

REVIEWS

THE ADVANTAGES OF INTERLOCKING INTRAMEDULLARY FIXATION OF FIBULA FRACTURES OVER CONVENTIONAL PLATING

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ABSTRACT

INTRODUCTION: Ankle fractures are among the most common injuries encountered in the emergency department. They affect young and elderly people equally and up to a quarter of them require surgical intervention to restore the ankle joint. For the last 50 years, plate osteosynthesis has been the gold standard for open reduction and internal fixation of fibula fractures. A new alternative to this method is the locked intramedullary fixation with fibula nails.

AIM: The purpose of the current paper is to introduce the main advantages of fibula nail fixation over plate fixation in fibula fractures.

METHODOLOGY: A total of 28 papers relevant to fibular nailing complications were identified using the PubMed search engine. After excluding irrelevant articles, the information was compared to the abundance of information about complications after plate fixation in the literature.

RESULTS: Locked intramedullary fixation of fibula fractures appears to be a viable alternative to plate fixation, especially in patients with diabetes mellitus, osteoporosis, and peripheral vascular disease due to significant reduction in the wound complication and reoperation rates.

CONCLUSION: The new generation of fibula nail implants are a valuable tool in the armamentarium of trauma surgeons. Although data is still limited in the literature and further studies are required, this technique provides promising results in the treatment of ankle fractures in the presence of multiple comorbidities or advanced age.

Keywords: *fibula nail, ankle fracture, complication*

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INTRODUCTION

Ankle fractures are frequently encountered in clinical settings, with their occurrence being on the rise due to the active lifestyle of younger individuals and the increasing lifespan of the population. They rank as the third most common type of fracture, following wrist and hip fractures, and constitute up to 10% of all fracture cases (1). After analyzing 50000 ankle fractures for a 10-year period, Ryd-



berg reported that there was an increasing incidence in all age groups with bimodal distribution in young age and advanced age and peak points in adolescent males and females over 60. The most common mechanisms of injury were sports injuries and ground-level falls (2,3,4).

Danis-Weber is undoubtedly the most popular classification that is currently used for fibula fractures. This system divides the fractures into three groups:

- ◆ In Weber type A the fracture line is below the level of syndesmosis, with the syndesmosis and deltoid ligament being intact. As such fractures are considered stable, the main treatment approach is non-operative with CAM Walker or cast, non-weight bearing in the first days, followed by weight-bearing as tolerated.
- ◆ Weber B is also called trans-syndesmotic—the fracture line is on the level of the syndesmosis and requires high suspicion for syndesmotic injury. This is the most common type of fracture patterns in this region (2).
- ◆ Weber C—the fracture is above the level of the syndesmosis—this is usually associated with disruption of the syndesmosis, with widening in the distal tibiofibular joint (5).

Weber B with syndesmotic disruption and Weber C result in damage to the stability of the joint and its weight-bearing capacity. Epidemiological studies report that up to 24% of the ankle fractures are unstable and require surgical intervention (1). Additionally, in more than 50% of those injuries, the lateral malleolus is involved. An imperative objective in the treatment is the restoration of the anatomical alignment in the ankle mortise, thus preserving the weight-bearing surface of the joint and ensuring the recovery of the joint motion. If the fracture is not treated accordingly, long-term disability, chronic pain, and arthrosis occur.

Plate and screw fixation has long been the standard approach for open reduction and internal fixation (ORIF) of these injuries. Traditionally, the use of tubular or locking plates, adhering to the AO principles, has yielded consistently excellent long-term outcomes, with a reported union rate of 99.5% within 12 months (6). However, performing ORIF requires a sizable skin incision on either lateral or posterolateral

side of the ankle, typically ranging from 7 to 10 cm of length (7). This procedure necessitates soft tissue stripping, which causes additional iatrogenic damage to the adjacent musculature, vessels and periosteum. The condition of the soft tissue must improve before making such an incision, leading to delays in surgery of up to 14 days. Furthermore, an extensive surgical approach is associated with longer hospital stays, increased analgetic use and additional edema. These factors collectively prolong the recovery period and affect the local immune and nutritional status, increasing the risk of complications (Fig. 1).



Fig. 1. Classic posterolateral approach for fibula fractures.

An alternative to the conventional plating technique is the less invasive intramedullary interlocking fixation. This is an uncommon method of osteosynthesis of fibula fractures, which has gradually increased its popularity in recent years as more and more publications support the biomechanical and clinical outcomes after fibula nail fixation (8,9,10). One of the potential advantages of such construct is that it requires several smaller incisions, with much less interference to the soft tissues surrounding the ankle joint while maintaining reliable stability during the bone-healing process.

AIM

The aim of this manuscript is to provide a summary of the main differences in the complication rate between plate fixation and intramedullary interlocking osteosynthesis of fibula fractures.

MATERIALS AND METHODS

In an attempt to capture the relevant information, the keywords “fibula nail” AND “complication”, “locked”, “ankle fracture” were entered in the PubMed search engine. The search period was from 2010 to June 2024 in which 28 papers were identified. After reviewing those papers, irrelevant articles involving arthrodesis techniques, elastic or Rush nailing and nonunion treatment were excluded. A total of 23 original papers were selected, and the data was compared to the information of several meta-analyses of the well-known fibula plating technique.

RESULTS/DISCUSSION

PLATE FIXATION

Although surgical intervention with plate fixation is a widely adopted method for ankle fractures, it entails inherent risks. Besides the severity of the fracture and the level of energy involved, these risks are exacerbated by various and common patient-specific factors. The most prevalent complications following ankle surgeries include wound-related problems, such as wound edge necrosis, dehiscence, delayed healing, and surgical site infections (Fig. 2, Fig. 3). In the general population, the reported wound complication rate varies between 3% and 15% (11,12). However, in the cases of preexisting medical conditions, the reported complication rate ranges from 13% up to 30%, with diabetes independently increasing the risk up to four times (13,14). After analyzing more than 57000 surgically treated cases of ankle fractures, SooHoo et al. reported that advanced age, insulin dependent diabetes mellitus, and peripheral vascular disease were significant risk factors for short-term complications influencing the wound-healing process (11). Numerous studies afterwards confirm those findings and add high BMI, smoking, and dementia as potential reasons for unsatisfactory results (15). Although new low-profile plate implants and MIPO techniques were developed in order to improve the short-term complication rate, the latter remains high. Such factors considerably influence the outcome and greatly increase the cost of treatment as well as the recovery period.

Hardware-related complications following plate fixation of ankle fractures are relatively common, although scarcely discussed in the literature. The primary cause for hardware removal is chronic pain and



Fig. 2. Superficial surgical site infection.



Fig. 3. Deep surgical site infection.

restricted movement caused by the implants, which adversely affects patients' daily activities. Jacobsen et al. reported that up to 90% of the patients in the study reported discomfort over the implant tissue and strain-related reduced ankle joint movement (16). Later, Jung et al., in a cohort of 80 patients, reported that 89% of the patients of the study were satisfied as they received improvement in the subjective feeling of walking on uneven ground, squatting, and skin irritation after implant removal (17). Up to 35% of the ankle fractures with plate fixation require a reoperation with the primary cause being implant removal due to hardware irritation, which represents a burden for both the patients and the healthcare system (18).

INTRAMEDULLARY INTERLOCKING FIXATION

The technique of application of the modern interlocking intramedullary fibular nails requires a

small incision at the tip of the fibula to introduce the nail and several stab incisions for the interlocking screws that fix the fibula fragments. In addition, if syndesmotic instability persists after fibula fracture fixation, a trans-syndesmotic screw could be placed through the nail. With the size of the incisions ranging from 1 to 2 cm such less-invasive approach proves to be beneficial for soft tissue recovery (Fig. 4) (19).



Fig. 4. Scars and soft tissues 30 days after intramedullary fixation of the fibula.

In a meta-analysis conducted by Tas et al., they compared 1710 cases of intramedullary and plate fixation. Even though they included cases with non-locked intramedullary fixation, the reported wound-related complication rate was 1.7% in the nail group compared to 15% in the plate group. Although the smaller incisions do not allow for perfect anatomical reduction or removal of the periosteal interposition, no significant difference was found in the union rate or functional outcomes between the two groups. A disadvantage of the mentioned review is that the selected patients were not divided into groups according to their comorbidities.

Rodrigues et al. reported 203 cases of fibula nails with minimal incisions in the zone of the fracture to visually verify the anatomical reposition (Fig. 5). They established that, even after the additional incision, fast restoration of comfort, motion, and strength followed, with no apparent increase in the postoperative pain and swelling.

Another systematic review conducted by Jain et al. analyzed 627 cases of ankle fractures treated with intramedullary nail fixation. Their study confirmed the significant improvement in wound-related com-



Fig. 5. A small incision in the fracture zone to visually debride and verify reduction.

plication rate and identified fibula shortening malreduction as the main complication. This is a disadvantage of the technique caused by its minimally invasive nature. The lack of perfect anatomical reduction, combined with the poor translational and axial control of the fragments warrants meticulous C-arm verification during nail insertion and interlocking.

Patients in advanced age with diabetes mellitus, vascular disease, or damaged surrounding soft tissue envelope appear to benefit from the intramedullary fibula fixation the most. Numerous smaller studies present favorable difference in the wound complication and infection rate caused by the soft-tissue sparing nature of this technique (6,20–23). Furthermore, the low-profile intramedullary implants cause fewer symptoms of metalware irritation, which inadvertently reduces the hardware-related reoperation rate. The reported implant removal rate is 24.2% (22).

OTHER COMPLICATIONS

Additional complications that occur in the surgical treatment of ankle fractures, but are not mentioned in the manuscript, are complex regional pain syndrome (CRPS), nonunion, post-traumatic osteoarthritis, neurological complications, thromboembolic complications. Literature is scarce when it comes to fibula nailing and those complications. In the reviewed papers, they were either poorly described or no significant differences were reported between the nailing and plating techniques.

CONCLUSION

The influence of comorbidities such as diabetes mellitus, poor bone quality, and peripheral vascular

disease in the presence of advanced age is a crucial part in the preoperative decision-making process. Such conditions greatly influence the race between implant failure and bone healing. With the ankle joint being an integral part of the lower limb locomotion, any complications significantly affect the quality of life of the patients. With the onset of individualized approach and patient-specific treatment, it is imperative to choose not the most stable, but rather the most appropriate implant for the patients. The interlocking fibular nail appears to be capable of providing similar functional outcomes to plate fixation, while being soft-tissue sparing. We consider this technique to be a valuable tool in the armamentarium of trauma surgeons for high-risk patients. Further studies are required to ascertain the advantages of interlocking fibular nails before becoming the core part of the treatment algorithms addressing patients with ankle fractures and vulnerable soft tissue envelope.

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