Reconstruction of a traumatic lateral malleolus bone loss using the bone sliding technique: a case report (two years follow up)

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Introduction
Traumatic lateral malleolar bone loss of the ankle joint is relatively uncommon event, it has a devastating impact on the ankle joint and can result in a permanent disability regarding the standing function stability, and the walking function mechanism. As management of this rare event is challenging, in literature; some authors discussed options of treatments including reconstructions options.
Design
As it is an uncommon injury, we discuss a case presented to us, as a case report with its sequences, and its two years follow-up.
Method
We describe a unique simple technique for the Reconstruction of a traumatic lateral malleolus bone loss using the bone sliding technique, which is described in the treatment of bone loss segment of other bone in literature[1], however not mentioned for lateral malleolus bone loss reconstruction.
Results
After two years follow-up; our patient has painless plantigrade stable ankle joint; painless stable standing function on his ankle, painless considerable ankle joint range of motion, and painless unaided walking function. The American Orthopaedic Foot and Ankle Society score was 86.
Conclusions
As it is an easy, not costly, and not jeopardizing or traumatizing remote donor site, we think our procedure is reliable for the treatment of similar cases whenever the lateral malleolus is traumatically lost or severely pathologically affected and need its excision.

Keywords:
ankle reconstruction, bone loss, bone sliding technique, lateral malleolus loss

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Introduction

Lateral malleolus as known is a lateral bony component of the ankle joint, attached to it the lateral collateral ligaments of the ankle; 1- syndesmosis (which composed of, anterior inferior tibiofibular ligament, posterior inferior tibiofibular ligament, transverse tibiofibular ligament, and interosseous ligament), 2- anterior talofibular ligament, 3- posterior talofibular ligament, 4- calceneofibular ligament, and 5- lateral talocalcaneal ligament.

Open ankle fractures are not as common as closed one, not exceeding 2% of ankle joints fractures, and mostly result from high-magnitude trauma [1].

Traumatic lateral malleolar bone loss of the ankle joint is relatively uncommon [2], it is a devastating insult results in a permanent disability regarding the standing function stability, and the walking function mechanism. Treatment of this injury is not easy, and needs planning, Sanders *et al.* [3] reported sequelae of these ankle injuries. The traumatic lateral malleolus bone loss, with its ligaments, and overlying soft tissue and skin, can lead to ankle instability, and, eventually, post-traumatic arthritis and permanent disability.

We describe the reconstruction of the ankle using the bone sliding technique for traumatic lateral malleolus bone loss, with a reasonable functional outcome after 2 years follow-up.

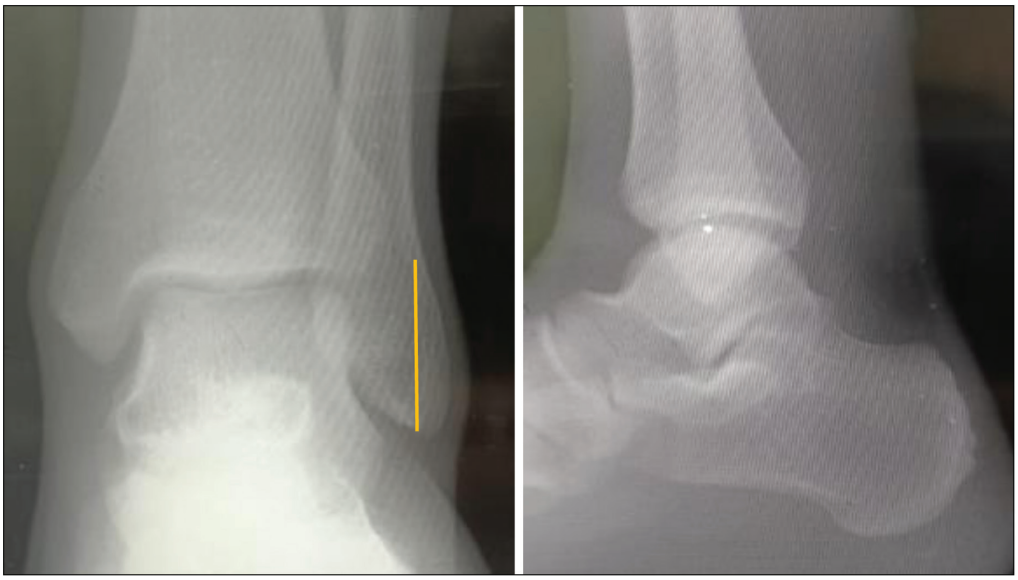
Case presentation

A male patient, 20 years old presented to us, at our emergency room, with an isolated open (Gustilo 3b) traumatic lateral malleolus bone loss of his right ankle (traumatic ankle instability) by a traffic accident (Fig. 1). Contralateral ankle plain radiography done for

Figure 1

Plain radiography right Ankle joint, anteroposterior, and Lateral views, showing traumatic lateral malleolus bone loss with ankle instability.

Figure 2



Plain radiography left Ankle joint, anteroposterior and Lateral views, showing right lateral malleolus bone lost segment about 4 cm.

comparison and assessment of the lost segment length, about 4 cm. (Fig. 2). Skin of the lateral aspect of his right ankle was damaged, lacerated, and dusty. The lateral malleolus and soft tissue were defective.

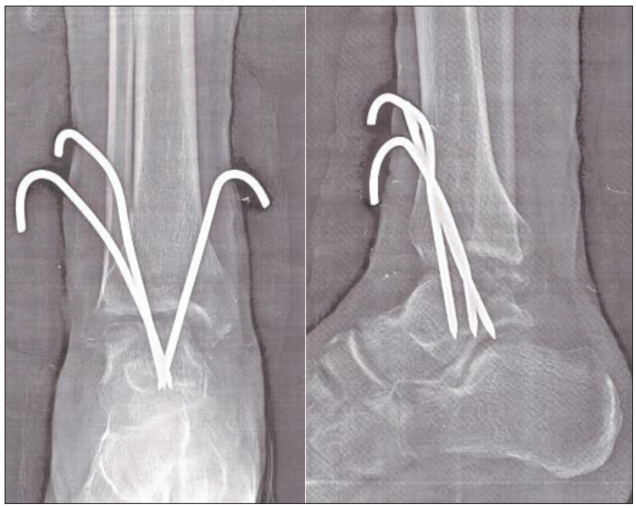
Immediately wounds were washed and thorough debridement was done in our operating room and the wound edges were approximated, bare area of about 8 cm length, and 3 cm width resulted, however, the remaining skin flap and edges are viable. Under the image intensifier (C arm), the Ankle was reduced and fixed primarily by three percutaneous K wires; from the tibia to the talus; for skin and soft tissue nursing and care (Fig. 3).

Wound care was done by daily dressing, antibiotics, two sessions of wound debridement, and washing needed in theater till the wound became clean, remained skin loss defect was treated by skin graft, which unfortunately failed due to infection, debridement and revision required and done to it.

Eight weeks are needed to recover the skin coverage (Fig. 4).

We planned to reconstruct the lost lateral malleolar bone (about 4 cm) by sliding distal fibular osteotomy technique to preserve the ankle joint.

Figure 3



Plain radiography right Ankle joint, anteroposterior and Lateral views, showing Ankle reduction and fixation primarily by three percutaneous K wires; from the tibia to talus.

Figure 4

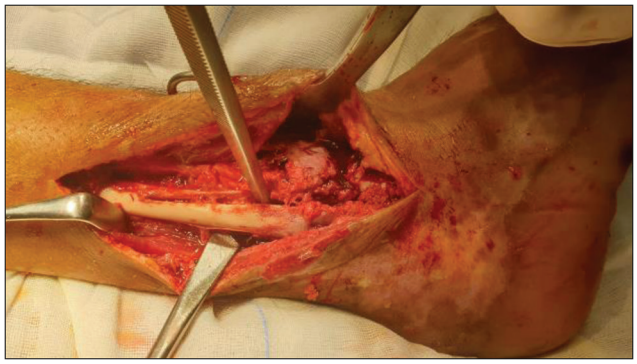
Skin status after 8 weeks of care and graft covering.

Through direct lateral incision to the ankle, we exposed the distal fibula (Fig. 5), periosteum incised longitudinally, and through the anterior surface of the distal fibula, we made a (Z) shaped osteotomy (about 6 cm longitudinal midline, osteotomy, anteroposteriorly in the sagittal plane done, then a transverse exit osteotomy medially at proximal osteotomy end, and a transverse exit osteotomy laterally at distal osteotomy end (Fig. 6). Sliding the medial cortex osteotomy distally to lengthening the distal fibula, to reconstruct the lateral malleolus.). Periosteum and soft tissues were approximated and repaired. Fixation was done by using 12 holes one-third small plate, with two syndesmotic screws (Fig. 7), two percutaneous K wires removed, and one kept for adding more stability to the ankle joint.

Figure 5

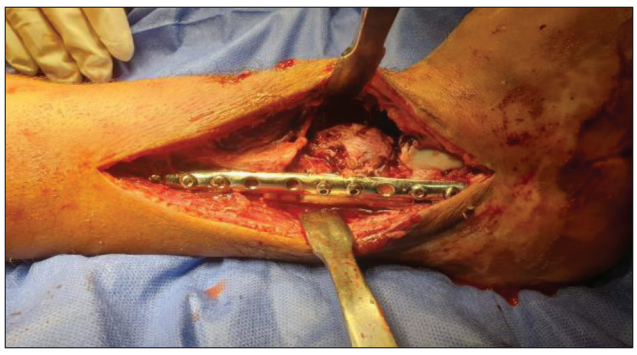
Exposure of the distal fibula through direct lateral incision to the ankle (notice talus articular surface affection).

Figure 6



About 6 cm longitudinal midline, osteotomy, anteroposteriorly done. Then a transverse exit osteotomy medially at the proximal osteotomy end, and a transverse exit osteotomy laterally at the distal osteotomy end to create a (Z) shaped osteotomy.

Figure 7

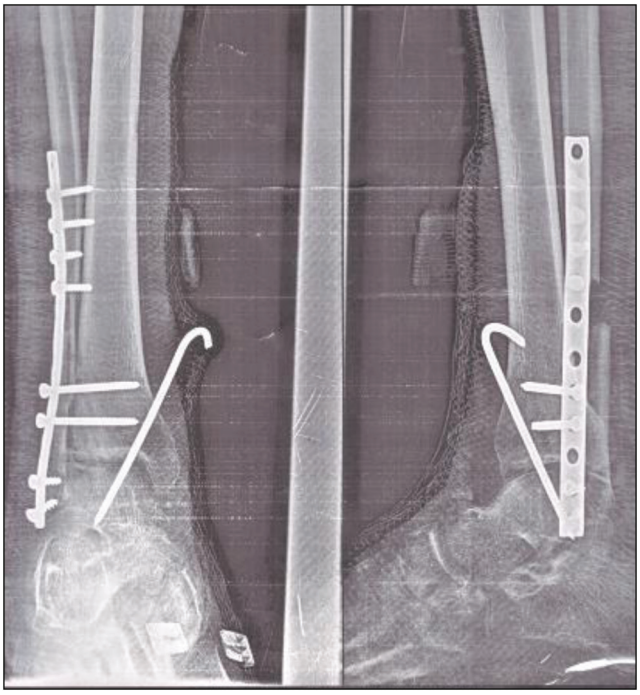


After sliding the osteotomy distally to lengthen the distal fibula and reconstruct a lateral malleolus, Fixation is done by using 12 holes one-third small plate, with two syndesmotic screws (notice talus articular surface affection).

Unfortunately, during exposure, intraoperatively, we noticed severe contused talus articular cartilage with ulceration and cracking due to the initial accident trauma (Figs 5, 7).

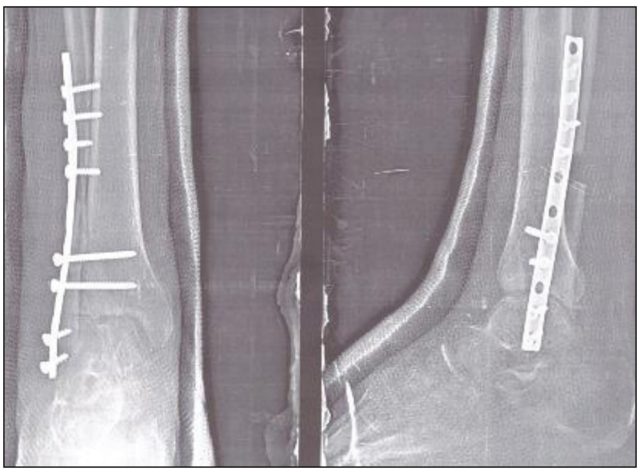
A piece of fat excised from the subcutaneous tissue used to cover and lining of the distal end of the created tip of

Figure 8



Postoperative plain radiography right Ankle joint, anteroposterior and Lateral views.

Figure 9



Plain radiography right Ankle joint, anteroposterior and Lateral views after removal of all percutaneous K wires.

the lateral malleolus. After wound closure, below knee cast done. Postoperative plain radiography done (Fig. 8). Beside the traditional postoperative medication the patient received indomethacin given orally 25 mg three times a day for 6 weeks to decrease heterotopic ossification [4].

After 6 weeks the remaining percutaneous K wire removed at our OPD (Fig. 9), this K wire left this period to add stability to the joint till the healing process for bone and soft tissues occurred.

Eight weeks postoperatively (16 weeks post-trauma) gradual weight bearing on below knee cast started for 4 weeks, then the cast removed, and gradual weight bearing without cast permitted with physiotherapy to regain the ankle range of motion (ROM).

Eight months postsliding osteotomy (10 months post-trauma) the plate and screws distally showed loosening (Fig. 10), so we removed the metal to helping improvement ROM, and to treat pain and discomfort resulting from loose subcutaneous loose metal, intraoperatively we noticed; stable ankle joint, considerable union and consolidation of the osteotomy site, and gentle mobilization done for the joint under anesthesia, then below knee cast done for a couple of weeks with full weight bearing, then removed with continue physiotherapy to increase ROM (Fig. 11).

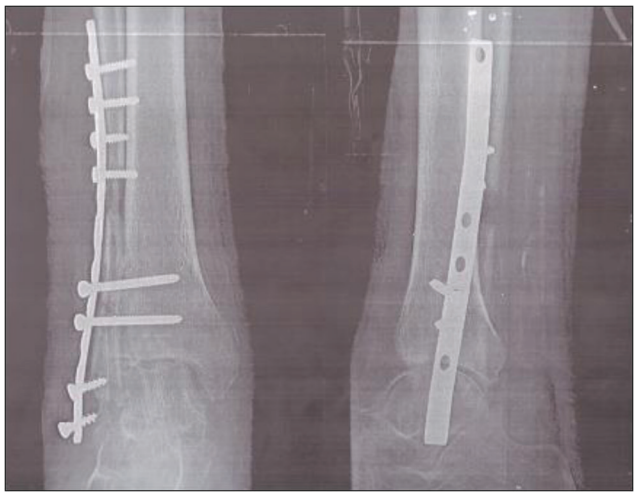
Two months later (1 year post-trauma) the physiotherapist contacted and denoted that there is no progression in improvement of ROM. He suspect bone block, so we did ankle computed tomography, we found talofibular bone bridge synostosis (Fig. 12), so we excised it surgically under an image intensifier and did gentle mobilization under G.A., again used a piece of fat as lining to decrease recurrence of bone synostosis and heterotopic ossification, and indomethacin 25 mg three times a day given postoperative for 6 weeks, and immediately postoperative the patient referred back to the physiotherapist to resume his program (Fig. 13).

The patient was encouraged to continue his physiotherapy program and strictly followed-up clinically and radiologically at 4 weeks intervals. After 2 years last radiography was done for both ankles in mortise view, showing consolidation of the reconstructed right Lateral malleolus, restoring its length, and stable right ankle joint (Fig. 14).

Results

At 2 years follow-up, after Reconstruction of a traumatic lateral malleolus bone loss using the bone sliding technique, the patient is satisfied with no complaints. He has a painless plantigrade stable ankle joint; painless stable standing function on his ankle (Fig. 15), painless considerable ankle joint ROM (although with nearly 5° of dorsiflexion and 25° of plantar flexion) (Fig. 16), and painless unaided walking function (Fig. 17). The American Orthopaedic Foot and Ankle Society score [5] for ankle- hindfoot was 86. Radiographically, consolidation of the sliding bone osteotomy appeared 4 months postoperatively.

Figure 10



Plain radiography right Ankle joint, anteroposterior, and Lateral views, showing loosening of the distal screws and plate, 8 months post the sliding osteotomy and fixation.

Figure 11

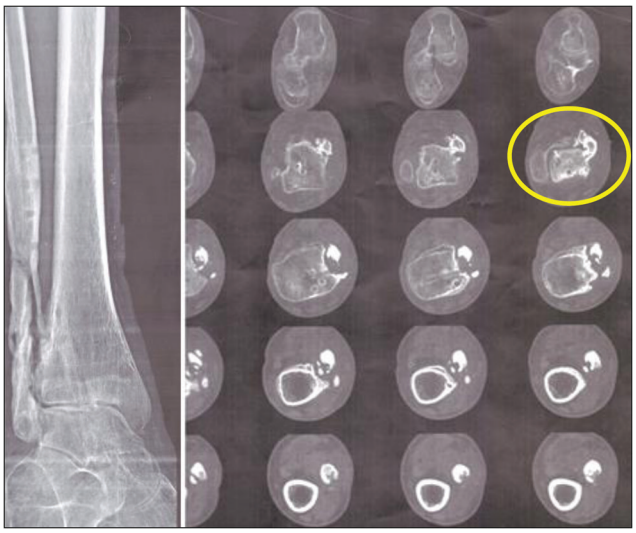
Plain radiography right Ankle joint, mortise, anteroposterior, and Lateral views, after metal removal.

Discussion

Traumatic lateral malleolar bone loss of the ankle joint is relatively uncommon [2], it is a devastating event that results in a permanent disability regarding the standing function stability, and the walking function mechanism. Treatment of this injury needs planning and understanding of the joint function and the patient's needs.

Once this infrequent injury arises, options for management are limited to; fusion of the unstable joint surgically or by continuous using of an orthotic brace, Reconstruction of the lost bone either with another bone which somewhat similar to it, or with a prosthetic replacement for it [6].

Figure 12



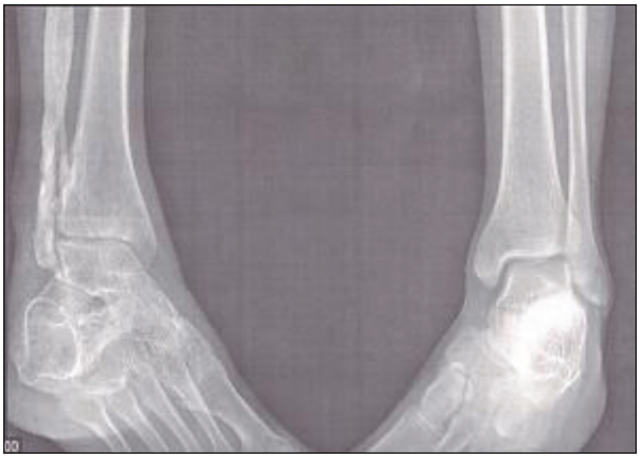
Plain radiography right Ankle joint, mortise view, and computed tomography scan right Ankle, showing talofibular bone bridge synostosis.

Figure 13

Postoperative plain radiography right Ankle joint, mortise and Lateral views, showing excision of the talofibular bone bridge synostosis.

The ankle fusion option (tibiotalar fusion) has the advantages of maintaining stability and alignment without joint bracing, however, it has the disadvantages of delayed union, fibrous union [7], valgus deformity, growth arrest, and limb length discrepancy in growing

Figure 14



Two years follow-up plain radiography both Ankles joint, mortise view, showing restored consolidated reconstructed right Lateral malleolus, with stable right Ankle joint.

Figure 15

Painless stable standing function with plantigrade right foot. A. Planter flexion. B. Dosi flexion.

Figure 16

A. Planter flexion.

B. Dosi flexion.

A and B: right ankle joint range of motion after 2 years.

Figure 17

Painless unaided walking function (tip toeing).

bone [8,9], and loss of ankle joint mobility function. And as known after any joint fusion, due to changes in biomechanics and stresses, the nearby joints will be affected later on in the future. So, although Fusion gives good stability and alignment functions, due to its serious disadvantages, it is better to avoid it [6]. Our procedure in this article may be a good alternative solution option.

Reconstruction of the lost bone with another bone which is somewhat comparable to the original lost lateral malleolus is reported by some authors as either a non-vascularized or a vascularized graft [6–14].

Some authors used the proximal fibular segment as a comparable segment for the replacement of the lateral malleolus in traumatic and other pathological causes. In 1938, Cattrell [10] reported four cases with osteomyelitis and neoplasms of lateral malleolus resected and replaced by proximal fibula. Concannon *et al.* [11] reported a child case of a 4-year-old with a traumatic injury of the distal fibular physis, they used a free vascularized epiphyseal graft from the contralateral proximal fibula to replace the lost segment of the distal fibula. A free nonvascularized proximal fibula usage for an absent distal fibula replacement should be done after the proximal fibular physis closure unless a vascular transfer is done [11–13]. Also, we think, besides failure

of the grafting procedures and its complications, the disadvantages of this procedure is jeopardizing the knee joint mechanism, surrounding ligaments, and nerves.

In literature, some authors reported the Repair of a lateral malleolus defect with a composite pedicled second metatarsal flap [14].

Reconstruction of lateral malleolus bone loss by prosthetic replacement is a new procedure reported as the first case report in China, using titanium alloy and individualized three dimensional-printed, however, it needs further study, longer follow-up, and more case studies [15].

Our procedure described in this article, for the Reconstruction of a traumatic lateral malleolus bone loss, is by using the bone sliding technique (this technique is not mentioned for lateral malleolus reconstruction, however, described for other areas in literature) [1] when doing the osteotomy, we slide the medial cortex distally, not the lateral cortex, to decrease formation of bony synostosis between medial fibular cortex and the ankle joint (the adjacent surface to the joint is cortical, not cancellous).

Ankle ligament sprains and injuries are classified into three grades. In grade I, the ligament is stretched without tearing; in grade II, the ligament is partially torn and has minimal laxity, in grade III, there is complete rupture of the ligament with instability of the joint [16]. In our case, there is a complete acute rupture of the lateral ankle ligament (Grade 3), which is treated by simple soft tissue repair and, a long immobilization period [17]. Ligament tears can be surgically repaired by stitching them back together, re-attaching them to the bone, or replacing them with a graft [18].in our case, we re-attach the remnant of the ruptured ligaments to the reconstructed lateral malleolus, followed by the immobilization period. Nearly all low ankle sprains can be treated without surgery, even a complete ligament tear (Grade 3) will heal without surgical repair if it is immobilized and rehabilitated appropriately [19]. The immobilization period needed may take 2 weeks for minor sprains or up to 6 to 12 weeks for more severe injuries [19]. Finally, in our case, the ankle was stable on follow-up.

Unfortunately, severe articular surface affection of the talus by the primary trauma (which was noticed intraoperatively), most probably affected our results; clinically, by affection the ROM, and radiologically, by starting radiological signs of post-traumatic ankle osteoarthritis.

However, Our procedure described in this article, for the Reconstruction of a compound traumatic lateral malleolus bone loss using the bone sliding technique is easy, low cost, not jeopardize or harvest other joints or donor site, with good results regarding painless stable ankle joint stability function, and reasonable ROM of the ankle joint and walking mechanism.

We think, this reconstruction method for the lateral malleolus, can be applied whenever indicated in cases rather than traumatic loss. We hope to apply our procedure in more indicated cases for further study in the future through long-term follow-up studies.

Conclusion

Our method which described, Reconstruction of a traumatic lateral malleolus bone loss using the bone sliding technique, with 2 years follow-ups, shows a satisfying promising functional outcome with painless plant grade stable ankle joint; painless stable standing function on the ankle, painless considerable ankle joint ROM, and painless unaided walking function, with American Orthopaedic Foot and Ankle Society score of 86. We think it is a good choice for the reconstruction of the lateral malleolus loss.

Ethical approval

Our case report; uncommon event, ethics committee review, and ethical endorsement are not required and not applicable. However, we have got the patient's agreement and consent for surgeries and his permission to publish his data.

Consent

Written informed consent was obtained from the patient for all surgical interventions, according to the revised Helsinki Declaration of 2000, and also written informed consent was obtained from the patient for publication of this case report and accompanying images.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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