Outcomes of the Chrisman-Snook and Modified-Broström Procedures for Chronic Lateral Ankle Instability

A Prospective, Randomized Comparison

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ABSTRACT

We prospectively and randomly compared the outcomes of the Chrisman-Snook and modified-Broström procedures for chronic lateral ankle instability in 40 patients. Both operations provided good or excellent stability in more than 80% of the patients. However, the modified-Broström procedure resulted in higher Sefton scores than the Chrisman-Snook procedure. In addition, a statistically significant greater proportion of complications occurred in patients treated with the Chrisman-Snook procedure.

The Chrisman-Snook and the modified-Broström operations are commonly performed for chronic lateral ankle instability. In 1934, Elmslie reported using fascia lata graft to reconstruct the anterior talofibular and calcaneal fibular ligaments. In 1969, Chrisman and Snook modified the Elmslie procedure by eliminating the drill hole in the talus, creating a transverse drill hole in the fibula, and reconstructing the torn lateral ligaments with one half of the peroneus brevis tendon. In 1985, Snook et al. reported four additional modifications of the 1969 technique: 1) making a drill hole tunnel in the calcaneus, 2) suturing the end of the graft in front of the lateral malleolus, 3) placing the foot in only mild eversion while securing the graft, and 4) eliminating the recommendation for an ankle support or outer heel wedge after cast removal.

MATERIALS AND METHODS

Our prospective study was approved by the hospital research committee and informed consent was obtained from 40 patients (42 ankles) from July 1989 to August 1992. We evaluated only patients with isolated chronic lateral instability of the ankle. Inclusion criteria included skeletal maturity, a history of significant ankle injury followed by episodes of giving way for at least 6 months, and a positive anterior drawer sign on physical examination. Patients were excluded if they demonstrated a generalized ligamentous laxity disorder, had evidence of arthritis or tarsal coalition on radiographs, or had previous ankle surgery. Before surgery, all patients had participated in a physical therapy program that did not relieve their symptoms.

Thirty-six men and four women participated in the study. The average patient age was 26 years (range, 19 to 37). Thirty-nine patients were active-duty military personnel (27 sailors, 10 marines, and 2 army soldiers) and 1 was a military dependent. All patients were recreational
athletes. Twenty right ankles and 22 left ankles were reconstructed. Two patients had bilateral procedures: one patient had two modified-Broström procedures and another had two Chrisman-Snook procedures. The interval between procedures was 6 to 9 months for patients who had bilateral procedures.

Before surgery, the chief symptom of all patients was instability—frequent episodes of ankle sprains with giving way followed by pain and swelling. The interval from original injury until surgery averaged 5 years (range, 6 months to 20 years). Overall, the time from the injuries to the operations averaged 6.4 years for the Chrisman-Snook procedure and 4.5 years for the modified-Broström procedure. Ten patients had instability for more than 10 years.

All 40 patients had mechanical instability demonstrated by positive anterior drawer tests that were elicited manually as described by Hoppenfeld. Thirty-seven patients had increased inversion testing as described by Hoppenfeld. The anterior drawer test evaluates stability of the anterior talofibular ligament, and the inversion or talar tilt test evaluates the anterior talofibular and the calcaneal fibular ligaments. The modified-Broström procedure was performed, as described by Karlsson et al., with one half of the peroneus brevis tendon to reconstruct the anterior talofibular and the calcaneal fibular ligaments. 17

Standardized talar tilt radiographic measurements of ankle joint stability were made using TELOS equipment (TELOS, Weiterstadt, Germany), as described by Karlsson et al. 10, 11 The average radiographic talar tilt before surgery was 14° (range, 0° to 45°) in the operated ankles. The average radiographic talar tilt in the 38 contralateral uninjured ankles was 7° (range, 0° to 15°). Anterior drawer stress radiographs were not routinely performed.

All study participants were randomly assigned to the Chrisman-Snook or modified-Broström procedures by means of consecutively numbered envelopes that contained randomly allocated assignments. Sixteen men and 4 women had modified-Broström procedures, and 20 men underwent Chrisman-Snook procedures, thus forming two patient groups. The average ages of these patients were 25 years (range, 19 to 35) and 26 years (range, 19 to 35), respectively. The radiographic talar tilt measurements averaged 13° (range, 0° to 24°) for the modified-Broström group and 14° (range, 0° to 45°) for the Chrisman-Snook group.

We performed the Chrisman-Snook procedure as described by Snook et al., using one half of the peroneus brevis tendon to reconstruct the anterior talofibular and the calcaneal fibular ligaments. The modified-Broström procedure was performed, as described by Karlsson et al., with transection, shortening, reinsertion, and imbrication of the injured ligaments. Of the 21 ankles that had modified-Broström procedures, 7 had reconstructions of the anterior talofibular ligament only and 14 had reconstructions of the anterior talofibular ligament and the calcaneal fibular ligaments. The operations were performed by either staff orthopaedic surgeons or residents supervised by staff orthopaedic surgeons. Magnification with use of a loupe was done for all patients to minimize injury to the sensory nerves. All patients received antibiotics during surgery. The tourniquet time averaged 93 minutes (range, 67 to 114) in the Chrisman-Snook procedure and 67 minutes (range, 36 to 96) in the modified-Broström procedure.

Followup averaged 29 months (range, 6 to 49). At the most recent followup, 18 patients were available for an interview, physical examination, and radiographs. We interviewed 20 patients, who had relocated, by phone using a standardized questionnaire. Physical examinations were not obtained on these patients. Two patients were lost to followup. Functional assessments at final followups were graded according to the following criteria of Sefton et al. 23 Excellent, full activity, including strenuous sports, with no pain, swelling, or giving way of the ankle; Good, occasional aching of the ankle but only after strenuous exercise, no giving way or feeling of apprehension; Fair, residual instability and remaining apprehension but less instability and apprehension as compared with the patient's ankle condition before surgery; Poor, recurrent ankle instability and giving way, unchanged or worse in normal activities with episodes of pain and swelling.

After surgery, the ankle was immobilized in a bulky compression dressing with the ankle in the neutral position. Two weeks after surgery, the dressing and sutures were removed and a short leg walking cast was applied for 4 weeks. After the plaster cast was removed, the patient began dorsiflexion and plantar flexion exercises. Athletic activity was restricted for 3 months after cast removal. After surgery, the 39 active-duty patients were placed on limited-duty status that excluded ship deployments and field exercises for 6 months.

Our statistical analysis included Fisher's exact test of contingency on categorical variables, Student's t-tests on means, F tests on variances for two-group measured variables, and one-way analysis of variance on measured variables with more than two groupings.

RESULTS

Both surgical procedures resulted in excellent or good results in more than 80% of the ankles. Specifically, for the Chrisman-Snook patients, the functional results were excellent in 3 ankles, good in 13, fair in 1, and poor in 2. Functional results for patients having the modified-Broström procedure were excellent in 10 ankles, good in 7, fair in 3, and poor in 1.

Eighteen patients (19 ankles) were available for clinical and radiographic follow-up examinations. Among the nine patients in the Chrisman-Snook group who were examined, one patient demonstrated an anterior drawer sign, but none showed an increase in inversion testing. Among the 10 patients in the modified-Broström group we examined, none demonstrated an anterior drawer sign and one showed increased inversion on testing. Postoperative talar tilt averaged 5° (range, 0° to 15°) for the Chrisman-Snook group and 7° (range, 6° to 15°) for the modified-Broström group. Both procedures improved the patients' radiographic talar tilt by an average of 8° as indicated by radiographs taken before surgery.

The Sefton scores were compared for patients undergoing the two treatments by a Fisher's exact test of contingency. The modified-Broström procedure resulted in better Sefton scores (P = 0.043) than the Chrisman-Snook procedure.
Significantly more complications (Fisher's exact test, \( P < 0.001 \)) occurred in the Chrisman-Snook group than in the modified-Broström group. For example, 5 of 20 patients who underwent the Chrisman-Snook procedure had postoperative wound complications. Three of these patients had wound infections and two had wound dehiscence (Fig. 1). Eleven of the patients who had the Chrisman-Snook procedure had sensory loss over the distribution of the sural nerve. Sensation returned for three patients within 3 months after surgery; however, eight patients had permanent sensory loss. Six patients in our Chrisman-Snook group reported that their ankles felt "too tight" and one of these patients developed painful iatrogenic flat foot, presumably due to overtightening of the ankle's lateral side. This patient underwent a second operative procedure.

No wound infections or dehiscence occurred in the modified-Broström patient group. However, two patients in this group had temporary paraesthesia in the distribution of the superficial peroneal nerve. No permanent nerve injuries occurred in the modified-Broström patient group. Two patients who received this surgical treatment reported that their ankles felt "too tight."

Two patients who had Chrisman-Snook procedures reported residual instability that was unchanged or worse than before surgery, and these two results were graded as poor. Both patients had repeat injuries to the ankle after surgery. One patient (modified-Broström procedure) had a poor result. He did well until 15 months postoperatively, when he reruptured the repair on a Marine Corps obstacle course. He subsequently underwent a Chrisman-Snook procedure at another institution. After this second surgical procedure, he developed a wound infection and partial dehiscence. On followup at our hospital, 37 months after his initial modified-Broström operation and 16 months after the secondary Chrisman-Snook procedure, he reported pain, limited eversion, and decreased sensation over the lateral foot; he was unable to perform his Military Physical Readiness Test.

Among the 39 study participants who were on active military duty, 6 of 20 patients in the Chrisman-Snook group and 5 of 19 patients in the modified-Broström group were discharged from the service before their anticipated separation date because they were unable to perform their jobs because of ankle symptoms. The higher the Sefton score, the fewer discharges from active duty were seen (Fisher's exact test of contingency, \( P = 0.017 \)).

DISCUSSION

Chronic lateral ankle instability resulting from trauma stems from injury to the anterior talofibular and calcaneal fibular ligaments. The anterior talofibular ligament passes from the anterior distal fibula to insert horizontally on the neck of the talus. The calcaneal fibular ligament spans the ankle and the subtalar joint and arises from the fibula and passes obliquely to insert on the calcaneus.\(^1\) The anterior talofibular and calcaneal fibular ligaments function together at all positions of ankle flexion to provide lateral ankle stability. The anterior talofibular ligament is most likely to tear if the ankle is inverted in plantar flexion and internal rotation; however, the calcaneal fibular ligament tears during inversion if the ankle is dorsiflexed.\(^13\) The anterior talofibular ligament is the most commonly injured ligament of the lateral ankle because most ankle sprains occur during plantar flexion and inversion. In severe ankle sprains, the calcaneal fibular ligament is injured in combination with the anterior talofibular ligament.\(^4\) Occasionally, the calcaneal fibular ligament is injured alone; this type of injury can occur when the foot is in dorsiflexion and inversion at the time of trauma.\(^18,19\)

The modified-Broström and Chrisman-Snook procedures have similarly high rates of good and excellent clinical results in more than 85% of the patients studied in published series.\(^1,2,6,10,11,14,20–22,24\) For example, Snook et al.\(^24\) reported on 48 patients who had 93% excellent or good results after Chrisman-Snook procedures; followup of these patients averaged 10 years. Three of the 48 patients had recurrent instability. All three patients sustained significant reinjuries. One third of the patients' ankles had limited subtalar motion compared with the opposite side; however, Snook et al. wrote that up to 20% loss of inversion was consistent with results of the procedure and that this loss did not cause problems. Other authors report good stability after Chrisman-
Snook procedures, but they also report significant complications.3,16,20,21

The incision needed to harvest the tendon is long (about 15 cm) and leaves a long scar in the area of the sural nerve. Sural nerve entrapment has been reported to occur in up to 30% of patients.16,21 Snook et al. reported 14 cases of sural nerve numbness after surgery. Four patients had permanent injuries to the sural nerve and one patient underwent excision of a sural nerve neuroma with partial relief of symptoms.24 Despite using loupe magnification during all cases in an effort to prevent nerve injuries, eight of our patients sustained permanent sural nerve injury. This high rate of nerve injury may be due, in part, to orthopaedic residents performing surgery under staff supervision. The high rate may also reflect an accurate recording of a sometimes overlooked complication.

The soft tissues on the lateral side of the ankle are very sensitive, and skin slough has been reported. Rechtine et al.20 reported a 12% (3 of 25) incidence of skin slough and one deep infection—osteomyelitis of the calcaneus. Snook et al.24 reported a 4% incidence of delayed wound healing in 48 ankles. We report two patients with wound dehiscence and three with superficial wound infections.

Although the Chrisman-Snook procedure attempts to reconstruct the anterior talofibular and calcaneal fibular ligaments, the modifications of the original Elmslie operation by Chrisman and Snook are not anatomic. Occasional loss of motion occurs in the ankle or subtalar joint because of excess tension when tightening the graft24 or possibly nonanatomic realignment of the ligaments.16 Horstman et al.9 found a high incidence of postoperative pain and loss of inversion after the Chrisman-Snook procedure. Snook et al.24 mentioned three cases of painful limitation of inversion in their 1985 report, and they modified the original intraoperative recommendations from the 1969 article.3 Snook et al. now recommend placing the foot in "mild eversion" rather than "forced eversion" when tightening ligament reconstruction. We reported one case of painful iatrogenic flat foot, presumably secondary to overtightening of the lateral side of the ankle. In addition, six patients who underwent the Chrisman-Snook procedure reported the subjective sensation of their ankles being too tight, compared with two patients who had similar descriptions of ankle tightness after modified-Broström procedures.

The rationale for the modified-Broström procedure is to repair the lateral collateral ligaments without using additional tendons. Instead, the ligaments are divided, shortened, reinserted, and imbricated. A modified-Broström procedure is simpler and easier to perform and does not prohibit doing a Chrisman-Snook procedure at a later date should the modified-Broström procedure fail. Healthy tissues are not sacrificed, resulting in a more anatomic lateral ligament repair.

Karlsson et al.11 reported 87% good or excellent results in 152 ankles with average followups of 6 years. Residual mechanical instability was most often seen in patients with histories of more than 10 years of instability before surgery and generalized joint laxity, and when the antero-
In addition, the importance of radiographic stress tests to demonstrate instability is controversial. Chrisman and Snook 23 and Snook et al. 24 did not routinely use or report stress radiographs. Other authors believe that stress radiographs are indicated to evaluate the chronically unstable ankle. 12, 16 Karlsson et al. 10–12 used the TELOS device for radiographic evaluation before and after surgery. Karlsson and Lansinger 12 defined mechanical instability as anterior tibial translation more than 9 mm and defined excessive talar tilt as more than 8° as determined using TELOS equipment. They believed this radiographic method was highly reliable and showed correlation between functional and mechanical stability.

In our series, all patients had histories of trauma to the ankle, subjective symptoms of repeated giving way, and objective evidence of instability on physical examination. Stress talar tilt radiographs were standardized using the TELOS device. The change in mechanical instability as determined by radiographic talar tilt measurements was similar in patients who underwent Chrisman-Snook and modified-Broström procedures. Improvement of talar tilt averaged 8° for both groups after surgery.

CONCLUSIONS

In this study, the Chrisman-Snook and modified-Broström procedures effectively corrected lateral ankle instabilities; however, the rate of complications after the Chrisman-Snook procedures was significantly higher (P < 0.010) than the rate after the modified-Broström procedures. Overall, the modified-Broström procedures resulted in higher Sefton scores (P = 0.043) than did the Chrisman-Snook procedures. Anatomic ligament reconstruction with shortening, reinsertion, and imbrication of the injured ligaments is a simple procedure with good long-term results and few complications. In our series, modified-Broström anatomic ligament reconstruction was superior for chronic lateral ankle instability.

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