Percutaneous Chrisman-Snook Double Ankle Ligament Repair with Suture Anchors: A Case Series and Surgical Technique

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Abstract

Lateral ankle sprains, if a candidate for surgical repair, are classically repaired with a Brostrom or Brostrom-Gould approach with numerous modifications that have included open or arthroscopic repair. However, many patients with significant instability require a double ligament repair to the anterior talo fibular ligament (ATFL) and calcaneofibular ligament (CFL). To date, this has most successfully been repaired with an open Chrisman-Snook procedure with use of a split peroneal brevis tendon or allograft. The present study examines n=12 patients with lateral ankle instability who underwent a double ankle ligament repair with suture anchors performed percutaneously. The patients were followed up for a mean of 24.2 (9-38) months. The mean time to full weight bearing was initiated at a mean of 21.3 (18-29) days. All patients participated in physical therapy by week 4. They were transitioned into an ankle stabilizing orthosis brace on average of 3.5 weeks. Overall, there were only 4 reported post-operative complications including suture reaction, 2 cases of neuritis, and a DVT. We have shown that patients with a minimally invasive percutaneous technique have an improved post-operative recovery in terms of pain, functional outcome and clinical outcome and may begin weight bearing earlier than previously studied. To review a novel approach including surgical technique to double ankle ligament repair with suture anchors in a percutaneous fashion.

Introduction

Acute ankle sprain is one of the most common musculoskeletal injuries, accounting for an estimated 2 million injuries per year and 20% of all sports injuries in the United States [1]. Patients will report symptoms including pain, instability, “lack of trust in ankle,” difficulty in activities, weakness, or “rolling of ankle” [2]. Non-operative care is initially recommended in mild ankle sprains including RICE (rest, ice, compression, elevation) and eventual functional rehabilitation [3]. Most patients will recover well with non-operative therapy. However, acute ligament tears and those with chronic ankle instability often require operative ankle stabilization to improve pain and function.

Historically lateral ankle stabilization procedures have been described as either anatomic or non anatomic repairs [4]. Anatomic repair utilizes pre-existing ligament remnants that are either reattached or tightened to improve stability of the ankle [5]. The original anatomic procedure is classically described by [6] in 1966, later modified by Gould et al. [7]. If an anatomic repair is insufficient or the ligament structures are beyond repair, then a non anatomic (anatomic reconstruction) technique is used [5,8]. Updates, modification and additional procedures including the more minimal arthroscopic approach and use of stronger constructs (i.e., anchors) have been described in published literature with superior results [5,9,10].

Glazeman et al. performed a minimally invasive approach to the Chrisman-Snook with a free tendon graft however demonstrated risk for graft rejection, higher cost for allograft use, and is more technically challenging. In recent years, procedures using a suture anchor for various types of ligament or tendon reconstruction have been widely reported and have shown to be technically easy with excellent outcomes [9,11,12]. Suture techniques have shown to minimize the ligament-bone interval by strong fixation forces in the early post-operative period and maintain sufficient strength against repetitive mechanical load, ultimately leading to biological recovery of the ligament and bone tissue [9]. To date, however, there are no reported studies taking the success of a double ligament reconstruction with use of suture anchors in a minimally invasive approach.

We have performed a percutaneous modification technique using suture anchors into the fibula, talus and calcaneus to reinforce both the ATFL and CFL repair. We believe this
provides a strong construct, less post-operative complications and enables patient to return to weight bearing earlier, initiate physical therapy and overall shows better patient outcome.

**Patients and Methods**

N=12 lateral ankle ligamentous reconstructions were performed. Preoperative and follow-up physical examinations consisted with inversion and eversion stressing, range of motion, anterior drawer tests, crepitation and tenderness. Magnetic Resonance Imaging and stress X-rays were obtained prior to surgery for evaluation of the lateral ankle complex pathology. At follow-up, additional radiographic imaging were evaluated for maintenance of the suture anchor position and ankle joint alignment. All operative procedures and physical examinations were performed by the senior author to ensure uniform results.

**Surgical Technique**

Each patient received a peripheral nerve block to anesthetize the ankle. They were brought in to the operating room and placed in a supine position with bolsters and bumps to internally rotate hip and have adequate exposure to the lateral ankle and foot. A well-padded thigh tourniquet was placed on the patient. A skin marker was used to outline the anatomy including distal fibula, peroneal tendons, intermediate dorsal cutaneous nerve, sural nerve, ankle joint, and lateral talar neck (Figure 1).

![Figure 1: Percutaneous Chrisman-Snook procedure.](image)

A. Orientation of the reconstruction of the ATFL and CFL utilizing bone anchors.
B. ReelX (blue) and ICONIX (green) placement with portal locations 1, 2 and 3.

Next, attention was directed to the lateral ankle where a 1.5 cm longitudinal incision was made along the anterior aspect of the lateral gutter extending distal laterally [PORTAL 1]. Blunt dissection is made through the subcutaneous tissue with care to neurovascular structures. A linear incision through the periosteum anterior to fibula was made to expose the distal anterior aspect of the lateral malleolus (Figure 2).

A 2.3mm drill guide is positioned to anterior aspect of the distal fibula with positioning confirmed under fluoroscopy. A guide hole was drilled with care to avoid the posterior cortex of the fibula. An anchor was then inserted and seated in place with a mallet. The placement of the anchor was confirmed with fluoroscopy. The anchor system used was a 2.3mm all suture anchor system (ICONIX, Stryker, Paramus, NJ). The drill guide is removed and the all suture anchor is released and the four strands of #2 ribbon are now visualized (Figure 3A & 3B).

![Figure 3A: Drill Guide Placement.](image)

![Figure 3B: All Suture Anchor System.](image)

Next, a tendon passer is placed through the incision and angled towards the direction of the anterior talo-fibular ligament (ATFL) insertion with care taken to stay intracapsular, deep fascia and above the periosteum of the talar neck and tension the skin to locate accessory incision point [PORTAL 2]. Utilizing a #15 blade, a small focal linear longitudinal incision is made for the tendon passer to come through (Figure 4A). Blunt dissection to expose the talar neck laterally is made. Next, a 4.0mm drill guide is positioned lateral to talar neck with care to avoid the sinus tarsi and invade the subtalar joint (Figure 4B).

![Figure 4A: Tendon Passer guide towards insertion of the anterior talofibular ligament (ATFL) creating Portal 2.](image)
Temporary placement of a Kirschner wire is used into drilled site to maintain location of future anchor site. Next, utilizing a tendon passer, obtain two of the #2 ribbon threads and lasso them towards the ATFL insertion and out through the incision site. (Figure 5A & 5B).

Next, attach the ICONIX two strands into the ReelX guide and insert anchor into the drilled site at PORTAL 2. (Figure 6A & 6B) Position is confirmed under fluoroscopy. An anchor was then inserted and seated in place with a mallet. (Figure 6C) The placement of the anchor was confirmed with fluoroscopy. The anchor system used was a 4.5mm knotless PEEK anchor system (ReelX STT, Stryker, Paramus, NJ) The drill guide is removed and the PEEK anchor is released and 2 strands of ultra high molecular weight polyethylene and the #2 ribbon from ICONIX are visualized.

Utilize a hemostat to bluntly dissect deep to the peroneals and against the lateral subtalar joint but dorsal to the periosteum towards the insertion of the calcaneofibular ligament (CFL) (Figure 7). [PORTAL 3] With the hemostat, tent the skin near the landmark of the calcaneal insertion of the CFL (lateral tubercle on the lateral surface of the calcaneus) to create a portal incision with a #15 blade (Figure 8A & 8B) and with a 2-0 vicryl hand tie, pull back through the skin exiting Portal 1. Obtain the final two strands of the #2 ribbon threads and lasso them towards the CFL insertion and out through Portal 3. (Figure 9A-9C).
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Figure 8B: Utilize a tendon passer with 2-0 hand tie and pull back towards Portal 1.

Figure 9A-C: Sequential steps of gathering the final #2 strands of the ICONIX sutures to recreate the CFL at Portal 3.

Figure 10A: ReelX Tapping.

Figure 10B: Application of the second ReelX anchor into the calcaneus with the ICONIX sutures incorporated.

A second ReelX bone anchor was inserted using the same technique as Portal 2, with placement in the calcaneus to secure the ICONIX suture to mimic the CFL (Figure 10A & 10B). The placement of the anchor was confirmed with fluoroscopy. A probe is used to gather all strands from the portals subcutaneously with all strands exiting portal 1. It is important to maintain the foot in a neutral position in relation to the leg. Secure the strands with hand tie technique. All strands are cut flush to bone with a #15 blade with additional tension applied to the sutures (Figure 11A-11C). The skin incisions were re-approximated, closed and a sterile dressing was applied followed by a posterior splint in a neutral position. Patients were placed in CAM boot at post op week 1, allowed to partial weight bear at week 2 and full weight bear at week 3.

Figure 11A: Gathering all suture from Portals 1 & 3 with tendon passer.

Figure 11B: Pull all sutures through exiting portal #1.

Figure 11C: Plan to cut fiber tape with #15 blade flush to bone.

Results

Follow up physical examinations showed that all patients had a negative anterior drawer and talar tilt test. N =4 complications noted including 2 cases of sural neuritis, DVT and deep suture reaction. The 2 cases of transient sural neuritis improved over time with one patient requiring 2 corticosteroid injections providing permanent relief. The patient with the deep suture reaction required removal of the ATFL ribbon that was ejecting from the portal site and was successfully closed 8 weeks post.
op. Clinical evaluation at 4 weeks post op showed excellent range of motion with minimal swelling (Figure 12A & 12B). (supplemental video available) No patients reported recurrence of ankle instability in their operated ankle(s). Post-operative serial radiographs were taken to confirm continued stability of the ankle joint and maintained anchor positioning (Figure 13A-13C).

Figure 13A-C: Postoperative radiographs with noted anchor placement and rectus ankle mortise.

From our results, we demonstrate a novel surgical approach to the double lateral ankle procedure that is effective in stabilizing the ankle, early mobility and shows fewer side effects. Our current technique does not require the use of a free graft, the technical demands of arthroscopic anchors and shows good early clinical results without any major complications.

Discussion

There have been several modifications to the lateral ankle stabilization from anatomical repair to non-anatomical reconstructive surgery. The Brostrom or Brostrom-Gould modification, although able to restore good stability of the ankle for a ruptured ATFL, is often insufficient for unstable ankles involving both the CFL and ATFL. The need for both ankle and subtalar joint restoration is important to avoid disabling instability [10,13,14]. In order to provide sufficient stability to both the ankle and subtalar joint, there is high emphasis to support both the CFL and ATFL [15]. Clinical correlation to support surgical planning includes both the anterior drawer and the talar tilt test. While the anterior drawer test alone is best used to evaluate the ATFL ligament, excessive talar tilt has been shown to be due to a laxity of both the ATFL and CFL [13-16]. When there is excessive talar tilt, this will require additional stability to the subtalar joint by augmentation to both the CFL and ATFL. In 1969, GA Snook and OD Chrisman understood this by creating an effective procedure for lateral ankle instability which is still the most effective double ligament repair to date [17].

The long term results of the Chrisman-Snook operation showed good long-term function in 93% of patients over a range from four to forty-eight years [18]. The original operation utilized one-half of the peroneus brevis tendon to replace the damaged lateral ligaments. Although the original authors argued to diminish the concern on losing the peroneal brevis function over lateral ankle stability, today, many find the imbalance a high post-operative complication. With the introduction of free grafts and suture anchors, double ligament support is possible with the same goals and ideal outcomes as the original procedure [5,9,19].

Successful surgical intervention for lateral ankle stability is based on both functional and mechanical outcomes. Recently, there have been advances in the field of arthroscopic and minimally invasive ankle stabilization techniques [5,19-21]. These procedures have shown faster recovery compared to open techniques [22]. The encouragement of minimally invasive technique have allowed for changes in post-operative protocols to early mobilization. Karlsson et al. [23] showed comparison between groups of early mobilization with immobilization and found those with earlier mobilization were able to return to sports earlier and achieved greater range of motion to the ankle [23]. By utilizing a percutaneous technique, this offers a simpler conceptualization without compromising effectiveness. Through smaller incisions, reliability of fluoroscopic guidance, and anatomic approach, this is favored over previously reported open procedures. There have been clinical studies with favored outcomes utilizing suture anchors in modified Brostrom procedures showing excellent clinical and functional outcomes with improved mechanical stability [11,12,16,24].

We argued to incorporate the effectiveness of the Chrisman-Snook procedure with the use of suture anchors in a minimally invasive approach in lateral ankle instability patients. All 12 patients did not have any recurrence of instability 1 year post-operatively and were able to return to normal activities with no limitations. Limitations within our study are lack of comparison group, small sample size and short follow up period.
Conclusion

In conclusion, we have demonstrated the percutaneous modified Chrisman-Snook with bone anchors is a minimally invasive anatomic reconstruction approach for lateral ankle instability that is easily reproducible, aims to achieve early rehabilitation, and long term mechanical and functional stability. Further studies would be useful to evaluate.

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