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CASE REPORT

A Z-Fibula Osteotomy Lengthening and Medial Malleolus Osteotomy for Mal-United Ankle Fractures- A Case Report and Literature Review

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Abstract

As we know that ankle fracture union has been compromised by persistent syndesmotic diastasis following mal-reduction and inappropriate internal fixation, both external rotation and shortening of the fibula have been identified as prominent features combined with mal-union of medial malleolus fractures.

We present cases of medial malleolus mal-union with secondary talus lateral translation and syndesmotic incongruence. At the same time mal-union of the distal fibula was present. In order to restore a congruent tibiotalar joint, medial and lateral malleolus osteotomies were performed for correction of the mal-united deformity.

This study reported a technique that uses a z-osteotomy to achieve both lengthening and internal rotation of the fibula to correct persistent talar shift following ankle fracture fixation.

A 40-years-old man with symptomatic ankle joint due to mal-united medial malleolus and distal fibular fractures, and persisting syndesmosis diastasis. The procedure included medial malleolus osteotomy with shifting medial malleolus medially and z-fibular osteotomy for restoration of the lateral malleolar alignment, acute distraction of the osteotomy to restore the fibular length with inter-positional bone graft and reduction of subluxation of the distal tibia-fibular articulation. Internal fixation of the osteotomies were performed with screws and trans-syndesmotic screws. The z-osteotomy to achieve both lengthening and internal rotation of the fibula to correct persistent talar shift for chronic deformities.

One and two years postoperatively follow up showed that The American Orthopedic Foot and Ankle Society score preoperatively 45 and at follow up reaching 95.

Significant improvement of AOFAS Score and greatly improved range of motion with resolution of pain symptoms are recorded. Postoperative radiographs show a congruent mortise with syndesmosis reduction. At the latest clinic review, our case exhibited satisfactory clinical and radiological union. He has returned to full mobility and are satisfied with the outcome.

Medial malleolus osteotomy combined with Z-fibula lengthening and syndesmosis debridement and anatomical reduction and fixation allowed immediate talus medial translation to its original position. It is an effective solution, with an optimal functional outcome.

Keywords

Ankle, Fractures, Mal-union, Medial malleolus, Osteotomy, Debridement, Syndesmosis incongruence

Introduction

Ankle fractures are among the most common injuries, however, the failure to obtain an anatomic reduction of the ankle mortise leads to altered loading of the tibiotalar joint [1-3] and subsequent post-traumatic arthritis [4-7] with poor functional outcomes [8]. Once malposition is diagnosed, corrective surgery is indicated to avoid long-term disability.

A re-operation rate of 1.6% due to mal-reduction has been described and the most common cause for re-operation is syndesmotic malreduction [9] 46% of the re-operated patients have at least two different mal-reduction sites, and except lateral malleolus mal-

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reduction, a medial malleolus mal-reduction is present in 38% of the cases [9].

The current literature includes several reports of lateral malleolus poor reduction, rotational mal-union, and syndesmosis postoperative incongruence [10-12]. However, the existing literature overlooks the medial malleolus mal-union after internal fixation of ankle fractures and lacks solutions for its treatment. Osteotomy through the original fracture line pattern and internal fixation has been described as an effective solution [12].

The tibiotalar joint is unstable in lateral direction. To prevent such tendency, the ankle relies on the lateral malleolus, syndesmosis, deltoid ligament, and aligned medial malleolus (where the deltoid ligament is attached). If the medial malleolus is laterally deviated (lateral translation or lateral rotation), all the constructions are doomed to fail because the talus will be laterally displaced, especially combined with fibular mal-union and syndesmosis diastasis, preventing syndesmosis fixation in the correct position.

An osteotomy through the original fracture pattern and re-fixation is the most valid option. The indication for this procedure is a mal-united medial malleolus causing lateral talar translation, in which a displacement osteotomy and re-fixation in anatomical footprint is important for talus centralization.

Through the medial and lateral approaches, under direct visualization, we can confirm the correct tibiotalar congruency, followed by the evaluation of the ankle sagittal motion (plantar flexion and dorsiflexion) during surgery. An open syndesmosis debridement is required if the fibrous or/and bony tissues are compromising anatomical reduction.

Mal-union of persistent displacement of ankle fractures increases the stresses on the articular cartilage and leads to degenerative arthritis. Correction of the ankle mortise restores the normal ankle biomechanics and supposedly prevents the development of degenerative joint disease. In cases where ankle fracture union has been compromised by persistent syndesmotic diastasis following inappropriate open reduction internal fixation, both external rotation and shortening of the fibula have been identified as prominent pathology.

Case Description

A 40-years-old man who had internal fixation of a bi-malleolar fracture with two-years ago. The patient was first treated with an AO distal fibular locking plate on the lateral malleolus, and x2 cannulated screws for fractured medial malleolus, and syndesmosis screw fixation (Figure 1).

Two year post surgery, the patient showed impaired gait, with permanent daily pain and severe limitation of daily activities. The dorsiflexion was limited to 0°, with 15° of plantar flexion. An AOFAS score of 45 was recorded.

Initial plain radiographs illustrate mal-union of bi-malleolar ankle fracture. Medial malleolar fragment was mal-united and translated laterally. The ankle AP radiograph (Figure 1) showed joint incongruence with valgus mal-union of the medial malleolus with talus lateral translation, syndesmotic diastasis, and fibular shortening significantly. To further investigate the degree of deformity a CT scan was performed (Figure 2 and Figure 3). The coronal and sagittal and axial images illustrate the complete mal-union at both malleoli as well as the presence of syndesmosis diastasis (Figure 2 and Figure 3).

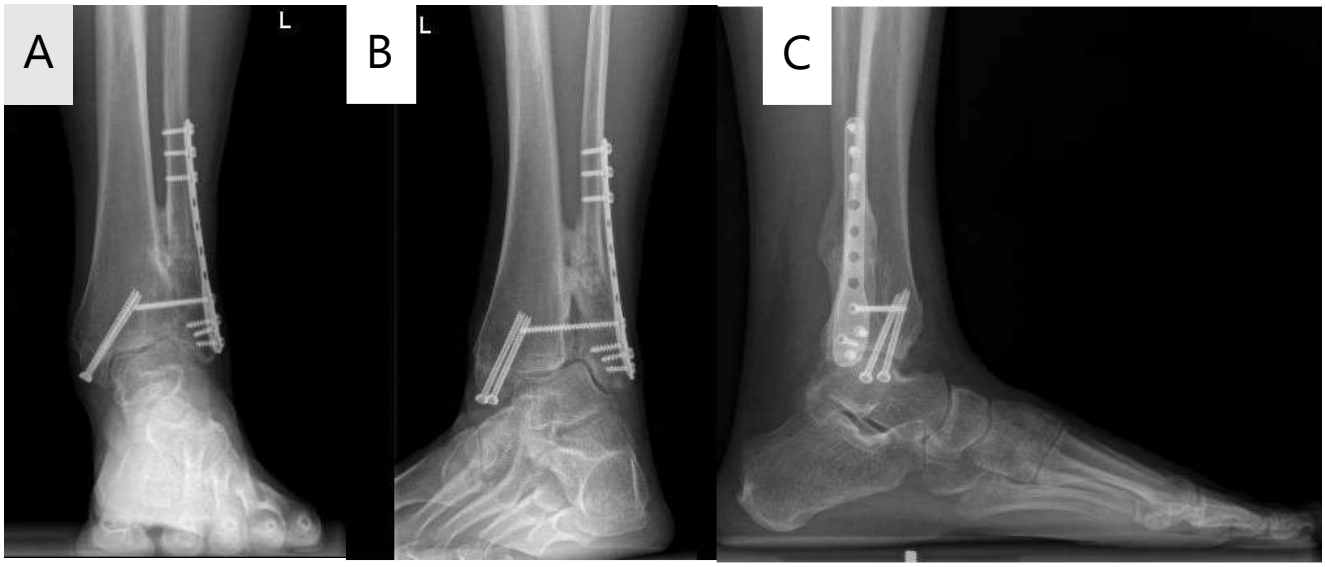

Figure 1: Two years after ORIF ankle fractures initial AP radiographs view showing mal-union of medial malleolus shifting laterally significantly and tilting medially with hind foot in valgus and shortening of the fibula with talus translating laterally (A); Mortise view showing syndesmosis diastasis and synostosis between tibia and fibula (B); Lateral view showing the fibula was shorter than medial malleolus (C).

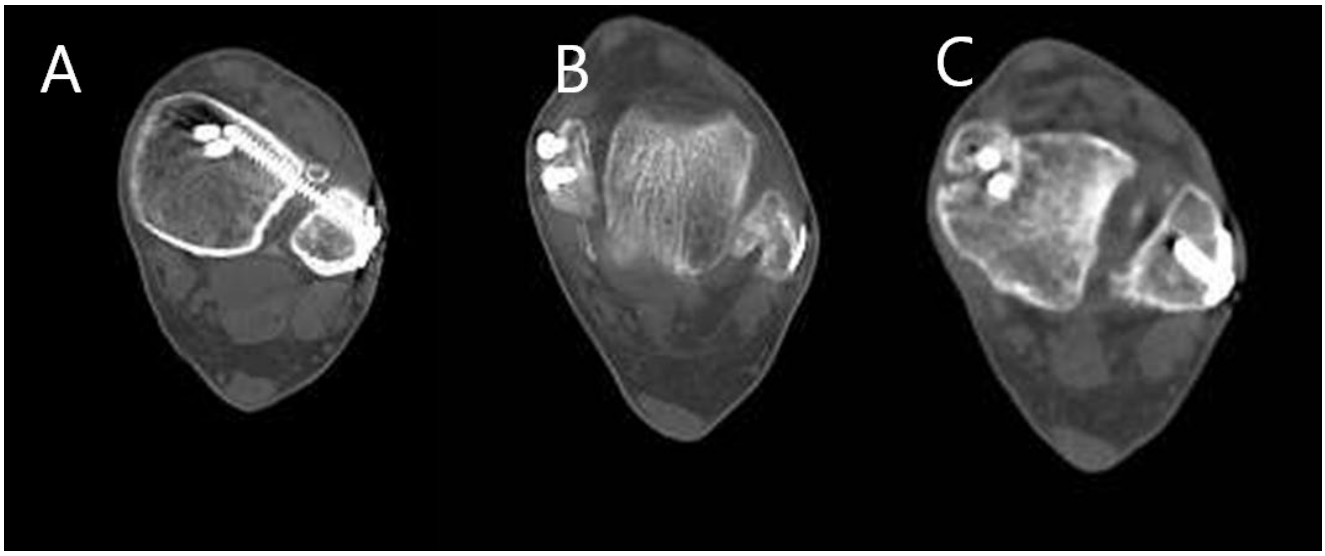

Figure 2: Axial views of CT scans showing that the syndesmotic screw was placed too anteriorly with mal-reduction of the syndesmosis (A and C); and medial malleolus (B).

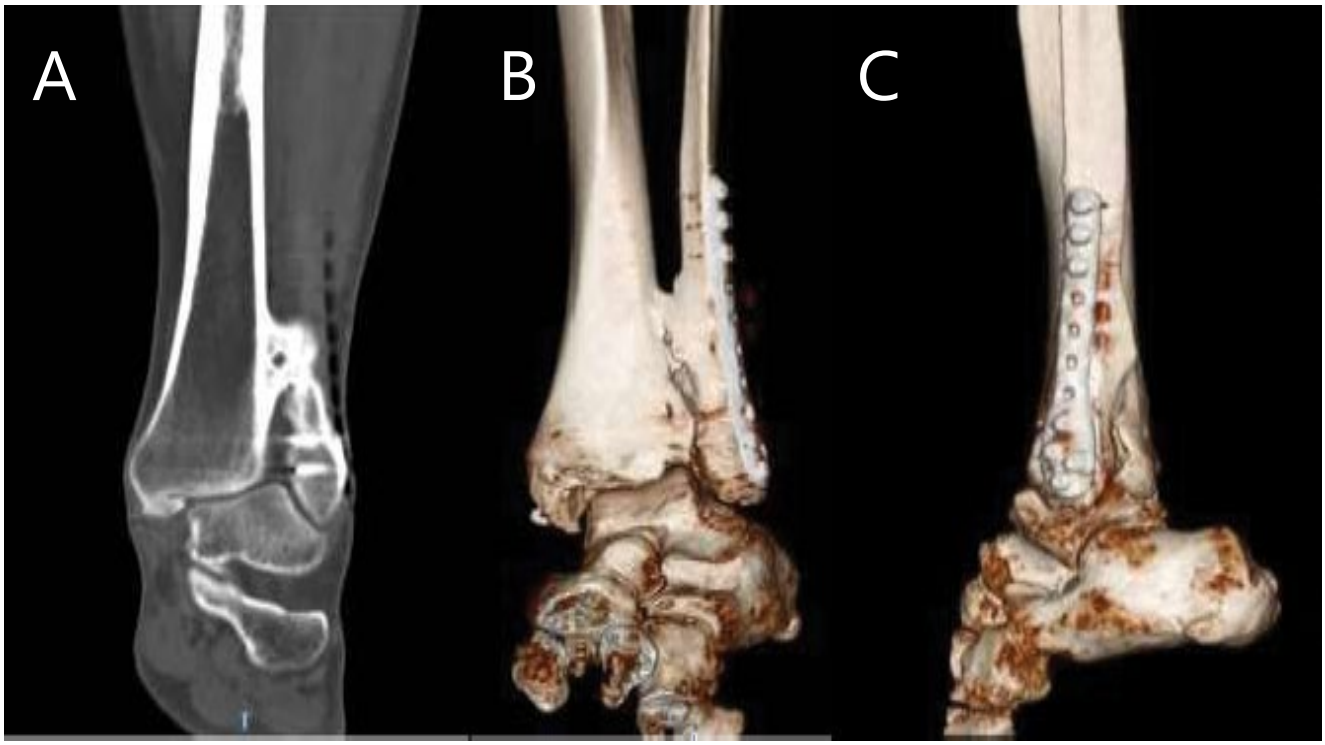

Figure 3: Coronal view of CT showing talus shifting laterally with shortening of the fibula and syndesmosis diastasis (A and B); lateral view of the 3D reconstruction image showing fibula was placed too anteriorly in index surgery (C).

Due to the unacceptable multiple site mal-union, with severe clinical impact, we decided for revision surgery. After hardware removal, the medial translation of the talus was again impossible due to a mechanical block by the mal-united medial malleolus. Medial malleolus transverse osteotomy was performed via old fracture line keeping deltoid attached on distal osteotomy fragment and shifting medially about 10 mm. A Z-osteotomy of the fibula was performed to regain correct length and alignment (Figure 4 and Figure 5). Articular congruency was obtained with a stable full range of motion. The final result shows a congruent joint (Figure 6).

The patient can now walk without mobility aids and with no pain. A dorsiflexion of 25° was achieved, with 45° of plantar flexion. Twelve months after surgery the AOFAS score was 95.

Operation description

The patient was under general aneasthea, preps and drapes routinely, medial ankle skin incision first and removal of x 24.0 mm cannulated screws and medial malleolus osteotomy via old fracture line was performed at distal tibia articular level and shifting MM medially about 10 mm with intraoperative fluoroscopy guidance

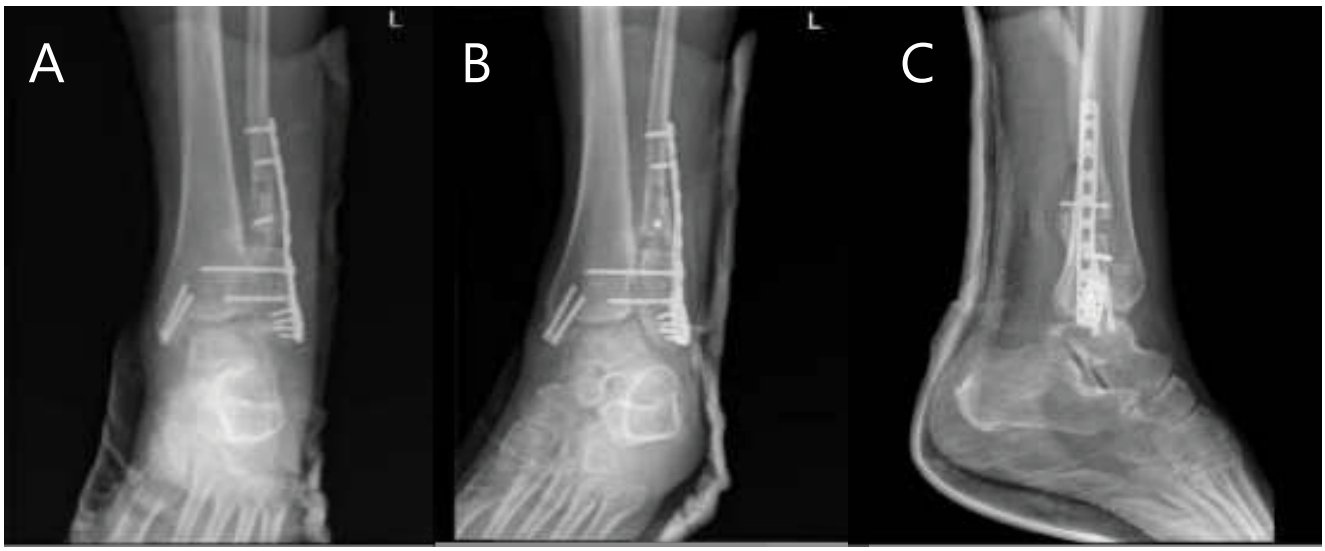

Figure 4: Post-osteotomy radiographs showing medial malleolus shifting 1 cm laterally, fibula lengthening 2 cm after Z osteotomies (A); and debridement of syndesmosis and reduction of the syndesmosis anatomically back to incisura of the fibula on the lateral aspect of the distal tibia (B and C).

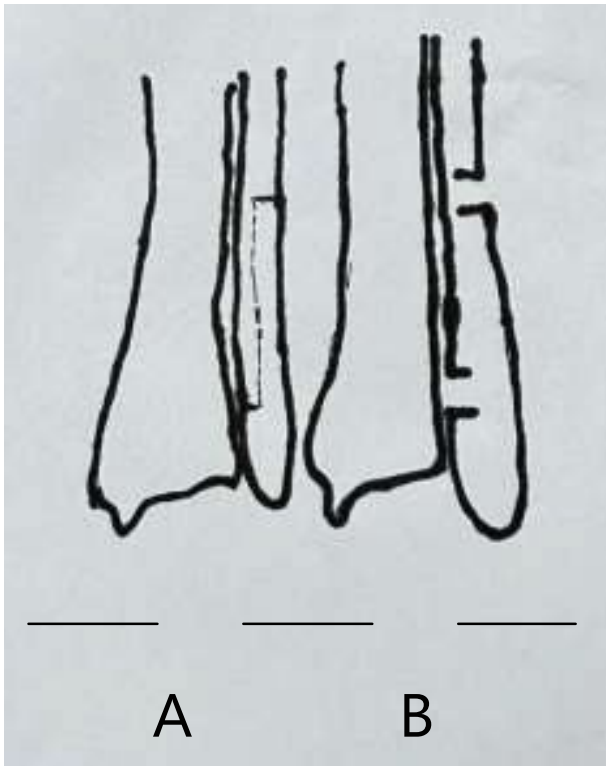

Figure 5: Illustration of Z-osteotomy of the fibula.

and fixed with x 24.0 mm Acumed screws.

Release all adhesion in medial ankle gutter and joint space and excision of all adhesive scar tissues.

An anterolateral approach was used along old surgical scar, protection of the superficial peroneal nerve and dissection down to distal tibio-fibular joint and resection of all synostosed bone cartilages and took down arthrodesed syndesmosis and kept all bone as auto graft and frees the distal fibula from incisura of the tibia. And then distal fibular Z-osteotomy (Figure 5) was performed with an oscillating saw and a Steinman pin was inserted into distal fragment for distraction and lengthening fibular about 20 mm and fixed with an AO distal fibular plate. The osteotomy gap was grafted with allograft mixed with auto graft plus BMP protein and covered with gel forms.

Reduction of the syndesmosis anatomically, maintained reduction with a large pointed clamp and fixed with an Acumed screw distally and another cortical screw proximally with frequently intraoperatively fluoroscopy confirmations.

Discussion

Ankle mal-union with a shortened fibula and syndesmosis widening can pose challenges to the patient and treating surgeons. Indications for revision-operative intervention include persistent pain and disability. Shortened fibula mal-unions can be addressed using a lengthening fibular osteotomy and revision fixation [13-15]. Chronic syndesmotic injuries can be addressed with syndesmotic debridement, open reduction, and screw fixation [16,17]. In this report, we present our surgical techniques and rationale for the management of a shortened fibular mal-union with persistent syndesmotic widening. Corrective osteotomy of fibular mal-union produces considerable improvement provided that the patient does not have significant degenerative changes before surgery.

Failure to anatomically reduce and stabilize the fractured medial malleolus and distal fibula combined with syndesmosis diastasis can result in malunion of medial malleolus and fibula, and mal-reduction of the ankle mortise. Fibular mal-union results in altered ankle joint biomechanics which often leads to the development of pain, stiffness, and premature joint degeneration. Different osteotomy techniques are indicated depending on the location and characteristics

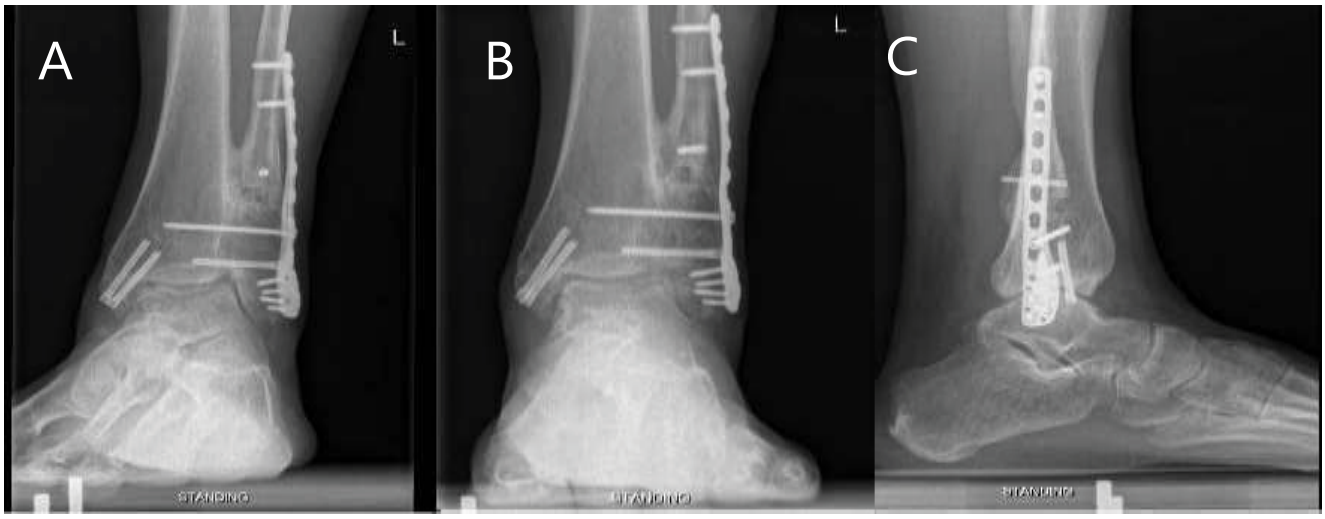

Figure 6: One year post op revision surgery, radiographs showing fully healed medial and lateral malleolus osteotomy, talus in the mortise centrally and fibula in an appropriate length and position on AP and lateral views (A, B and C).

of the mal-union. In this case, the Z-fibula lengthening osteotomy is described for the reconstruction of SER-type fibular fractures.

One year after surgery follow up showed satisfactory clinical and radiological union and returned to full mobility and are satisfied with the outcome. The effectiveness of lengthening z-osteotomy of the fibula in correcting persistent talar shift following internal fixation of ankle fractures is a practical approach for mal-union of the ankle fractures.

Early contact studies of ankle joint congruency show that a deviation of the talus by 1 mm may reduce tibiotalar contact surface area by as much as 42% [12,16]. These classic articles lower the threshold for intervention when we consider that a high percentage of mal-unions ultimately lead to debilitating post-traumatic arthritis. Medial malleolus mal-union in this case leaded to tibiotalar incongruency and subsequently causing syndesmotic incongruency.

The consequences of medial malleolus mal-union lead to translation of the talus laterally causing incongruent joint. If medial malleolus mal-union is responsible for an incongruent mortise, with respective mal-reduced syndesmosis, corrective surgery is mandatory. Robertson, et al. described the option of re-creating the original fracture pattern and fixation as a revision method [18]. In our case, our primary goal was to restore a congruent tibiotalar joint with full range of motion. As soon as this procedure was done, the mechanical block was removed and the talus was re-centered in its correct position. With this technique, all deformity issues are addressed: The mortise becomes congruent, the syndesmosis is reduced, and the deltoid ligament plays its role to avoid medial instability.

In summary, we reported a case of Z-fibula osteotomy lengthening for mal-united distal fibular fracture causing persistent talar shifting laterally and realignment, shifting medial malleolus medially after osteotomy and revision syndesmotic repair for ankle fracture mal-union. The syndesmosis was mal-united probably due to talus lateral translation that arose from a medial malleolus mal-reduction or/and malunion of the fibular fracture, syndesmosis diastasis. The corrective osteotomy of the medial and lateral malleoli with syndesmosis reduction and stabilization appears to be a reasonable and effective way to achieve an optimal functional outcome.

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