CHAPTER **17**

ANKLE ARTHROSCOPY, LATERAL LIGAMENT REPAIR, AND PERONEAL TENDON REEFING FOR CHRONIC LATERAL ANKLE INSTABILITY: THE TRIAD VERSUS ARTHROSCOPY WITH LIGAMENT REPAIR

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INTRODUCTION

Chronic lateral ankle instability is a documented complication following 10-30% of significant ankle sprains (1, 2). Some reports suggest that chronic instability remains about the lateral ankle as frequently as 40% of the time leading to high re-injury rates with increased and repetitive use of the same unstable ankle. Many surgical procedures have been described to reconstruct the lateral ankle ligament complex. Most foot and ankle surgeons would agree that the "gold standard" for continued ankle instability or recurrent sprains has been the Broström procedure with or without Gould type modifications (3). Commonly, the peroneal tendons are also used to reconstruct the lateral collateral ankle ligaments in an anatomic or nonanatomic manner. Many surgeons augment their modified Broström procedures with ankle arthroscopy to assist in evaluation of any intra-articular pathology and also reduce any intra-articular synovitis (4, 5).

Lateral peroneal pain is commonly associated with chronic ankle instability. It is the authors' belief that a low lying peroneus brevis muscle belly can lead to attenuation of the inferior portion of the peroneal retinaculum resulting in painful symptomatology following a severe ankle inversion injury (6). It is our hypothesis that peroneal pathology contributes to lateral ankle instability. Chronic synovitis, longitudinal rents or tears in the peroneal brevis, and incomplete or complete tears in the peroneal retinaculum can also lead to an inability of the peroneal tendons to react in a normal proprioceptive manner. Neither intra-articular repair of ankle ligaments nor the Broström-Gould procedure with its modifications address peroneal pathology (7).

The purpose of this study was to compare the post-operative course and subjective improvement between two study groups. The first group underwent an ankle arthroscopy and the standard Broström-Gould procedure. The second group (triad) underwent an ankle arthroscopy, the Broström-Gould procedure and excision of low lying peroneal muscle belly and/or tightening of the inferior peroneal retinaculum.

MATERIALS AND METHODS

A consecutive series of 993 patients were treated between August 2002 and May 2008 for acute ankle sprains in the authors' clinic. All patients were initially treated conservatively with immobilization and/or ankle bracing and/or physical therapy. Patients were excluded from the study due to diagnosis of fracture, osteochondral defect, previous surgery, inadequate fibular groove, or anterior lateral ankle impingement. Also excluded were patients with peroneal tendon pathology requiring direct repair, as peroneal tendon dysfunction was most likely the primary etiology rather than standard instability. Patients with neurologic or connective tissue disease were also excluded from the study.

Those who failed conservative treatment were given the option of surgical treatment. All preoperative patients reported continued anterior lateral ankle gutter margin pain. All procedures were performed by the same surgeon (JJA) and were done at two outpatient surgery centers and one outpatient hospital. A subgroup labeled "worker's compensation" was also evaluated that included 22 work injuries in which monetary compensation was typical and may skew the results in each group. Of 993 patients, 168 patients required surgical intervention. There were 71 patients in the Broström-Gould group (scope with lateral ligament repair) and 97 patients in the triad group (ankle scope, ligament repair, and peroneal tendon reefing). Of these patients, a total of 68 in the Broström-Gould group and 92 in the triad group were available for follow up. A modified American College of Foot and Ankle Society (ACFAS) hind foot ankle score system was used to obtain preoperative subjective scores (8). All patients were interviewed by the author and staff. There were 95 females and 73 males. Our mean age was 39.3 years with a range from 14 to 81 years. The average age for females and males in our study was 42.3 and 36.7 years, respectively. This supports average ages seen in previous studies by Karlsson et al (9). The two procedure groups were compared and a

Table 1

DEMOGRAPHICS

	Total no. (actual no.)*	Age (avg)	Smoker	Male/ female	Comorbidities†	Worker's comp
Brostrom + Scope	71 (68)	41.1	17 (24%)	31/40	11 (15.5%)	9 (12.7%)
Triad	97 (92)	37.9	15 (15.5%)	42/55	13 (13.4%)	13 (13.4%)
P		0.260	0.167	0.963	0.574	0.462

Total patients with ankle instability 993: 71 (7%) excluded, 754 (76%) treated conservatively, and 168 (17%) treated surgically.
*Actual number excludes patients lost to follow-up.
† Brostrom + Scope: 6 obese, 4 diabetes, 1 rheumatoid arthritis; Triad-6 obese, 7 diabetes.

chi-square analysis performed that determined there was no statistically significant difference between them (Table 1).

Preoperative magnetic resonance imaging (MRI) demonstrated a peroneal muscle belly extending at or past the distal tip of the fibula in 156 (~92%) of the total patients, 70 patients in the Brostrom and scope group and 86 patients in the triad group. This diagnosis was confirmed intra-operatively. A total of 45 patients exhibited synovitis of the peroneus brevis, peroneus longus, or both on MRI. A total of 12 patients had confirmed intrasubstance or longitudinal tears or rents of the peroneus brevis tendon. An additional 29 patients had confirmed intra-articular loose bodies of which 14 patients had confirmed osteochondral lesions of the talus.

Patients were examined by the primary author and the primary criteria for performing the triad procedure was retrofibular pain or swelling with or without concurrent MRI findings. The patients underwent surgery at an average of 6 months post injury with a range of 2.5 to 38 months. Follow-up appointments were scheduled at 2 week intervals for the first 3 months after which additional appointments were made based on individual patient progress. The patients were contacted at a mean follow up of 30 months with a range of 6 to 90 months for postoperative ACFAS scores, visual analog scale (VAS) scores, and overall satisfaction (yes or no). Patients were also asked to report the number of ankle sprains since surgery. A single sprain was considered a re-injury; whereas, multiple sprains with continued instability clinically, subjectively and objectively by stress radiograph were considered recurrent. Retrospective chart review was performed in order to determine the number and type of complications, as well as, individual patient postoperative course.

Surgical For Broström-Gould Procedure

A thigh tourniquet was applied and the standard medial and lateral ankle portals were entered with assistance from an ankle distracting unit. Gravity pressure was used to maintain joint distension. A full diagnostic arthroscopy including portal exchange occurred. Direct visualization of gross instability with forced inversion and anterior drawer was assessed. Arthroscopic ankle joint debridement of all scar and synovitic tissue was performed. Periosteum from the intraarticular aspect of the fibula was also resected. Pre- and post-debridement photos were taken and the scopes removed. The medial portal was closed using 4-0 nylon.

The lateral portal was extended to the distal tip of the fibula. Standard care was taken to avoid contact with neurovascular structures. Non-absorbable #0, #1, and #2-0 vicryl were used to re-approximate the anatomic alignment of the anterior talofibular and calcaneofibular ligaments and perform a vest-over-pants reefing of the lateral aspect of the extensor retinaculum or the Gould modification. The remaining incisions were closed utilizing 4-0 nylon. A modified cast splint was applied with the foot held in a dorsiflexed and everted position. The patient transitioned to an equalizer boot with passive range of motion at 2 weeks. Full weight bearing and physical therapy commenced at 4 to 8 weeks. The patient was allowed to return to full activity and sports at 8-12 weeks with an ankle stirrup brace.

Surgical Technique For Triad Procedure

The triad group consisted of a medial and lateral standard arthroscopy with portal exchange. Any intra-articular pathology was addressed similar to the Broström-Gould group. Following the ankle scope, a modified curvilinear incision was made directly over the lateral ankle gutter (Figure 1). Dissection was carried through the subcutaneous

Figure 1.

tissue exposing and incising the peroneal retinaculum. If present, low lying peroneal muscle belly was identified and debrided to approximately 5 cm proximal to the distal tip of the fibula. If synovitic or mucinous changes were present in the peroneal tendons, an open synovectomy was performed. The peroneal retinaculum was repaired in vest-over-pants type fashion including distally a direct calcaneofibular reefing along with the standard Broström-Gould modification utilizing #0, #1, and #2-0 vicryl and 4-0 nylon for skin closure. The triad group followed the same postoperative course as the Brostrom-Gould and scope group. A modified cast splint was applied for 2 weeks following transition to full weight bearing and return to full activity and sports at 8-12 weeks with an ankle stirrup brace.

RESULTS

Of 993 patients seen for acute ankle sprains, a total of 724 responded to conservative care. A total of 269 (27.1%) returned with chronic ankle instability after failing standard treatment including outpatient physical therapy and immobilization. Of the 269 chronic ankle instability patients, 30 (3%) patients elected to continue with an ankle support brace indefinitely and not proceed with surgery; 168 (16.9%) went on to surgery, 71 underwent modified Broström-Gould and ankle arthroscopy, and 97 underwent the triad procedure, 68 and 92 patients were available for follow-up, respectively.

There were 71 (7.2%) patients excluded from the study. A total of 38 patients had significant peroneal tendon dysfunction that included complete longitudinal tears of either or both peroneal tendons or peroneal subluxation, which required extensive repair, retrofibular groove deepening and/or peroneal tenodesis. An additional 12 patients with significant osteochondral lesions, greater than 0.5 Cm^2, were excluded given that significant joint pain was the primary cause for their continued pain. A total of 11 patients who required recurrent or revisional surgery with a modification of a peroneal tendon transfer or lateral ankle ligament reconstruction were excluded. Also excluded were 5 patients with significant anterior-lateral osteophytosis of the tibia and/or fibula causing lateral pain, impingement, and instability, which warranted an open exostectomy. Finally, 2 patients with mild cerebral palsy and 3 patients with underlying connective tissue disorders were excluded.

Patients from each group were contacted and evaluated using a modified ACFAS hindfoot and ankle scoring scale. The average preoperative ACFAS score was 76 in the Broström-Gould and ankle arthroscopy group and 75 in the triad group with a range between 66 and 90. Following surgery, the average ACFAS score was 89 in the Broström-Gould and ankle arthroscopy group and 92 in the triad group. The percentage of patients satisfied was 91% in the Scope and Brostrom group and 98% in the triad group. This approached significance with a P value of 0.05. The average VAS satisfaction score was 4.1 for the Broström-Gould group and 4.6 for the triad group. There was no statistically significant difference between preoperative, postoperative, and VAS scoring between the procedure groups (Table 2).

In the work injury group (Group B), the average preoperative ACFAS score was 69 with the Broström-Gould and ankle arthroscopy procedure and 70 with the triad procedure. Postoperative ACFAS scores were 81 and 85, respectively. The percentage of patients satisfied was 77% in the Scope and Brostrom group and 85% in the triad group. The average VAS satisfaction score was 3.6 for the Broström-Gould group and 3.7 for the triad group. Postoperative satisfaction and VAS scores between the worker's compensation (Group B) and all patients (Group A) approached significance with P values of 0.067 and 0.056, respectively (Table 3).

The complication rate was not influenced by age or surgeon experience. Of the Broström-Gould group 34 (50%) of all the patients had another ankle sprain and 12 (17.6%) of all those patients had continued chronic ankle instability. In the triad group only 10 (10.9%) of the patients had a re-injury and 4 (4.3%) had continued recurrent instability with multiple sprains. The triad group was statistically less likely to have a reinjury ($P < 0.001$) or recurrence ($P = 0.006$) when compared to the ankle scope and Brostrom group.

Three patients in the Broström-Gould group and 4 patients in the Triad group had non-persistent numbness over the superficial peroneal nerve laterally. No patient had deep venous thrombosis. Six patients in the triad group and 3 patients in the Broström-Gould group had superficial dehiscence of the distal aspect of the incision which healed

Table 2

MODIFIED ACFAS/SATISFACTION AND VAS SCORES

	All Patients (A)			Worker's Comp Only (B)		
	Preop	Postop	# Satisfied (VAS)	Preop	Postop	# Satisfied (VAS)*
Brostrom + Scope	76	89	61 (91%) (4.1)	69	81	7 (77%) (3.6)
Triad	75	92	90 (98%) (4.6)	70	85	11 (85%) (3.7)
Avg	75.3	90.6	151 (94.4%) (4.4)	69.6	83.3	18 (82%) (3.66)
P	0.483	0.351	0.05 (0.20)	0.338	0.373	0.466 (0.350)

*5 point visual analog score.

with superficial wound care. Other complaints noted in each group were direct pain in the lateral ankle gutter margin that resolved spontaneously with long term follow-up. Patients in both groups also reported postoperative intermittent edema for the first 6 months. "Clicking without pain" was also noted in 8 patients in the triad group and no patients in the Broström and scope group. It was not noted if this was present preoperatively in these patients (Table 4).

Patients in the triad group spent statistically more time in an ankle brace than did patients in the ankle scope with Brostom group ($P = 0.007$). They averaged 7.25 weeks in an ankle brace compared to 6.28 weeks in Broström and ankle scope group. These patients also took significantly longer to return back to normal activity, 11.7 weeks, instead of the average 10.4 weeks reported in the Brostrom and ankle scope group ($P = 0.001$) (Table 5).

DISCUSSION

Direct immediate repair of the ankle ligament complex following acute injury has been described extensively for repair of the ankle ligament complex following acute injury. The Broström procedure with the "Gould" modification, consisting of direct and anatomic repair of the anterior-talofibular and the calcaneofibular ligaments, is certainly less invasive and easier to perform than many of the other described procedures (10). Repair of long term instability can be combined with anatomic or non-anatomic transfer of tendon, tensor fascia lata, and/or other grafts (11). Ankle arthroscopy has been advocated in the recent decade as being an excellent adjunct to addressing any intra-articular pathology such as anterior lateral ankle impingement. Other methods of peroneus brevis and peroneus longus tenodesis are also advocated by many for chronic ankle instability.

Table 3

P VALUES FOR GROUP A (ALL PATIENTS) VERSUS GROUP B (WORKER'S COMPENSATION PATIENTS)

	Preop	Postop	No. satisfied (VAS)*
Brostrom + Scope	0.481	0.440	0.238 (0.396)
Triad	0.481	0.376	0.065 (0.059)
Avg	0.366	0.212	0.067 (0.056)

*5 point Visual Analog Score.

It is the authors' belief that peroneal synovitis and the presence of a low lying peroneal muscle belly should be addressed if concurrent with chronic instability. Our MRI findings demonstrated a higher presence of a low-lying peroneal muscle belly than previous reports, 92% of our patients had a low-lying peroneal muscle belly compared to previous reports of 30% in the normal population (12). This study would suggest that long-term excellent results can be achieved by both an ankle arthroscopy with an open Broström-Gould modification and a tightening or reefing of the inferior portion of the peroneal retinaculum with excision of a low lying peroneal muscle belly. The authors maintain that the inferior portion of the peroneal retinaculum is significant to the functionality of the peroneus brevis and peroneus longus tendons, which are a major stabilizing force for the lateral ankle complex. The

Table 4

COMPLICATIONS

	Numbness	Persistent edema		Dehiscence	Re-injury* Recurrence†
Brostrom + Scope	3 (4.4%)	13 (19.1%)	3 (4.4%)	34 (50%)	12 (17.6%)
Triad	4 (4.3%)	13 (14.1%)	6 (6.5%)	10(10.9%)	4 (4.3%)
P	0.359	0.265	0.411	<0.001	0.006

*Single postoperative sprain.
†Multiple postoperative sprains.

authors feel that the ankle ligaments provide only a portion of the overall stability of the ankle joint while the peroneal tendons form the lateral harness and sling to the ankle.

The authors recognize the multifactorial etiologies associated with lateral ankle instability and feel that ankle arthroscopy enables one to address any contributing intra-articular pathology in combination with the open modified Broström-Gould procedure. The author's experience demonstrates that peroneal tendon reefing improves the long term stability of the lateral ankle complex by stabilizing the forces of the peroneus brevis and the peroneus longus tendons. The authors advocate first line treatment with immobilization and physical therapy for all significant ankle sprains. If conservative treatment fails and physical examination and MRI corroboration demonstrate tenderness or swelling over the peroneal tendons or within the retrofibular complex, the threshold should be lowered for cleaning and reefing of the peroneal tendons and retinaculum.

Although recovery time from the Triad procedure was on average longer than the standard Broström and ankle scope procedure, the patients reported higher satisfaction scores, ACFAS scores and fewer recurrent injuries. The authors recognize the limitations of this study and the complexity involved with treatment of chronic ankle instability.

Ankle arthroscopy, lateral ligament repair and peroneal tendon reefing are combined techniques that can be included in the arsenal for treatment of chronic lateral ankle instability.

ACKNOWLEDGMENTS

The authors give special thanks to Donald Green, DPM for his help with preparation of the manuscript and Donna Agan, Ed. D for assistance with the statistical analysis.

Table 5

POSTOPERATIVE COURSE

	Splint/ boot (weeks)	Ankle brace (weeks)	Return to activity (weeks)
Brostrom + scope	4.13	6.28	10.4
Triad	3.92	7.25	11.7
P	0.097	0.007	0.001

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