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ABSTRACT

Sixty-one patients underwent a primary ankle lateral ligament reconstruction for chronic instability between 1989 and 1996. In addition to the ligament reconstruction, all patients had evaluation of the peroneal retinaculum, peroneal tendon inspection by routine opening of the tendon sheath, and ankle joint inspection by arthrotomy. A retrospective review of the clinical history, physical exam, MRI examination, and intraoperative findings was conducted on these 61 patients. The purpose was to determine the type and frequency of associated injuries found at surgery and during the preoperative evaluation. At surgery no patients were found to have isolated lateral ligament injury. Fifteen different associated injuries were noted. The injuries found most often by direct inspection included: peroneal tenosynovitis, 47/61 patients (77%); anterolateral impingement lesion, 41/61 (67%); attenuated peroneal retinaculum, 33/61 (54%); and ankle synovitis, 30/61 (49%). Other less common but significant associated injuries included: intra-articular loose body, 16/61 (26%); peroneus brevis tear, 15/61 (25%); talus osteochondral lesion, 14/61 (23%); medial ankle tendon tenosynovitis, 3/61 (5%). The findings of this study indicate there is a high frequency of associated injuries in patients with chronic lateral ankle instability. Peroneal tendon and retinacular pathology, as well as anterolateral impingement lesions, occur most often. A high index of suspicion for possible associated injuries may result in more consistent outcomes with nonoperative and operative treatment of patients with chronic lateral ankle instability.

INTRODUCTION

Inversion stress to the foot and ankle is a common musculoskeletal injury. It is noted most often in athletes participating at various competitive levels. The lateral ankle ligaments are the structures most frequently damaged, specifically the anterior talofibular ligament and the calcaneofibular ligament.[5,6,8,9,21] However many structures, both bone and soft tissue, have the potential for injury during a foot and ankle inversion stress. The at risk osseous structures include the talar dome, talar lateral process, fifth metatarsal base, distal and proximal fibula, and the anterior process of the calcaneus. In addition to the lateral ankle ligaments, the soft tissue structures at risk include the distal tibia-fibula ligament, posterior talofibular ligament, subtalar interosseous ligaments, peroneal tendons, peroneal retinaculum, superficial peroneal nerve branches, and the medial ankle structures.

Conservative management is usually successful in achieving full restoration of function after a typical ankle inversion injury. However, chronic pain and disability does occur in a subset of patients. This pain is intermittent and associated with specific inversion episodes in patients with symptoms of lateral ankle instability from incompetent lateral ligaments. Other patients will complain of ankle pain and disability between these instability episodes and these patients may have nonligamentous associated injuries. Recent reports have noted it is not uncommon for these patients to have additional injuries.[2,12-15,23,25,29] In particular, peroneal retinacular and tendon pathology has been increasingly reported in patients with chronic lateral ankle instability.

Frey et al.[11] and Cardone et al.[4] reported on the role of MRI in evaluation of acute and chronic lateral ankle sprains. In addition to finding MRI very useful for analysis of lateral ankle ligaments, they noted a large number of associated injuries mostly to the other lateral soft tissue structures, but also to the medial ankle structures. To our knowledge there has not been a large series investigating the various types of associated injuries noted at the time of surgical reconstruction of the lateral ligaments in patients with chronic lateral ankle instability. The existing studies report more on a specific associated injury, mainly peroneal tendon tears with

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and without retinacular injury, rather than on the various types of associated injuries. The purpose of this study was to review the findings of a surgical approach specifically designed to look for the various types of associated lesions, and thus determine the type and frequency of injuries associated with chronic lateral ankle instability.

MATERIALS AND METHODS

Sixty-seven ankles in 67 patients underwent a lateral ligament reconstruction for chronic instability between

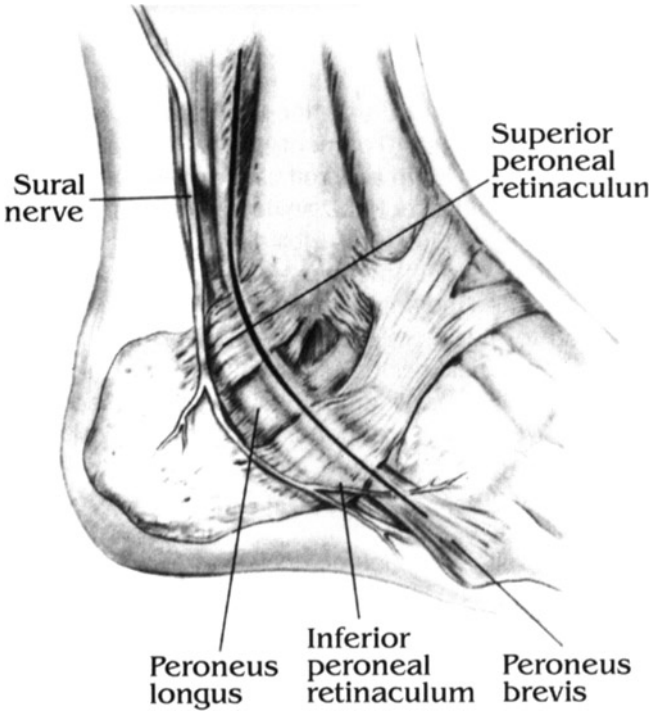

Fig. 1. A posterolateral incision was made beginning 8 cm proximal to the lateral malleolus and extending along the posterior margin of the fibula. It was then extended distally and anteriorly along the course of the peroneus brevis tendon and ends just proximal to the base of the fifth metatarsal. The superior peroneal retinaculum was inspected and then the peroneal tendon sheath incised.

1989 and 1996. Six revision procedures were eliminated. This resulted in a study population of 61 ankles in 61 patients in whom a primary ankle lateral ligament reconstruction was performed. There were 32 males and 29 females. Average age was 35 years, range 17-59. Patients were seen at an average of 13 months after the original injury. All failed conservative treatment including activity modification, physical therapy, and bracing. Time from original injury to the operative procedure averaged 18 months, range 7-72 months. All surgeries were performed by the senior author, and the type of reconstruction was a Chrisman-Snook in 16 patients and in more recent cases a Broström-Gould in 45 patients. In addition to the ligament reconstruction, the surgeon performed a systematic examination of intraarticular and lateral soft tissue structures in all patients to evaluate for possible associated pathology. The competency of the superior peroneal retinaculum was assessed by direct inspection and palpation along the fibular groove while pulling distally and laterally on the peroneal tendons, and during passive circumduction of the foot. The peroneal retinaculum was considered attenuated if a tendency for excessive peroneal tendon motion with subluxation was found during these manuevers. This was followed by routine opening of the peroneal sheath to evaluate for tendon pathology (Fig. 1). Peroneal tenosynovitis was diagnosed when excessive, hypertrophic, inflamed tenosynovium was identified. In addition the ankle joint capsule was incised longitudinally and the ankle joint systematically

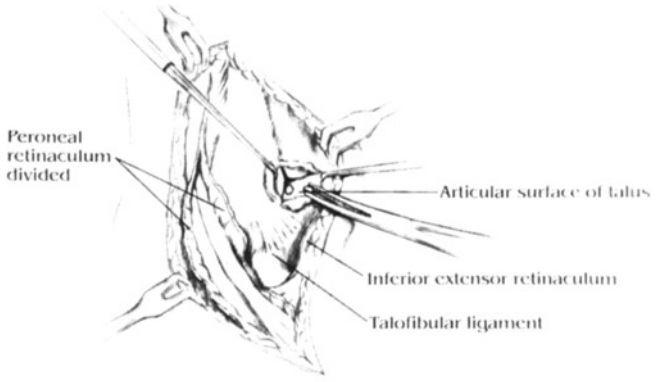

Fig. 2. The peroneal tendons were evaluated for damage, and the anterior ankle joint capsule incised longitudinally. The ankle joint was explored for possible pathology including anterolateral impingement lesions, osteochondral lesions, and loose bodies.

explored to identify any associated pathology such as loose bodies, osteochondral lesions, or anterolateral impingement lesions (Fig. 2). Proliferative, inflamed synovium with fibrotic scar tissue localized to the anterolateral ankle was diagnosed as anterolateral synovitis with impingement lesion. Diffuse, hypertrophic, inflamed synovium in multiple areas of the joint was considered "ankle synovitis". Finally, a Broström-Gould lateral ankle reconstruction was performed in the majority of cases. Additional pathology identified during preoperative evaluation and at surgery was addressed as necessary.

In these 61 patients, a retrospective review of the clinical history, physical exam, radiographs, MRI examination, and intraoperative findings was conducted. All patients had evidence of chronic lateral ankle inability by history and physical examination. MRI was used to

further assess the ligaments and to evaluate for non-ligamentous soft tissue and osseous injuries.[4,8] Stress radiographs were obtained if further information was needed on the degree of mechanical instability. The patients' records were analyzed for associated injuries noted at surgery and during the preoperative evaluation. These findings represented the data available to determine the type and frequency of associated injuries found in chronic lateral ankle instability.

During the course of treatment of these patients with chronic lateral ankle instability, the senior author noted a high frequency of peroneal tenosynovitis, ankle synovitis, and anterolateral impingement lesions during direct inspection at the time of surgery. Therefore to further define the pathology, cases performed in 1994-1996 which had evidence of inflammation by direct inspection were submitted for microscopic evaluation.

RESULTS

At the time of surgery, none of the patients in the study group was found to have isolated lateral ligament injury. Fifteen different associated injuries were noted. The type of pathology and the frequency of its occurrence is noted in table 1. Peroneal tendon and retinacular pathology were frequently noted, with peroneal tenosynovitis noted in 77% of cases and peroneal retinacular attenuation noted in 54% of cases. Longitudinal peroneus brevis tendon tears were found in 25% of cases, with all involving the peroneus brevis tendon and two cases with tears also in the peroneus longus tendon. Anterolateral impingement lesions[10] (67%) as well as ankle synovitis (49%) were other associated injuries commonly found. Other less common but significant associated injuries included: intra-articular loose bodies (26%), talus osteochondral lesions (23%), and tenosynovitis of a medial ankle tendon (5%).

In the subset of cases between 1994 and 1996 routinely sent for microscopic evaluation when inflammatory changes were noted by direct inspection, chronic inflammation was found in the majority of cases: 8/13 (62%) with peroneal tenosynovitis, 10/14 (71%) with ankle synovitis, and 10/13 (77%) with anterolateral impingement lesions. For evaluation of ankle synovitis, the area of synovium inspected and chosen for biopsy was away from the anterolateral gutter in order to differentiate this from anterolateral impingement lesions. Inflammation was defined as the presence of chronic inflammatory cells with associated synovial membrane edema and thickening based on independent interpretation by pathologists. These findings indicate that in the majority of cases direct inspection was accurate in assessment for inflammatory changes.

The preoperative physical examination and associated diagnoses assigned to these patients with lateral ankle instability were reviewed in order to determine the correlation between preoperative diagnoses and intraoperative findings. Physical examination was found to be particularly accurate for identifying those patients with peroneal tendon sheath and retinacular pathology. Of the 50 patients thought to have peroneal tenosynovitis preoperatively, 47 of 50 (94%) had significant tenosynovitis by direct inspection. In addition 37 patients were thought to have peroneal tendon subluxation or dislocation preoperatively, and at surgery 33 of 37 (89%) had an attenuated or avulsed peroneal retinaculum with peroneal tendon instability. Physical examination was less accurate for predicting the presence of an associated anterolateral impingement lesion or ankle synovitis. Of the 41 patients with anterolateral impingement lesions noted at surgery, only 28 of 41 (63%) were diagnosed preoperatively. In addition despite a high frequency of ankle synovitis noted at surgery, only 10 of 30 (33%) had an ankle effusion noted at the time of physical examination.

The accuracy of the preoperative MRI examination was also evaluated. Again ankle MRI examination was performed on all patients, and the radiologist's interpretation was reviewed. The MRI was performed at our institution and evaluated by a musculoskeletal radiologist in 60% of cases, with the remaining being performed and interpreted at the referring institutions. Overall, MRI noted 11 of 14 (79%) talus osteochondral lesions found at surgery. Twelve of these 14 lesions were chondral flaps requiring debridement only, and MRI noted 9 of the 12. The 2 lesions which were full thickness and required debridement and drilling were both noted on MRI. Furthermore, MRI examination was accurate for detection of peroneal brevis tendon tears, with 12 of 15 (80%) cases noted without any false positives. However despite two correctly diagnosed peroneal longus tears, there were 3 false positives readings. MRI examination was less sensitive for detection of anterolateral impingement lesions, 11 of 41 lesions (27%), and peroneal tenosynovitis, 18 of 47 (38%).

DISCUSSION

Isolated peroneal pathology has been reported in a number of studies. The possible pathologic conditions include synovitis of the tendon sheath,[3,20,30,31] longitudinal tendon tears,[2,13,18,19] and peroneal retinacular attenuation with peroneal tendon subluxation or dislocation.[1,7,16,17] Recently, Sobel et al.[24,26,28] studied peroneal tendon pathology in detail. They performed cadaveric studies and concluded peroneus brevis splits are more common than previously recognized with well defined splits found in 11% of ankles in one study[28] and 26% of ankles

in another.[24]

The mechanism of peroneal tendon and retinacular injury has been classically described as a sudden contraction of the peroneals combined with an abrupt involuntary dorsiflexion stress of the ankle, and noted most often in downhill skiers. However in 1993, Bassett and Speer[2] reported on longitudinal rupture of the peroneal tendons in eight young athletes with a history of ankle plantarflexion and inversion injury. All of the ankle sprains were stable after a period of rehabilitation, but the patients complained of persistent lateral ankle pain. At surgery, all had longitudinal peroneal tendon tears, with 3 in the brevis and 5 in the longus, and were treated with primary suture repair. In addition, recently Geppert et al.[13] performed an anatomic and biomechanical study to better understand the mechanism of injury to the superior peroneal retinaculum (SPR). They noted the calcaneal band of the SPR is parallel to the calcaneofibular ligament, and serial sectioning of the lateral collateral ligaments revealed increasing strain on the SPR with increasing ankle instability. They concluded forces resulting in chronic lateral ankle instability may also injure the SPR, with the SPR serving as a secondary restraint to ankle inversion stress. Thus the literature indicates peroneal tendon and retinacular injury can occur with the foot and ankle in a number of positions.

TABLE 1
Associated Injuries Noted At Surgery

Pathologic Structure	Number		Percentage
peroneal tenosynovitis	47/61		77 %
anterolateral impingement lesion	41/61		67 %
attenuated peroneal retinaculum	33/61		54 %
peroneal retinaculum avulsion		4	
ankle synovitis	30/61		49 %
intra-articular loose body	16/61		26 %
peroneus brevis longitudinal tear	15/61		25 %
peroneus brevis + longus tear		2	
talus osteochondral lesion	14/61		23 %
chondral flaps		12	
full thickness defect		2	
anterior talofibular ligament avulsion	7/61		11 %
accessory peroneus quatrus muscle[22,27]	5/61		08 %
medial ankle tendon tenosynovitis	3/61		05 %
FHL tenosynovitis		1	
FDL tenosynovitis		1	
PT tenosynovitis		1	
ankle capsular avulsion fracture	2/61		03 %

FHL=flexor hallucis longus; FDL=flexor digitorum longus; PT=posterior tibialis

Despite these numerous reports on isolated peroneal tendon and retinacular pathology, it was only recently that studies have reported the combination of peroneal pathology and chronic lateral ankle instability. In 1987, Larsen[14] reported on two patients with symptoms of lateral ankle instability and peroneal tendon pathology. At surgery one patient had intact lateral ligaments but the peroneal brevis tendon had a longitudinal tear and marked tenosynovitis. However, the other patient had an incompetent anterior talofibular ligament, which required ligament reconstruction as well as a longitudinal rupture of the peroneus brevis. In 1989, Sammarco and DiRaimondo[23] reported on 11 cases of longitudinal degenerative rents in the peroneus brevis tendon noted at the time of ankle ligament reconstruction in 47 cases treated for chronic lateral ankle instability. The authors concluded degenerative defects of the peroneus brevis tendon in association with chronic ankle instability may be more common than previously recognized, and peroneal pathology should be suspected when treating ankle instability.

Sobel et al. in 1990[29] published a case report of lateral ankle instability associated with dislocation of the peroneal tendons. At surgery findings included: attenuated anterior talofibular and calcaneofibular ligaments; attenuated peroneal retinaculum with peroneal tendon instability; and significant fraying of the anterior half of the peroneus brevis tendon. Ankle stabilization was performed by a modified Chrisman-Snook procedure, which also reconstructed the superior peroneal retinaculum. The authors stated they have also noted peroneal brevis longitudinal tears at the time of ankle reconstruction for lateral instability. They also suggest an increased suspicion for potential peroneal tendon and retinacular pathology when treating patients with chronic lateral ankle instability.

The current study provides additional evidence of peroneal tendon and retinacular pathology being commonly associated with chronic lateral ankle instability. In our group of patients with chronic instability confirmed at surgery, we noted a large percentage of patients who had coexisting peroneal tendon and retinacular pathology. Peroneal tenosynovitis and peroneal retinacular

TABLE 2
Comparison of Associated Injuries

Study	Current		Frey et al.[11]	Cardone et al.[4]
Cases	61		15	43
Ankle Pathology	Chronic instability		Acute sprain	Chronic sprain
Source of Findings	**Surgery**	**MRI**	**MRI**	**MRI**
Pathologic Structure				
peroneus brevis tear	25%	20%	27%	44% (PB+PL)
peroneus longus tear	03%	03%	13%	not available
attenuated retinaculum	54%	12%	27%	23%
osteochondral lesion	23%	18%	0	07%
deltoid ligament injury		05%	06%	12%
PTT tenosynovitis	02%	02%	53%	09%
FHL tenosynovitis	02%	02%	13%	0
FDL tenosynovitis	02%	02%	7%	0

FHL=flexor hallucis longus; FDL=flexor digitorum longus; PT=posterior tibialis
PB=peroneus brevis; PL=peroneus longus

attenuation were noted in over half of the cases, 77% and 54% respectively, and peroneal brevis tears were also found in 25% of cases. This data reflects the same trend as the other recent reports citing an increased recognition of coexisting lateral ankle instability and peroneal pathology. However, our numbers are even more dramatic and probably is secondary to the modified surgical approach which specifically evaluated for possible peroneal pathology in each case.

To our knowledge the current study is the first to review a large series of lateral ankle reconstruction cases to investigate not only for coexisting peroneal pathology, but also to determine the type and frequency of other associated injuries. In addition to the peroneal pathology we noted a large number of different associated injuries, fifteen in all (table 1). The more frequent injuries included anterolateral impingement lesions (67%) and ankle synovitis (49%). Other less common but significant associated injuries were intra-articular loose bodies (26%), talus osteochondral lesions (22%) and tenosynovitis of a medial ankle tendon (5%). Although a similar surgical review is not available for comparison, there are two MRI studies which described associated injuries in patients with acute[11] and chronic[4] lateral ankle sprains. These associated injuries were noted while investigating the effectiveness of MRI in evaluating lateral ligament injury. The findings of these two studies are compared to the current study in table 2. All 3 studies report a high percentage of peroneal retinacular and tendon injury. Medial tendon and deltoid ligament pathology were quite common after an acute injury, and although the majority appear to resolve over time it is not rare for them to persist in the chronic state. Osteochondral lesions were not noted in the acute injury cases but were noted fairly often in the chronic cases, and they appear to be more the result of recurrent instability stress rather than the acute episode.

Anterolateral impingement lesions and ankle synovitis were not described in these two MRI studies, but the current study noted large numbers of each. Ferkel et al.[10] described the diagnosis and arthroscopic treatment of anterolateral impingement lesion in 31 patients with persistent lateral ankle pain after an inversion injury. The term anterolateral impingement lesion refers to proliferative synovitis and fibrotic scar tissue in the lateral gutter, often with associated chondromalacia of the talus. Physical examination revealed localized tenderness of the anterolateral gutter of the ankle. Patients with evidence of lateral instability by physical examination or stress radiography were excluded from the study because they were not considered to have anterolateral impingement. Arthroscopic treatment provided good or excellent results in 26 cases, and fair or poor in 5 cases (4 fair, 1 poor). In the current study, this proliferative synovitis with fibrotic scar tissue was noted at the time of ankle arthrotomy in 41/61 (67%) of cases. Physical examination noted tenderness at the anterolateral joint line in 28 of 41 or 68% of surgically confirmed lesions. MRI examination was not very accurate in detecting this lesion, 11 of 41 cases (27%), and is similar to the findings of Ferkel et al.[10] who noted 3/31 (10%) by MRI.

The large number of anterolateral impingement lesions noted in the current study indicates this lesion may coexist with chronic lateral ankle instability more frequently than previously appreciated. We believe the mechanism of recurrent planter flexion, inversion stress to the ankle is responsible for both chronic lateral ligament instability and anterolateral impingement lesions, and they should not be viewed as exclusive of each other. Our results and those of Ferkel et al. indicate MRI is not very sensitive for diagnosis of anterolateral impingement lesions. Physical examination is much more accurate and a high index of suspicion is necessary to diagnose and effectively treat these lesions.

Ankle synovitis was the other associated pathology commonly noted in the current study, 30 of 61 cases.

This proliferative synovitis was usually mild to moderate, but ranged from mild, with localized redness, to severe with edema and thickening of the synovial membrane. This high rate of ankle synovitis is very similar to the findings of Larsen and Aru,[15] who investigated the frequency of ankle synovitis in 75 chronically unstable ankles undergoing ankle reconstruction. In this prospective study, synovial biopsies were obtained from the anterior joint, away from the injured ligaments. Microscopic evidence of synovitis was found in 62 of 75 ankles (83%), with 34 slight, 25 moderate, and 3 extreme cases. The high rate of ankle synovitis in this study and the current study may be a response to coexisting intra-articular pathology, or may be a response to repetitive inversion stress to the ankle.

CONCLUSION

There is a high frequency of associated injuries in patients with chronic lateral ankle instability. Peroneal tendon and retinacular pathology, as well as anterolateral impingement lesions and ankle synovitis, occur most often. In addition a number of different structures may exhibit pathology, including medial ankle ligaments and tendons. An awareness of the possible associated lesions, including those which are most common, is more important than the actual numbers reported.

It is difficult to predict which of the associated injuries found in chronic lateral ankle instability may cause persistent pain if not addressed at the time of ankle reconstruction. The recurrent inversion injuries may result in specific inflammatory responses which are self limited and will resolve after ligament reconstruction. In addition a certain percentage of the associated injuries may not be symptomatic. We would expect the majority of diffuse ankle synovitis as well as peroneal tenosynovitis to resolve after ligament reconstruction. However, the tenosynovitis associated with peroneal brevis and longus longitudinal tears is certainly a potential source of chronic pain after a successful ligament reconstruction, as are intra-articular loose bodies and talus osteochondral lesions. It is less clear what to expect for anterolateral impingement lesions and attenuated peroneal retinaculum.

The information gained from this study should allow for improved treatment of inversion ankle injuries, both nonoperative and operative, by assisting in a number of areas. An increased awareness of possible associated lesions should result in more accurate diagnoses after an acute lateral ligament injury and in chronic instability, and thus allow rehabilitation to also specifically address the coexisting pathology. It will also promote surgical treatment which is designed to address all pathology present. If peroneal tendon or retinacular pathology is suspected, a posterolateral incision as described in this study rather than the usual anterior incision for a Broström-Gould is necessary to address the associated pathology. If medial ankle pathology is identified, a separate medial incision may be needed. Lastly, the information gained from this study will also help identify the etiology of persistent ankle pain after an ankle reconstruction successfully restores stability but does not completely relieve pain and dysfunction.

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