs. 21%, CIOR 0.1 to 1.6) between pilon and ankle fracture groups, respectively. There was one (2%) fibular nonunion and one wound complication (2%) in each of the fracture groups.

Conclusion: Fibula IMN fixation of pilon versus ankle fractures resulted in a similar number of complications. Comparative studies of fibula IMN and plate fixation are necessary to determine if the benefits of fibula IMN in ankle fractures extends to pilon fractures.

Level of evidence: Level III, retrospective cohort.

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1. Introduction

Plate fixation of fibula fractures can be complicated by wound dehiscence, infection, loss of fixation, and symptomatic implants in up to 20% of patients.^{1,2} In patients with diabetes or vascular disease the risk of complication is even greater, with surgical site infections and wound healing issues being common.^{1,3,4} In comparison, intramedullary nail (IMN) fixation of the fibula for ankle fractures results in less wound complications, less implant removals, and similar union rates and functional outcomes.^{5,6}

Distal tibia pilon fractures, compared to ankle fractures, are at

increased risk of wound complications secondary to their high-energy nature and at-risk soft tissue envelope.^{7,8} Therefore, the benefits of IMN fixation of fibula for pilon fractures may be even more pronounced, although to date there is limited literature on the use of fibula IMN in the setting of pilon fractures.^{9,10} The purpose of this study was to compare complications and revision surgeries after fibula IMN fixation in pilon versus ankle fractures.

2. Materials and methods

After institutional review board approval a retrospective chart review from the year of 2013–2015 was performed to identify adult patients with malleolar ankle fractures (AO/Orthopaedic Trauma Association (OTA) fracture classification 44) and distal tibia pilon fractures (AO/OTA 43) who were treated with fibula IMN (Fig. 1).¹¹ Patients with tibial shaft fractures or less than 6 months of follow-

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Fig. 1. (A) Preoperative and (B) postoperative radiographs of a trimalleolar ankle fracture treated with a fibula intramedullary nail with a distal interlocking syndesmosis screw. (D) Preoperative and (E) postoperative radiographs of a comminuted pilon fracture treated with an unlocked fibula intramedullary nail.

up were excluded. Medical records were reviewed to identify patient demographics, implant type, complications, and revision surgeries. Symptomatic implant removals were reported separately from complications.

Continuous variables are reported as the mean \pm standard deviation (SD). The Wilcoxon Rank Sum test was used to compare

continuous variables. The Fisher exact test was used to evaluate differences between categorical variables. Due to the low number of events, only the 95% confidence interval of the odds ratio is reported to emphasize that the odds ratio could lie anywhere within this range with a larger sample size. All analyses were carried out using JMP statistical software (SAS institute, Cary, NC) p-value less

than 0.05 was considered statistically significant.

3. Results

Retrospective chart review identified 205 patients who were treated with IMN fixation of fibula fractures. After exclusions there were 95 patients left for analysis (Table 1). The average patient age was 50 ± 21 years and 47 (48%) were female. Average follow up was 15 months (range, 6–75 months). The AO/OTA fracture classification included 47 patients with type 43 fractures and 48 patients with type 44 fractures. Implants included the Acumed Fibular Rod (Acumed, Hillsboro OR) in 59 patients, The Advanced Orthopaedic Solutions Fibular Nail (AOS, Torrance, CA) in 18 patients, and the Sonoma Fibulock Nail (Sonoma Orthopedics, Buffalo Grove, IL) in 18 patients.

The pilon and ankle fracture groups did not have a detectable difference in age, gender, or use of distal interlocking screws, however the ankle fracture group was more likely to receive a syndesmotic screw (Table 1).

The fracture groups had no detectable difference in overall complications, fibular-specific complications, revision surgeries, or symptomatic fibula implant removals (Table 2). There were 7 (7.4%) patients who developed 8 fibula-specific complications with 4 requiring revision surgeries (Table 3). Four of these 8 complications were intraoperative implant-related complications that did not affect the patient outcomes. The remaining four complications included 2 nonunions, 1 wound dehiscence, and 1 case of osteomyelitis, which were all contributed to injury severity alone. The pilon and ankle fracture groups each had one case of nonunion for an incidence of 2% in each group. One patient in the pilon group had a wound complication at the site of an open fracture that required a free-flap and one patient in the ankle fracture group developed a deep infection of the fibula requiring operative debridement, for a wound/infection complication incidence of 2% in each group.

4. Discussion

This study evaluated complications of fibula IMN fixation of pilon and ankle fractures and found a low incidence of complications, including one nonunion and one deep infection or wound complication each in the pilon and ankle fracture groups.

Our results support previous studies showing that fibula IMN fixation results in high union rates and low complications rates.^{5,6,12} Giordano et al.¹³ demonstrated that most lateral malleolar fractures can be fixed with fibular IMN with few complications. White et al.⁶ performed a randomized control trial of 100 patients comparing fibula IMN versus plate fixation and found less wound complications in the IMN group with no difference in clinical outcomes at one year. In a similar randomized control study with 71 patients, Asloum et al.⁵ reported that fibula IMN fixation resulted in less complications than plating, 7% vs. 56%, while having

superior functional outcomes scores and similar union rates.

Pilon fractures, compared to ankle fractures, are typically high-energy axial loading injuries associated with significant soft-tissue swelling that often warrants external fixation to allow soft-tissue swelling and injury to subside.¹⁶ In contrast, ankle fractures are typically low-energy rotational injuries that are associated with less soft-tissue swelling and amenable to early fixation.¹⁷ Complications after pilon and ankle fractures are similar and include wound healing issues, infection, symptomatic implants, and nonunion, however the stark difference in injury severity translates to worse outcomes and more frequent complications in pilon fractures.^{16,17} Considering the differences in injury severity and complication rates, the benefits of fibula IMN fixation of malleolar ankle fractures may be even more pronounced in pilon fractures.^{9,10,14,15}

Intramedullary fibula fixation of pilon fractures has only been investigated in a few small series. Stewart et al.⁹ reported on distally locked fibular IMN in 23 pilon fractures and demonstrated a 100% union rate, no wound complications, no revision surgeries, and one symptomatic fibula implant removal. Evans et al.¹⁰ reviewed 38 patients who underwent unlocked intramedullary fixation of the fibula with 3.5 mm cortical screws or 2.5 mm humeral intramedullary nail guidewires in the setting of pilon fractures and found a 100% union rate with no wound complications. The results of these two studies are similar to our findings demonstrating that intramedullary fixation of the fibula has a low rate of complications and a high union rate when used in the setting of pilon fractures, similar to its use in ankle fractures.

Our study is limited by its retrospective nature, short-term follow-up, the lack of a plate fixation control group, and no assessment of reduction quality or functional outcomes. Despite its limitations this study does add to the sparse literature on fibula-specific complications after pilon fracture fixation. In one of the few studies that actually reports fibula-specific complications after pilon fracture fixation, 50 patients receiving fibula plate fixation developed 4 (8%) infections and 6 (12%) wound complications.¹⁸ While fibula-specific complications in pilon fracture fixation is under-reported, it is well documented for ankle fractures. A review of 404 fibula ankle fractures treated with plating reported a 4% complication rate and a 13% symptomatic implant removal rate.¹⁹ Another study of 330 fibula ankle fractures reported a 9% symptomatic plate removal rate for either infection or symptomatic implants.²⁰ Lynde et al.²¹ reported that the most common complications following plate fixation of the fibula in 216 ankle fractures were wound dehiscence (10%) and implant failure (3%). Brown et al.²² reviewed 126 fibula ankle fractures fixed with plates and found that 31% patients complained of pain over the fibula and 23% of these patients opted for removal of their implant. In comparison, two randomized control trials have shown that fibula IMN fixation results in lower rates of wound complications than plate fixation for ankle fractures.^{5,6}

Table 1
Comparison of pilon and ankle fracture groups.

	Pilon fracture (OTA/AO 43) n = 47	Ankle fracture (OTA/AO 44) n = 48	95% confidence interval of the difference	p-value
OTA/AO classification subtype	43A: 20 43B: 5 43C: 22	44A: 1 44B: 24 44C: 23		
Female gender	20 (43%)	26 (54%)	-8% to 30%	0.2
Age (years ± SD)	53 ± 20	48 ± 22	-12 to 5	0.4
Syndesmotic screw fixation	14 (30%)	42 (88%)	39% to 71%	<0.01*
Distal interlocking screw fixation	21 (45%)	22 (45%)	-18% to 20%	0.9

*Statistically significant difference was considered a p-value <0.05.

SD – Standard Deviation.

Table 2
Complications and revision surgeries.

	Pilon fracture (OTA/AO 43) n = 47	Ankle fracture (OTA/AO 44) n = 48	95% confidence interval of the odds ratio	p-value
All complications	13 (27%)	11 (23%)	0.5 to 3.2	0.6
Fibula-specific complication	3 (6%)	4 (8%)	0.1 to 3.5	1.0
Revision surgeries	2 (4%)	2 (4%)	0.1 to 7.5	1.0
Symptomatic fibula implant removal	6 (13%)	10 (21%)	0.1 to 1.6	0.4

*Statistically significant difference was considered a p-value <0.05.

Table 3
Details of fibula-specific complications and revision surgeries.

Pilon fracture (OTA/AO 43)	Ankle fracture (OTA/AO 44)
Retained broken guidewire in fibula (Sonoma implant)	Retained broken guidewire in fibula (AOS implant); Fibular nonunion requiring repair
Fibula nonunion requiring repair	Distal interlocking screw missed nail through targeting jig (AOS implant)
Wound breakdown requiring flap coverage in setting of open fracture	Fibular nail broke during insertion (Sonoma implant) Fibula osteomyelitis requiring hardware removal and saucerization

5. Conclusions

The advantages of fibula IMN lend themselves to the management of high-risk pilon fractures where wound healing and infection are a concern. This study found that fibula IMN fixation of pilon fractures, similar to ankle fractures, resulted in a low rate of wound complications. The advantages of fibula IMN over plate fixation of ankle fractures may also extend to pilon fractures. Future studies directly comparing fibula IMN to plate fixation in pilon fractures is warranted.

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Declaration of competing interest

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