Overcompression of the Syndesmosis in a Traumatic Geriatric Ankle Fracture Dislocation, a Case Report

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Purpose/ Abstract

- To date there is limited data in regards to syndesmosis malreduction in the setting of a geriatric ankle fracture dislocation.
- The purpose of this case report was to highlight our experience clinically and radiographically of malreduction and overcompresssion of a geriatric ankle fracture, with surgical intervention and subsequent revision surgical intervention.

Literature Review

Ankle fractures are among the most common lower extremity injury. Among them, injuries to the syndesmosis are highly debated and one of the most published research among ankle injuries and yet continue to be some of the most challenging. The syndesmosis is the articulation between distal tibial and fibula that is a dynamic ligamentous cohesion that is apart of the ankle joint. Malreduction of the syndesmosis is widely discussed topic as it relates to operative management. This is a highly debated and published research area among foot and ankle injuries. Literature has revealed that patients postoperatively have between 39% to greater than 50% incongruity, or malreduction, of the syndesmosis based on computer tomography (CT) [1,2]. Literature has evolved as guidelines for syndesmotic malreduction are differently defined and established. Causes for malreduction can be attributed to ligamentous injury to incisura morphology variability and translational forces, in conjunction with anatomy of incisura fractures of the tibia, as well as nonreduced accompanying injuries like distal fibula fractures [3–5]. Moreover literature supporting less malreduction is in favor of flexible suture button fixation as compared to screw fixation with regards to radiographic and noninferior functional outcomes (Naqvi 2012, Sanders 2019) [6,7]. Criteria for defining malreduction on plain film radiographs has been based on the criteria involving tibiofibular clear space (<6 mm), anteroposterior tibiofibular overlap (>6 mm), mortise TFO >1mm, and medial clear space (<5 mm) of which any deviation or incongruency met the threshold for malreduction (Gardner)[1]. However plain film radiographs only reliable predict widening at greater than 4mm of diastasis and deemed otherwise inferior reliability to computed tomography (CT) scan [1,8–10].

In previous reports, 1.5- 2mm of syndesmotic asymmetry has been defined as malreduction, however tolerances and relation to clinical outcomes have show this to be otherwise clinically insignificant (2018). Moreover 2mm threshold of asymmetry or diastasis on axial CT is widely accepted [4,9,11]. Nonetheless even with intraoperative CT scan, malreduction can be still as high as 10% [12]. Surgical fixation for these injuries have ranged from screw, suture button fixation, and screw-suture fixation and has been widely researched[1,4,5,13–20]. Excessive medialization of the fibula within the ankle incisura after fixation of the syndesmosis has been increasingly reported in recent years. This is the ethos of this case report. Over compression of the syndesmosis may limit ankle joint motion, affect patient outcomes and possible contribute to early onset ankle arthrosis and pain during ambulation. A study by Tornetta et al in 2001 was one of the first to contest this topic and deduced that while the ankle was dorsiflexed the overtightening of the syndesmosis was avoidable and otherwise did not contribute to lack of dorsiflexion ability post operatively, however this has been challenged by recent literature[16,21].

Over compression of syndesmosis has been defined by CT scan as medialization of the fibula >1mm compared to the c/l side on CT scan [22]. This can caused by iatrogenic fixation predominantly in the form of screw fixation and has been attributed to clamp force [5,18,23]. Moreover, varying tension in use of suture button fixation can also demonstrate overcompression in cadaver models [19]. Open reduction and internal fixation efforts are more clearly seen based on CT scans as compared to plain films which lend low power evidence for accurate reduction. In our review on the topic This has been reported in case studies in adolescent patient and young adults but not in geriatric population that is othweise in research [24,25].

Geriatric ankle fractures are associated with better survivorship and fewer complications than that of hip fractures. Furthermore, elderly patients, as they increase in age tend to suffer more for ankle injuries relating namely to falls and rotational injuries. Studies show that to what is previously thought, in a large study of insurance claims nonoperative management was associated with higher odds of mortality within 1 year of injury and greater than 10% than surgically treated ankle fractures. Moreover bone quality may impact fixation, but evidence shows that osteoporotic changes in relation to ankle fractures have been noninferior[26]. Theories remain that bone quality can be related to degree of malreduction during syndesmosis repair by way of inability to hold tension across 4 cortices fixation [19,27]. To the contrary, Baxter et al in a study on comparison of suture button fixation across age groups found that no significant complication rate differed among cohorts below and above 60 years of age[28]. Moreover, injuries of this manner are not entirely understood and quite complex, and is the reason for this report.

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Case Study

A 79 year old female patient was a passenger in a motor vehicle accident when she collided with a garbage truck. She sustained a closed displaced bimalleolar fracture the left ankle, left scapulolunate ligament injury to the left wrist, T10-12 compression fracture of the spine, subarachnoid hemorrhage, and abdominal hematoma. Lower extremity radiographs demonstrated ankle fracture dislocation with transverse intraarticular medial malleolus fracture, diaphyseal oblique fracture of the fibula, frank dislocation of the ankle with disruption of the ankle mortise, and significant diastasis of the distal tibia and fibula. No posterior malleolar fracture was seen (Figure 1). On physical exam she was neurovascularly intact. On exam there was gross lateral dislocation with skin tenting to the medial ankle at the level of the medial malleoli. Patient was able to wiggle digits, no high fibular neck pain, and all muscle strength was maintained however deferred due to guarding. Muscle strength was maintained. There was pain on palpation anteriorly over the anterior ankle and syndesmosis. Otherwise, her skin was intact, with underlying ecchymosis and swelling. No other overt lacerations were on the lower extremity. Prior to evaluation emergeny department staff obtained CT scan (Fig 2). Patient was closed reduced and placed into splint. Due to concern for subarachnoid hemorrhage necessitated patient be transferred to Level 1 facility. However, due the unstable nature of the injury during transfer by EMS patient sustained redislocation of the ankle within the splint. The patient's ankle dislocation was reduced for second time by the on call resident and placed into a plaster posterior splint where she remained non weightbearing.
She has past medical history of hypertension, hypothyroidism, osteopenia, vitamin D deficiency, atrial fibrillation, CHF, previous ankle fracture surgery on her left side in 2010, history of cerebrovascular accident in 2023.
Patient was kept in the hospital for 3 days and subsequently discharged. She was admitted to the hospital and evaluated by neurosurgery for suspected subarachnoid hemorrhage (SAH). Due to the small degree of traumatic SAH she was cleared by neurosurgery and placed on Eliquis after 3 days of injury in preparation for surgery to her ankle. Furthermore, with the patient was evaluated and cleared by the cardiology service with history of paroxysmal atrial fibrillation and CHF. She was deemed a low cardiac risk for ankle surgery Given the displacement of the fracture, risk of post traumatic arthritis, and severe instability of this injury we recommend surgical intervention open reduction internal fixation and arthroscopy assisted reduction in order to stabilize the fracture and improve position to help restore anatomic alignment. All questions were answered to the patient's satisfaction. The patient and family verbalize and demonstrates understanding and were amenable to surgical plan for open reduction internal fixation of the right ankle and syndesmosis, with ankle arthroscopy with use of arthroscopy assisted reduction.


Figure 1. injury films

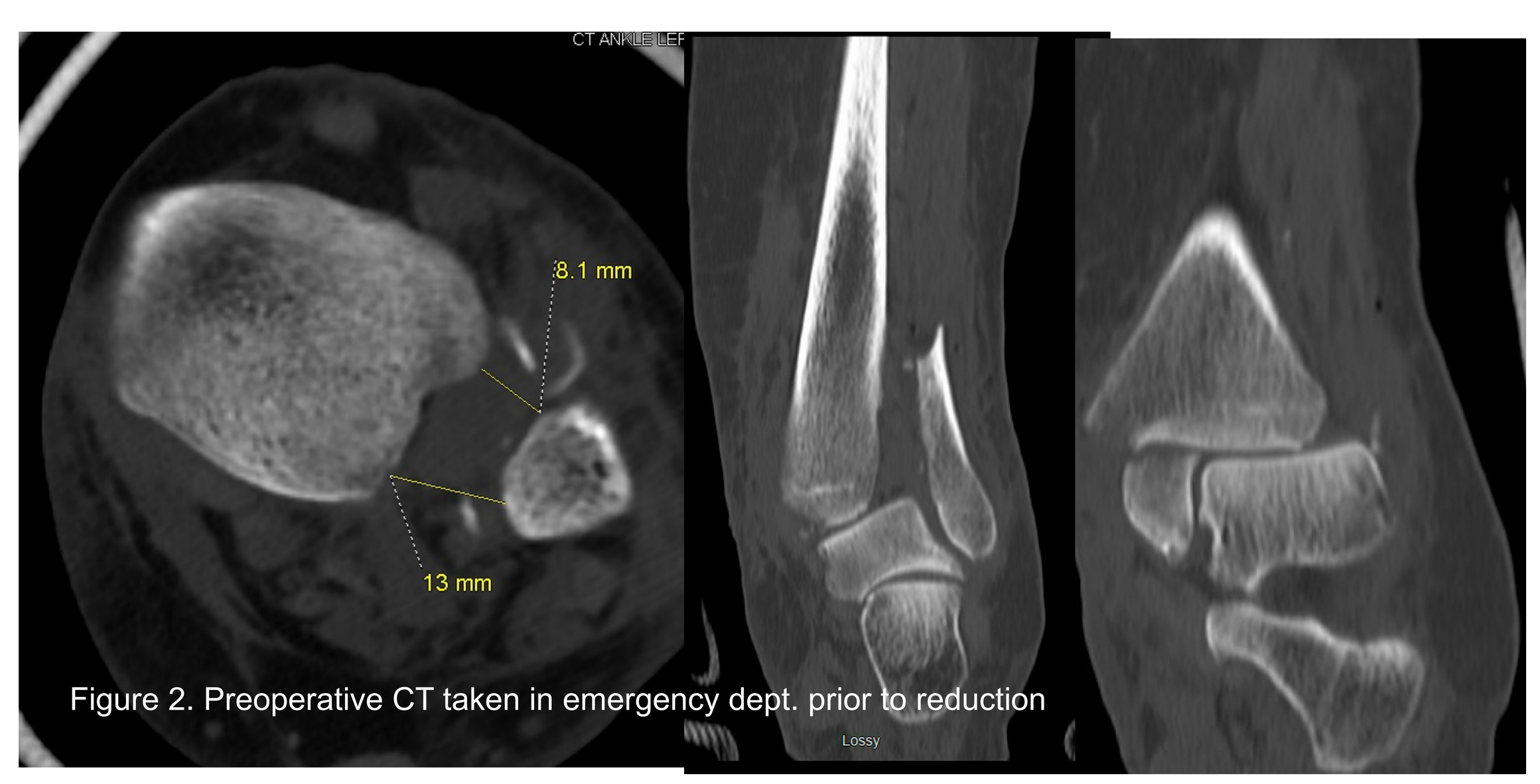

Figure 2. Preoperative CT taken in emergency dept. prior to reduction

Surgery 1

Patient was taken to the operating room under general anesthesia ankle arthroscopy, for use of arthroscopy assisted reduction and extensive debridement with 1.9mm camera. Anterior ankle joint arthroscopy was done in standard fashion (Fig 3). There was also noted to be clear disruption of the syndesmosis with hemorrhagic synovitis as well as hematoma formation. Camera was able to be placed with little resistance up within the incisura and captured on video, however due to technical difficulties this was not able to recalled. Upon further inspection there is noted to be osteochondral lesion of the medial and lateral talar dome. Both were noted to be chondral and debrided and not microfractured. Open reduction and internal fixation of the ankle fracture was done from a lateral approach first by addressing the fibula with an 8 hole 1/3 tubular plate acting as a neutralization plate after applying a 3.0 partially threaded lag screw. The medial malleolus was fixated with 2 4.0mm partially threaded screws that were unicortical. Throughout dissection The syndesmosis was fixated with a dynamic suture button fixation device through the lateral fibular plate. Next, the syndesmosis was addressed. Under live mortise view a hook test with dental pick was done which demonstrated instability of the syndesmosis with lateral subluxation of the talus. Given these findings with the directly visualized disruption of the syndesmosis arthroscopically and in the preoperative imaging we moved forward with fixation of the syndesmosis. The syndesmosis was reduced using tactile manipulation and large Weber reduction clamp. The appropriate hole was selected on the fibula plate. Initial fixation was performed utilizing suture button however after post implant imaging there was felt to be over compression of the syndesmosis. At this point it was believed that worping of the plate and poor bone quality allowed this to happen. It was decided that previously placed suture button device was removed and at this time another suture button device was placed was inserted through our fibular plate following manufacturer instructions. Stress testing which demonstrated improved stability and alignment of the tibiotalar joint. She was closed and placed into splint.

Intraoperatively it was felt that we had reasonable reduction of her deformity. However, her postoperative radiographs demonstrated malreduction of the medial malleolus, anterior subluxation of the talus within the tibiotalar joint mortise (Fig 4) . Findings were concerning for malreduction, particularly of her syndesmosis. She was brought into the office the next day for additional postoperative films which were consistent with her PACU radiographs. STAT postoperative computer tomography (CT) of the bilateral ankle was ordered which demonstrated malreduction of the distal fibula with anterior angulation, malreduction of the syndesmosis again with anterior angulation, rotational malreduction of the medial malleolus, anterior translation of the talus within the ankle mortise (Fig5). It was felt that her malreduction was in part due to her severe syndesmotic injury and associated soft tissue injuries of the distal fibula. We discussed with the patient that though her reduction is reasonable, it is not anatomic. We recommended revisional surgical intervention, the patient was amendable.


Figure 3. Intraoperative arthroscopic images showing hemarthrosis, two separate osteochondral lesions, one medial and one lateral as well as frank diastasis and disruption of the syndesmosis.


Fig 4. Post op XR 1. Red arrows demonstrating lateral displacement of the fibula and medial malleolus. Showing anterior subluxation of the talus (right).

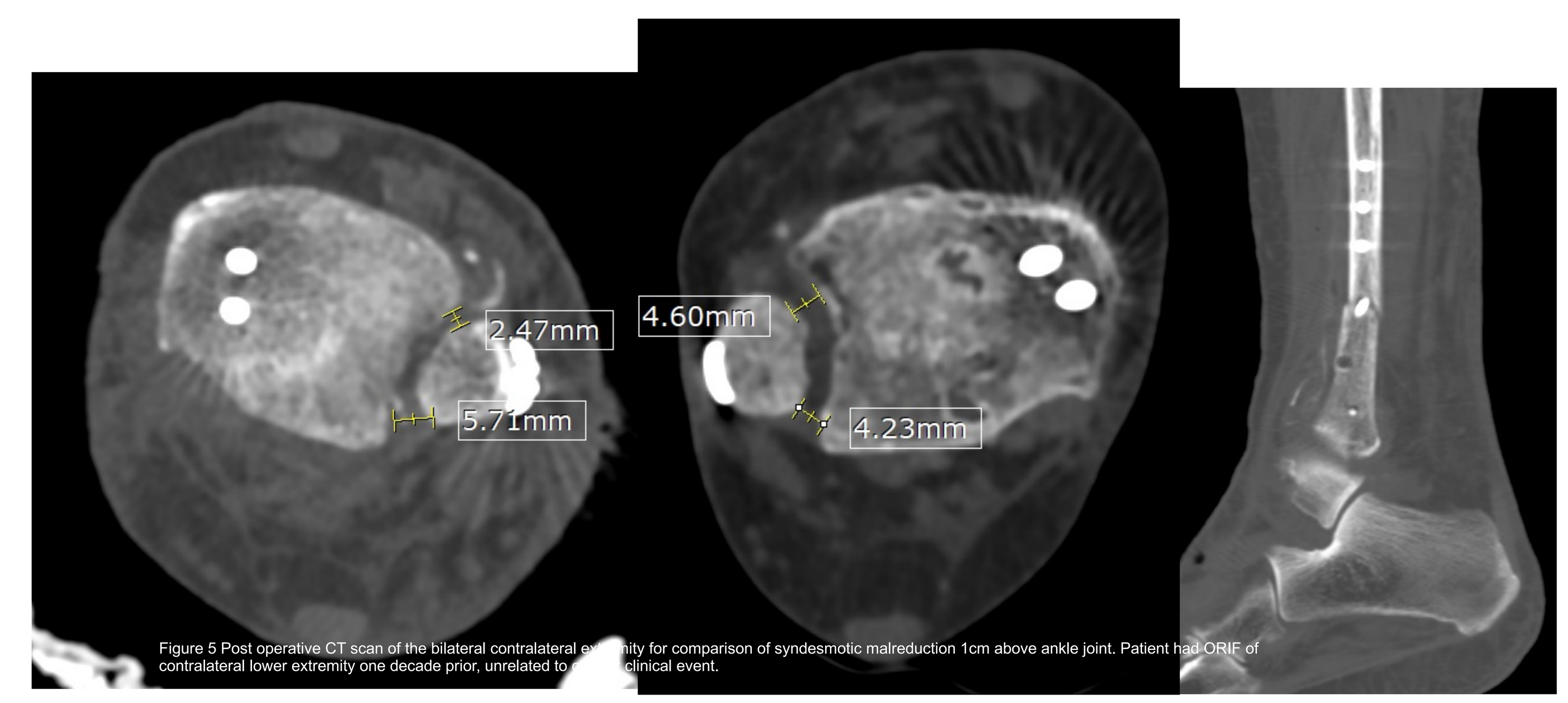

Figure 5 Post operative CT scan of the bilateral contralateral extremity for comparison of syndesmotic malreduction 1cm above ankle joint. Patient had ORIF of contralateral lower extremity one decade prior, unrelated to [illegible] clinical event.


Figure 6. Post operative radiographs after revision definitive fixation and syndesmosis repair with screw fixation.

Surgery 2:

We then proceeded with our revision open reduction internal fixation of bimalleolar fracture. Attention was directed to the lateral aspect of the left ankle, previous surgical incision was present. We then completed a standard lateral approach to the ankle. All hardware was removed except for the lag screw in the fibular for provisional stability and a single medial screw in the medial malleolus. A more robust 10 hole distal fibula anatomic titanium locking plate was pinned in place with use of provisional fixation. We placed a nonlocking 3.5-mm screw just proximal to our fracture to assist with reduction maintenance. Concomitantly, manual reduction with a combination of reduction clamp instruments were utilized to stabilize the entire distal fibula and its fracture segments in conjunction with the fibular plate for utmost precision during screw placement. As fixation was added the varus angulation of the lateral malleolar segment, improved in anatomic reduction. We then placed additional distal 2.7 mm locking screws and 3.5-mm nonlocking screws proximally in accordance with AO principles. Despite hardware placement, there was noted that the anterior migration of the proximal aspect of the plate thus owing to the poor bone density for fixation purchase that was eventually reduced with proximal screw placement. The previous screw within the medial malleolus was removed. fracture reduction clamp were used to manipulate in anatomically reduce the medial malleolus with addition of utilizing a freer elevator in the medial ankle joint gutter by applying an external rotation force on the fracture fragment for additional reduction maneuver. Provisional wires compatible with 4.0 mm and 4.5 mm lag screws were placed for additional stability. Fixation with use of headless fully threaded 4.0 mm lag screw and a 4.5mm partially threaded screw was utilized achieving reduction. Despite fixation there was a deficit visualized medially likely due to compression and impaction of the lateral portion of the medial malleolus that was intra-articular. Demineralized bone matrix made of beta-tricalcium phosphate graft puddy (Bonesync, Arthrex- Naples Fl) was placed to fill void to allow and augment scaffold for a medial buttress effect.

The syndesmosis was reduced using tactile manipulation and not use of clamp reduction. An ancillary anterior lateral incision was made over the syndesmosis, extended from her previous arthroscopic portal to ensure direct visualization of anatomic reduction. Mercedes-Benz sign was noted to be intact. The appropriate hole was selected on the distal fibular anatomic plate. We then proceeded with fixation with use of 2x 3.5 mm quadricortical syndesmotic screws. Upon placement of the first syndesmotic screw there was noted to be change in rotation of our distal fracture fragment despite plate fixation. Given compromised viability of her bone from revisional surgery we opted to maintain fixation as we still felt we had reasonable length and angulation. Multiple images were also obtained which demonstrated that the talus was anatomically reduced within the ankle mortise therefore we proceeded with fixation of the second screw. Under live mortise view we performed stress testing which demonstrated improved stability and alignment of the tibiotalar joint. Final AP, mortise, lateral radiographs of the left ankle which showed appropriate reduction and safe placement of hardware in all views. All incisions were flushed with care taken not to disturb bone graft. Incisions were sequentially closed. Splint and incisional wound vac applied. Post operative films were taken (Fig 6).

Postoperatively she followed up without complications. Incisions were healed at 2 weeks without complication. She progressed to partial WB with mechanical assistance at 2 weeks and was placed into it CAM boot walker where she maintained non weight bearing however was able to do minimal range of motion exercises out of the boot. At 4 weeks she was transitioned to be to touch weight bearing in CAM walker with use of assistive wheeled walker. 6 weeks postoperatively she began physical therapy. During follow up she was able to dorsiflex without pain with only minor pain during ambulation. She was transitioned to weightbearing in a CAM boot at as tolerated without assistance at 8 weeks where she remained until 13 weeks post operatively where she was progressed to lace up ankle brace and normal shoe gear. Syndesmotic screws remain in. Screw breakage post operatively did not occur. The patient is currently 11 months post op and is fully weightbearing as tolerated and has progressed back to normal functions.

Analysis and Discussion

- Overcompression and malreduction of the syndesmosis are of concern in any pronation external rotation injury.
- During initial evaluation it was though that overcompression was due to suture button fixation and subsequently caused the malreduction and anterior displacement of the fibula. It wasn't so much as over compression as it was malreduction of the distal fibula. The talus will follow the lateral buttress, and in our case, it was anterior displacement with an apex posterior fibular fracture.
- Fluoroscopy can be misleading, as evident by changes seen during post operative radiographs with a higher strength fluoroscopy machine, and this was learned in this case.
- The wrong choice after the initial surgical intervention was utilizing another suture button fixation device in the form of dynamic stabilization. Screw fixation would have been the more adequate choice for this patient. Under appreciation of miniscule details and gentile manipulation cannot be overstated.
- Bilateral injuries can make the CT evaluation of over compressions misleading. Where in this case the contralateral extremity has fixation, and it can be assumed that there is inherent bias that limb is not anatomic, and therefore comparison for overcompression may be skewed.
- Its been discussed recently in literature by Duggan et al that bone mineral density affects the strength of dynamic syndesmotic fixation in their cadaveric pilot study on center center technique with syndesmotic fixation[24]. Furthermore, the dynamic fixation with frank syndesmotic injury does not provide rigid fixation for unstable injuries as compared to screw fixation.
- Studies show that dynamic fixation allows for less malreduction overall[1-7]. We believe as it has not been mentioned in literature that the drilled canal of the syndesmosis for dynamic fixation offers too much flexibility and motion to where it does not provide a rigid enough fixation, especially in patients with unstable injuries and moreover syndesmosis injuries in conjunction with elderly patients with osteoporosis. This all can contribute to post operative malreduction of the incisura.
- Furthermore, plate flexibility for allowing fracture gapping as different type of 1/3 tubular plates are made with different materials and varying level of thicknesses.
- The fibula fracture pattern that is a part of a typical rotational ankle fracture injury must anatomically reduce with concomitant length, rotation, and alignment anatomically restored prior to syndesmotic fixation, either dynamic or screw fixation. Without anatomic reduction the fibula more easily will allow for talar subluxation upon restoration and compression across the distal tibia fibular syndesmosis. Care must be taken to restore the sagittal alignment of the fibula in that anterior or posterior translation of the lateral malleolar fragment with dictate the position of the talus as seen in our case. Lastly, traumatic, and rotational ankle fractures remain a challenging and complex issue for foot and ankle surgeons. The best outcomes result when the utmost priority is anatomic reduction and appropriate choice of fixation for achieving restoration to the apparent injury.

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