Tibia-through-Fibula: A Novel Anatomic Repair Technique for the Distal Tibiofibular Syndesmosis

Amanda M. Kohut DPM[1], Kyle Mauk DPM[2], Jason A. Piraino DPM, MS, FACFAS[3]

Department of Orthopedics, Division of Foot & Ankle Surgery, University of Florida Health Jacksonville

[1]Third Year Podiatric Surgical Resident, [2]Assistant Professor and [3]Chief of Foot & Ankle Surgery/Residency Director, UF College of Medicine

UF UNIVERSITY of FLORIDA College of Medicine Jacksonville

Statement of Purpose

Restoring anatomic congruency of the distal tibiofibular syndesmosis after an ankle injury is essential in preventing post-traumatic sequela. The practice of syndesmotic fixation via dynamic constructs are slowly gaining favor, as the physiologic motion of the joint is maintained. Static hardware failure has been attributed to the prevention of functional motion through the syndesmosis, routinely necessitating additional reoperation expense for removal. We present a novel approach for anatomic reconstruction of the syndesmosis, embracing the dynamic property of the joint and evaluating the postoperative functional and clinical outcomes.

Methodology

The University of Florida College of Medicine Institutional Review Board approved this study. A retrospective review was performed on patients who underwent ankle fracture ORIF with syndesmotic stabilization using the aforementioned novel technique (by a single surgeon, J.P.). The inclusion criteria were acute (within 1.5 months) closed ankle fractures that underwent ORIF with this procedure, who had at least one year of follow-up and complete AOFAS scores. Medical charts, operative reports, and radiographs were reviewed by one surgical resident, (A.K). American Orthopedic Foot and Ankle (AOFAS) Hindfoot and Lower Extremity Function (LEFS) scores were recorded at 5 different time frames for each patient: pre-operatively, 8 and 12 weeks, 6 months and 1 year post-operatively. Orthogonal radiographs at similar times were also reviewed. Maintenance of correction was supported by analyzing tibiofibular overlap, reduction of medial clear space, and ankle mortise alignment as per standard methods. Complications and the incidence of hardware removal were also evaluated. We hypothesized that performing syndesmotic reduction with flexible fixation would embrace the physiologic function of the tibiofibular joint, leading to equivocal, if not better, patient outcomes with reduced rates of hardware removal than standard screw implantation.

Results

Of the 22 consecutive patients who underwent ORIF with dynamic syndesmotic stabilization, 14 patients met inclusion criteria. The cohort consisted of 5 male and 9 female patients with a mean age of 43 (range 20-66). There was a total of 3 complications (21.4%). Two of the three were due to superficial soft tissue infections treated effectively with oral antibiotic therapy. The one revisional complication was due to loss of reduction after a fall one month postoperatively. There were no deep vein thromboses or infections requiring intravenous antibiotics. At one year, 13/14 (92.8%) patients had normal weight-bearing radiographs, alluding to intact suture constructs. AOFAS scores improved significantly from an average pre-operative value of 19 to post-operative value of 92 (out of 100) at one year follow-up. LEFS showed improvement of function from 32.5% to 72.25% postoperatively, which is also a statistically significant increase.

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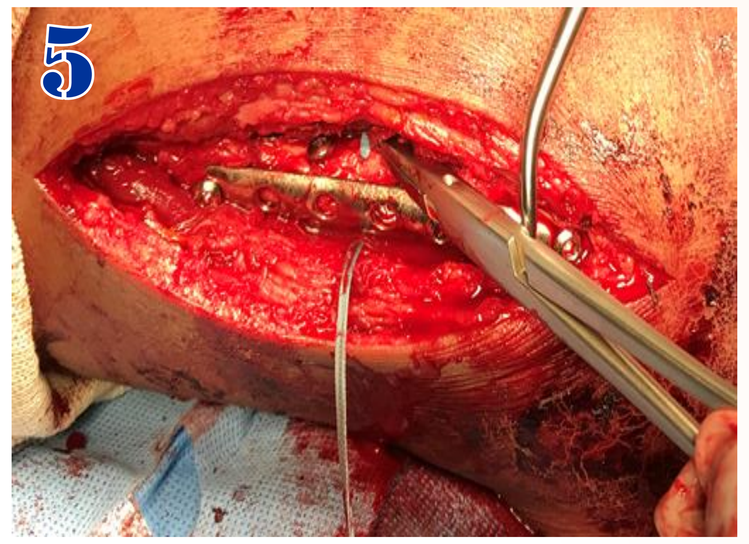
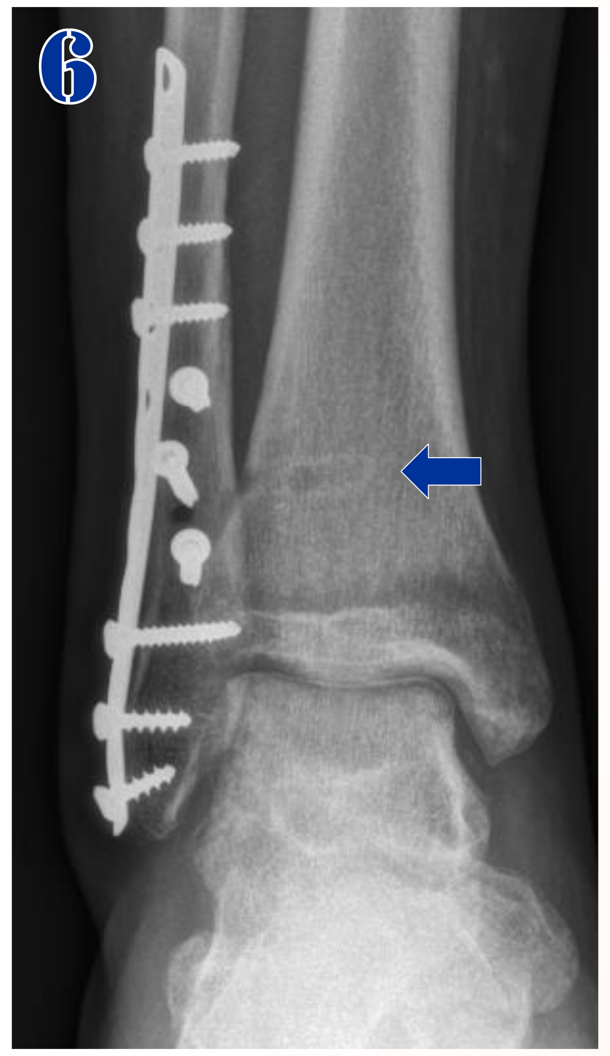
Procedure

All ankle fractures were fixated with standard AO technique, utilizing fully-threaded cortical or cancellous screws and various plates. Syndesmotic stabilization was performed in the following manner by the primary surgeon (J.P.).

- **<u>Construct</u>**
  - **One suture anchor loaded with a multi-stranded high molecular weight polyethylene suture tape passed through a fibular tunnel**
  - **A second knotless suture anchor mimicking the anterior and posterior inferior tibo-fibular ligaments**
- **<u>Technique</u>**
  - **After successful reduction and fixation of the ankle fractures via standard AO technique, the syndesmosis was stressed under intraoperative fluoroscopy. When found to be insufficient, dynamic stabilization was performed. Bone clamps are utilized to hold reduction of the syndesmosis in desired position.**
  - **The first anchor with suture is placed into the anterolateral tibia just proximal to the inferior tibiofibular joint and anterior to the fibula. (Fig. 1-2)**
  - **A 2.5mm drill hole is created at this same level through the fibular shaft in an anterior to posterior direction and the suture tail is passed through this osseous tunnel out the posterior aspect of the fibula. (Fig. 3-5)**
  - **The suture is then attached to the second anchor and placed into the postero-lateral aspect of the tibia, just posterior to the fibular shaft.**
  - **The suture is fully tensioned prior to insertion. The bone clamps are removed and the syndesmosis is stressed under intraoperative fluoroscopy and noted to have no diastasis.**
  - **This construct mimics the anatomic trajectory of the anterior inferior tibiofibular and posterior inferior tibiofibular ligaments and restores the physiologic motion of the joint.**





5) Anterior anchor placed with suture tape, fed through fibular tunnel, ready for implantation via anchor into posterolateral tibia
6) 8 week weight-bearing post-operative AP radiograph displaying osseous fibular tunnel (bullethole) and suture anchor tracts (arrow) with maintenance of reduction, normal tibiotalar articulation and no increase in medial clear space

1) Suture anchor locked and loaded for insertion into anterolateral tibia, mimicking the anteroinferior tibiofibular ligament
2) Suture trochar trajectory on anteroposterior fluoroscopic image (the reduction forceps would be removed prior to full tensioning of suture tape and full insertion of anchor
3) Anterior to posterior drilling for fibular tunnel
4) Lateral fluoroscopic image displaying trajectory

Discussion

- **Distal tibiofibular syndesmotic injuries can involve the anteroinferior tibiofibular ligament (AITFL), posteroinferior tibiofibular ligament (PITFL), and interosseous tibiofibular ligament (ITFL). Syndesmotic injuries can occur in up to 13% of external rotation ankle injuries. Posttraumatic osteoarthritis, functional disability, and persistent ankle pain can develop from the abnormal ankle joint biomechanics and articular contact pressures. The importance of anatomic reduction of the joint is paramount when treating these patients.[1]**
- **The proper way to address distal tibiofibular syndesmosis repair after destabilizing ankle fractures is a controversial topic in current foot and ankle literature. There exists a myriad of fixation options, all with an emphasis on anatomic reduction while avoiding malreduction of the syndesmosis.[2] Long-regarded as the gold standard for stabilization, static screw use limits physiologic syndesmotic motion and can result in breakage. Recent studies cite screw removal as high at 40%[3], influencing the paradigm shift to more flexible repair of the syndesmosis[8]. However, dynamic repair is not without it's own issues – disadvantages to the technique include high cost, steep learning curve, and gradual relaxation under weight-bearing conditions.[4,5,9]**
- **A recent systematic review by Zhang et al compared AOFAS scores and complications of suture-buttons and traditional screws. The authors found that for dynamic stabilization (150 patients), the AOFAS score was 91.06, implant removal of 3.7% with no documented implant failures, and 1% malreduction. In contrast, the static fixation group (134 patients) had AOFAS scores of 87.78, implant removal of 40% with 30.9% implant failure and 12% malreduction. Postoperative complications were 12% and 16.4% respectively. The authors concluded that although functional outcomes and complication rates were equivocal between the two methods, the dynamic fixation group had better range of motion and earlier return to work.[3]**
- **Traditionally, the relatively high cost associated with suture buttons was believed to have been offset by the significantly lower rate of reoperation. As the practice of routinely removing syndesmotic screws has drifted towards removal only if symptomatic, the cost-effectiveness dynamics have changed substantially. Two recent cost-effect analyses have shown that for reoperation rates below 10% [7] and 17.5% [6], suture buttons are favored over screw fixation.**

Conclusion

The procedure has shown good satisfaction rates in this small patient population with maintenance of anatomic reduction at one-year follow-up. As this is an ongoing study, future research will encompass a larger patient cohort, with the expectation of similar functional outcomes. None of the patients necessitated hardware removal due to non-traumatic hardware failure or symptomatic implants as is common with static screws and suture buttons respectively. Presented is a novel physiologic reconstruction technique for syndesmotic repair which mimics the dynamic function of the joint and is effectively without conventional hardware concerns.