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Br. J. Sports Med. published online 18 Aug 2006;
doi:10.1136/bjsm.2006.026807

BJSM Online First, published on August 18, 2006 as 10.1136/bjsm.2006.026807

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Original Article

Dorsal Calcaneocuboid Ligament vs. Lateral Ankle Ligament Repair - A Case Control Study

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Key Words
Calcaneocuboid joint instability, lateral ankle instability, anatomic repair, periosteal flap augmentation, recurrent giving way.

Abstract

Objective: Anatomic reconstruction is the treatment of choice for lateral ankle ligament instability. A similar technique has recently been described for stabilization of a chronic unstable calcaneocuboid joint as an alternative to the previously proposed tenodesis and arthrodesis procedures.

Methods: Five consecutive young females, suffering from recurrent giving way of six calcaneocuboid joints were operatively treated during a four years period using an anatomic ligament repair, reinforced by a periosteal flap. Results were compared to five patients who underwent an anatomic lateral ankle ligament repair in a case control design. Outcome was measured using the Foot and Ankle Outcome Score, physical examination, stress radiographic and MRI (calcaneocuboid group) investigation. Functional neuromuscular performance was evaluated by isokinetic torque measurements, posturometry, single-leg drop and long jumps.

Results: Outcome scores at follow-up (5-61 months after surgery) revealed excellent results for both groups. There was no relevant difference found between the affected legs and the not affect legs and between groups with respect to the outcome measures. MRI exhibited ligament like structures at the repaired dorsal calcaneocuboid joints in five out of six patients.

Conclusions: Results of anatomic repair of unstable lateral ankle and isolated calcaneocuboid joint instability equally lead to excellent results.

Introduction

Lateral ankle ligament instability is a well-known and frequent condition. Diagnostic principles and evidence based treatment is established and is generally accepted [1, 2]. Incidence is rated to be one sprain per 10 000 persons each day and 20 to 40% are reported to develop persistent problems following this injury [3]. Differential diagnosis in these cases includes additional injuries affecting different structures [4]. Isolated dorsal calcaneocuboid ligament lesions may possibly be one cause [5]. Rare epidemiologic data regarding the frequency of the occurrence of this injury reveal that about 5.5% of all inversion injuries involve the dorsal calcaneocuboid ligament. About one third of these patients develop a chronically unstable calcaneocuboid joint [5]. Considering this numbers one can calculate about one chronically unstable calcaneocuboid joint in 500 000 people per day.

In principle, lesions of the dorsal calcaneocuboid ligament and lateral ankle ligaments seem to result from a similar mechanism, indicating that both joints are functionally connected [6, 7]. Calcaneocuboid joint injuries have been graded respective to radiographic and stress radiographic findings [8]. Arthrodesis [9], plantaris [10] or peroneus brevis [8] tenodesis and periost augmented repair [11] has been suggested for treatment of chronically unstable cases.

The purpose of this report is to compare outcome of operatively treated calcaneocuboid and lateral ankle ligament lesions in order to contribute to the need for further differentiation of the term “ankle sprain” because of different therapeutic consequences.

Patients, Materials and Methods

Patients

This series comprises five consecutive patients who were surgically treated for chronically unstable calcaneocuboid joints using an augmented periosteal flap repair *(calcaneocuboid joint repair group)* [11]. Diagnosis was made combining results from individual case history, physical examination and from calcaneocuboid stress radiographs [5, 9, 11] (Table 1).

Table 1: Diagnostic criteria for isolated calcaneocuboid ligament instability. 1 = acute injury. 2 = chronic injury. 3 = there is one report about combined instability of the lateral ankle and the calcaneocuboid joint respectively [7].

	mandatory	optional
History	Inversion-plantarflexion injury	Hematoma covering the calcaneocuboid joint[1]
	Recurrent (fear of) giving way[2]	Calcaneocuboid joint swelling and load induced pain
		Walking on uneven ground is painful
Physical examination	Pain on palpation at the calcaneocuboid joint	
	Lateral ankle ligament injury excluded[3]	
Dorsoplantar stress X-ray	Lateral calcaneocuboid angle >10 °→ unstable joint no fractures or bone avulsions	No or mild degenerative signs (spurs)

Surgical files were screened retrospectively for patients who underwent lateral ankle ligament repair [12] because of a chronic lateral ankle instability during the same period. These patients were matched to the calcaneocuboid joint repair group with respect to sex, age and sport activity level. Five patients were found who met these criteria (*lateral ankle repair group)*. Comparison of both groups was done in case control.

Follow-up Examination

The study was approved by the local ethics committee and written consent was obtained from all patients. Anthropometric data, the course of the postoperative rehabilitation and the individual level of activity [13] were assessed.

Physical examination comprised investigation of axial alignment and hypermobility testing of the lower extremities. Talar tilt and anterior talar drawer tests as well as lateral calcaneocuboid instability test [11] were estimated in degrees or millimeter. Range of motion was determined

for all ankles using a goniometer. A reduction of more than five degrees as compared with the respective contralateral side was considered to be a limited range of motion [2]. Tenderness at the lateral ankle and calcaneocuboid joint was determined. The circumference around the transverse tarsal joint and around the anterior part of the ankles and the heels was measured.
Patient relevant outcome was assessed by the *Foot and Ankle Outcome Score*, which is a valid and reliable evaluation instrument related to ankle ligament reconstruction, including sport and recreational function [14].
Ankle [15] and calcaneocuboid *stress radiographs* [9, 11, 16] were bilaterally executed and analyzed.
MRI investigation was performed for all repaired calcaneocuboid ligaments (1.5 Tesla unit, Sonata, Siemens, Erlangen, Germany).
Single-limb posturometry is a validated test, which has been shown to differentiate between functionally unstable and stable ankles [17]. The stance plate of a Posturomed® system (Haider Bioswing, Pullenreuth, Germany) was unexpectedly perturbated 25 mm in a lateral to medial direction with the upright standing patient (open eyes, directed straight ahead) trying to stabilize the system as fast as possible. The path of the center of gravity was recorded for 20 s. Each patients best of three tests of either leg was used for further calculation.
Isokinetic testing has been shown to be a reproducible instrument for quantification of the muscular status of the ankle [18]. Measurements (Biodex System 3 PRO, Biodex Medical Systems, New York, USA) were taken using a standard concentric/concentric dorsal-/plantarflexion ankle protocol at 30°/s. From this, peak torque values were calculated for either ankle.
Functional motor performance was examined by single-leg drop jump and single-leg long jump test. Drop jumps were executed from a height of 24 cm with the hands fixed to the hips. Time interval between take off and landing was registered (contact mat biovision® Wehrheim, Germany) and jumping height was calculated. Long jumps were executed from a standing position with the tested foot positioned to the starting line. Landing had to occur on the same foot and the covered distance was measured. Initially patients were allowed to accommodate to both jumping techniques. The best of three trials for each leg was considered for further calculation.
In a pilot study the reliability of the single-leg drop and long jump as well was tested. For this, both legs of 11 rhythmic gymnasts (11 - 16 years old) were evaluated it in a test-retest design (one week interval). Pearson's product moment correlation coefficients, Cronbach`s alpha and intraclass correlation coefficients for single leg drop and long jumps all were ≥ 0.95.

Statistical analysis
Analysis was done comparing the injured and non injured side, between treatment groups, and to preoperative values. Anthropometric data and outcome score measurements of both groups (n = 5 in each group) were compared by paired student's t-test. Injured (n = 6 in the *calcaneocuboid joint repair group* and n = 5 in the *lateral ankle repair group*) and non injured joints (n = 14 and n = 15 respectively) were compared by unpaired t-test. Significance level was set at $p < 0.05$. Due to one bilaterally operated patient only four patients remained in the *calcaneocuboid joint repair group* for individual side to side comparisons (clinical ratings radiographs and functional motor performance). Consequently descriptive analysis was performed for these parameters.

Results
All patients were females. With the exception of body height (p=0.04), anthropometric data between groups did not differ. At surgery, patients of the *calcaneocuboid joint repair group* were 13.7 (10 - 18) years old. Patients of the *lateral ankle repair group* were 16.0 (14 - 19) years old (p = 0.33). Follow-up investigation was done 26.6 (9 - 59) months (*calcaneocuboid joint repair group*) and 24.2 (5 - 61) months (*lateral ankle repair group*) after surgery (p=0.89). There was no specific side dominance, while take off leg was injured in all patients. The period from initial injury to the first clinical presentation was 3.0 months (0 - 10 months) for the *calcaneocuboid joint repair group* and 8.6 months (0 – 35 months) for the *lateral ankle repair group*. A forceful plantarflexion-inversion mechanism during sport initiated the injury in all patients, resulting in recurrent instability or fear of giving way preoperatively. One gymnast underwent repair of the contralateral calcaneocuboid joint 15 months following initial

surgery. There was no history of or actual lesion as well as previous surgery of any other joint of the same lower leg, no signs of generalized joint laxity or generalized neuromuscular disorder. There were no postoperative complications. Early functional postoperative treatment was implemented for both groups [5, 11].

Physical examination at follow-up revealed no axial misalignment or limitation of range of motion. All ankles and calcaneocuboid joints were clinically stable. There was no swelling or pain on palpation in the operated feet.

As a consequence of the calcaneocuboid ligament lesion, ankle specific sport abilities [13] were considerably reduced. At follow-up, preinjury levels were regained (Table 2). Patient relevant outcome was good or excellent in all cases (Table 2).

Tab. 2: Results of the operative interventions for *calcaneocuboid joint repair group* (CC) and *lateral ankle repair group* (Ankle). Retrospectively calculated Ankle Activity Score [13], and Foot and Ankle Outcome Score [14] measured at follow-up. Mean ± standard deviation (range).

	CC	Ankle	P
Ankle Activity Score [13] worst result = 0 best result = 10			
• Preinjury	**7.8**±1.9 (5-10)	**7.4**±1.7 (6-10)	0.59
• Post injury pre-operative	**2.7**±1.3 (1-4)	**3.4**±1.2 (1-4)	0.47
• Follow-up	**7.6**±1.9 (5-10)	**7.0**±1.8 (5-10)	0.43
Foot and Ankle Outcome Score [14] worst result = 0 best result = 100			
• Pain	**97.6**±3.0	**86.6**±12.6	0.20
• Symptoms	**91.4**±7.4	**74.8**±10.7	0.11
• Activity of daily life	**98.8**±1.5	**90.6**±11.0	0.28
• Sport and recreational activity	**94.0**±5.8	**79.0**±23.5	0.31
• Quality of life	**82.4**±15.6	**71.6**±16.6	0.52

Preoperative and follow-up radiographs of one patient demonstrated minimal calcaneocuboid bone spurs bilaterally. In the *lateral ankle repair group* a similar finding was visible at one calcaneocuboid joint postoperatively. Two injured and one uninjured ankles had minimal spurs preoperatively and at follow-up.

Calcaneocuboid and ankle stress radiograph values improved significantly comparing preoperative and follow-up values in the respective groups (Figure 1). However, no difference was found in follow-up values for talar tilt ($p = 0.43$), anterior talar drawer ($p = 0.29$) and lateral calcaneocuboid instability test ($p = 0.81$) comparing the uninjured and the injured joints with respect to the relevant diagnoses (Table 3).

Tab. 3: Follow-up values for stress radiographic evaluation of the lateral calcaneocuboid and lateral ankle joints under investigation (CCI = calcaneocuboid stress radiographic instability). Mean ± standard deviation (range).

radiograph evaluation at follow-up	**n**	**Mean±SD (Range)**	**p**
CCI [°]affected joints	6	**9.5**±3.5 (7-11)	0.81
CCI [°] not affected joints	14	**8.9**±5.3 (0-16)	
Anterior talar drawer [mm]affected joints	5	**7.0**±4.2 (3-15)	0.29
Anterior talar drawer [mm] not affected joints	15	**5.5**±1.7 (3-8)	
Talar tilt [°] affected joints	5	**4.0**±3.3 (0-9)	0.43
Talar tilt [°] not affected joints	15	**2.8**±2.5 (0-9)	

Follow-up MRI investigation of the operated calcaneocuboid joints demonstrated ligament like structures in all cases. Two of them were graded as normal, two were thicker than normal, one was thinner than a normal dorsal calcaneocuboid ligament, while in one case an inhomogeneous structure was detected (Figure 2 a + b).
Postural sway in posturometry at follow-up was lower both in the affected (-29.9%) and in the non affected (-18.3%) leg of the *lateral ankle repair group* (Table 4). No difference could be detected between the injured and the respective non injured leg in isokinetic testing, single-leg drop and single-leg long jumps (Table 4). These values, however were 1.8 – 22.4% higher in the *lateral ankle repair group* but not statistically significant (Table 4).

Tab. 4: Results of functional testing for *calcaneocuboid joint repair group* (CC) and *lateral ankle repair group* (Ankle) comparing the operated with the uninjured sides. N for the affected side is six in the CC group and five in the ankle group. N for the opposite side is four in the CC group and five in the ankle group. Mean ± standard deviation (range).

	CC	**Ankle**	**Mean Value Difference in %**
Single-leg drop jump [m] affected side	**0.15**±0.03 (0.12-0.19)	**0.17**±0.03 (0,14-0,23)	**13.3**
Single-leg drop jump [m] opposite side	**0.16**±0.02 (0.13-0.19)	**0.17**±0.03 (0.13-0.21)	**6.3**
Single-leg long jump [m] affected side	**1.78**±0.19 (1.40-1.96)	**1.95**±0.15 (1.80-2.20)	**9.6**
Single-leg long jump [m] opposite side	**1.72**±0.23 (1.38-2.01)	**1.96**±0.14 (1.70-2.09)	**14.0**
Isokinetic plantarflexion 30° [Nm] affected side	**41.0**±19.9 (16.00-75.50)	**50.2**±14.1 (34.40-73.90)	**22.4**
Isokinetic plantarflexion 30° [Nm] opposite side	**43.3**±17.5 (27.80-61.10)	**44.1**±11.5 (28.10-57.20)	**1.8**
Isokinetic dorsilflexion 30° [Nm] affected side	**11.2**±2.5 (8.50-15.10)	**14.0**±2.8 (10.80-18.60)	**25**
Isokinetic dorsilflexion 30° [Nm] opposite side	**12.3**±1.7 (10.20-14.40)	**13.5**±3.3 (10.20-18.10)	**9.8**
Posturometry length of path [mm] affected side	**197.7**±17.2 (172.0-223.0)	**138.6**±9.9 (130.0-155.0)	**-29.9**
Posturometry length of path [mm] opposite side	**195.5**±125.7 (65.0-365.0)	**159.8**±62.2 (94.0-278.0)	**-18.3**

Discussion

Freeman et al. [19] introduced the term functional ankle instability for recurrent giving way of the mechanically stable ankle. Frequently unrecognized in the past, isolated calcaneocuboid instability may be one mechanical reason for this condition which has been previously attributed to a merely proprioceptive deficit.

There are reports dealing with combined lesions of the talo-navicular [20] or the cuneo-navicular [21] joints, therefore leading to a more serious transverse tarsal joint instability. Isolated calcaneocuboid instability is rare and the respective reports are anecdotally [7, 8, 9, 10, 11, 16]. Principles of the diagnostic procedure, treatment and posttreatment have been established [5, 8, 11]. This investigation presents the largest series of surgically treated isolated calcaneocuboid instabilities. Contrasting to literature, calcaneocuboid injuries in our study occurred exclusively to young females during sports. Preoperatively patients of both groups complained persisting giving way and/or fear of giving way, associated with pain and inability in sport.

Anatomic reconstruction [12, 22] and functional posttreatment is the golden standard for treatment of lateral ankle instability [1, 2]. An analog procedure may prevent the calcaneocuboid joint [5, 11] from risks associated with fusion or tenodeses (hypomobility, reduced mobility of the lateral foot column, transfer arthritis, graft consumption).

“Ligamentization” of the calcaneocuboid repair could be demonstrated by MRI investigation in five out of six patients in the calcaneocuboid repair group. MRI morphology however, was not associated with outcome as evaluated with clinical, functional and stress radiograph investigation.

The rationales for choosing lateral ankle ligament repair patients as a control group is substantiated by the fact that lesions of the dorsal calcaneocuboid ligament seem to be relevant in the differential diagnosis of anterolateral ankle instability. Besides this, the surgical techniques and posttreatment are similar.

Follow-up evaluation gathered data not only at a patient relevant (*Foot and Ankle Outcome Score*) and a mechanic level (physical and stress radiographic examination). Furthermore different levels of neuromuscular control have been included. No relevant differences between the injured and the uninjured sides could be detected (Table 3 + 4). Considering the fact, that all injuries met the dominant leg, one might argue, that functional tests should show superior capacity on this side. Literature however, does not support this assumption, stating that regardless of whether the dominant or nondominant leg is involved, the uninvolved leg can be used as a reference [23, 24]. Follow-up stress radiographic investigation demonstrated normal values as compared to standards known from literature for calcaneocuboid joints [16] and lateral ankles [2, 15]. If the observed systematic group differences in favor of the *lateral ankle repair group* regarding jumping abilities, isokinetic performance and posturometry (Table 6) are not by random needs substantiation by further research. Furthermore, these findings are not mirrored by the results of patient relevant outcome score evaluation (Table 4). The restoration of the sport activity levels (Table 2) are in accordance with previously published material for anatomical ankle ligament reconstruction [2].

In summary results of this study indicate, that both interventions lead to excellent results, restoring mechanical and functional capacity. In the calcaneocuboid instability group no deterioration could be detected in a longer term follow-up 29-77 months postoperatively [5]. Conclusions however, drawn form this study are limited, due to the low numbers. Further prospective research including higher numbers of patients and longer follow-up periods is recommended to confirm these statements.

Acknowledgements

- The calcaneocuboid repair group was subjected to a second follow-up investigation 52 (29-77) months after surgery [5].
- No financial support was obtained for this study.
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References

1. Pijnenburg ACM, van Dijk CN, Bossuyt PMM, Marti RK. Treatment of ruptures of the lateral ankle ligaments: a meta-analysis. J Bone Joint Surg (Am) 2000; 82-A: 761-773

2. Krips R, van Dijk N, Lehtonen H, Halasi T, Moyen B, Karlsson J. Sports activity level after surgical treatment for chronic anterolateral ankle instability. Am J Sports Med 2002; 30: 13-19

3. Renström PAFH. Persistently painful sprained ankle. J Am Acad Orthop Surg 1994; 2: 270-280

4. Lohrer H, Arentz S. Posterior approach for arthroscopic treatment of posterolateral impingement syndrome of the ankle in a top level field hockey player. Arthroscopy 2004; 20: e15-e21

5. Lohrer H, Nauck T. Augmented periosteal flap repair of the chronically unstable calcaneocuboid joint - a series of six cases. J Bone Joint Surg (Am) (accepted for publication)

6. Hellpap W. Das vernachlässigte untere Sprunggelenk. Die "Frakturlinie" der Supination. Arch Orthop Unfallchir 1963; 55: 289

7. Lohrer H. Combined lateral ankle and calcaneocuboid joint instability. Sportverl Sportschad 2004; 18: 175-178

8. Andermahr J, Helling H-J, Maintz D, Mönig S, Koebke J, Rehm KE. The injury of the calcaneocuboid ligaments. Foot Ankle Int 2000; 21: 379-384

9. Zwipp H, Krettek Ch. Diagnostik und Therapie der akuten und chronischen Bandinstabilität des unteren Sprunggelenkes. Orthopäde 1986; 15: 472-478

10. Mcharo CN, Ochsner PE. Isolated bilateral recurrent dislocation of the calcaneocuboid joint. J Bone Joint Surg (Br) 1997; 79-B: 648-649

11. Lohrer H, Arentz S. Calcaneocuboid joint instability – A novel operative technique for anatomic reconstruction. Foot Ankle Int 2004; 25: 349-356

12. Karlsson J, Bergsten T, Lansinger O, Peterson L. Surgical treatment of chronic lateral instability of the ankle joint. A new procedure. Am J Sports Med 1989; 17:268-273

13. Halasi T, Kynsburg A, Tallay A, Berkes I. Development of a new activity score for the evaluation of ankle instability. Am J Sports Med 2004; 32: 899-907

14. Roos EM, Brandsson S, Karlsson J. Validation of the foot and ankle outcome score for ankle ligament reconstruction. Foot Ankle Int 2001; 22: 788-794

15. Forster G, Scheuba G, Weber EG. Die standardisierte „gehaltene Aufnahme" zur Diagnostik der Bandverletzungen an der unteren Extremität. Akt Chirurgie 1978; 13: 239-252

16. Leland RH, Marymont JV, Trevino SG, Varner KE, Noble PC. Calcaneocuboid stability: A clinical and anatomic study. Foot Ankle Int 2001; 22: 880-884

17. Konradsen L, Beynnon BD, Renström PA. Techniques for measuring sensorimotor control of the ankle: evaluation of different methods. In: Lephart SM, Fu FH (eds). Proprioception and neuromuscular control in joint stability. Leeds: Human Kinetics, 2000: 139-144

18. Holmbäck AM. Reliability of isokinetic ankle dorsiflexor strength measurements in healthy young men and women. Scand J Rehabil Med 1999; 31: 229-329

19. Freeman MAR, Dean MRE, Hanham IWF. The etiology and prevention of functional instability of the foot. J Bone Joint Surg (Br) 1965; 47-B: 678-685

20. Milgram JW. Chronic subluxation of the midtarsal joint of the foot: A case report. Foot Ankle Int 2002; 23: 255-259

21. Quintart Ch, **Burton P.** Une luxation intratarsienne inhabituelle: disjonction conjointe des interlignes naviculo-cunéen et calcanéo-cuboidien. Revue de chirurgie orthopédique 2001; 87 : 826-829

22. Thermann H, Zwipp H, Tscherne H. Treatment algorithm of chronic ankle and subtalar instability. Foot Ankle Int 1997; 18:163-169

23. Barber SD, Noyes FR, Mangine RE, McCloskey JW, Hartman W. Quantitative assessment of functional limitations in normal and anterior cruciate ligament-deficient knees. Clin Orthop Rel Research 1990, 255: 204-214

24. Petschnig R, Baron R, Albrecht M. the relationship between isokinetic quadriceps strength test and hop tests for distance and one-legged vertical jump test following anterior cruciate ligament reconstruction. JOSPT 1998; 28: 23-31

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Figure legends

Fig. 1: Results of the calcaneocuboid stress radiographic investigations after isolated dorsal calcaneocuboid ligament repair. The preoperative mean value was 20.7° ± 3.2° (range 17-25°). Stability was significantly (p=0.001) improved to 9.5° ± 3.5°(range 7-11°) at follow-up 2.3 years later. Paired student's t-test. Confidence interval = 95%.

Fig. 2: MRI presentation of reconstructed dorsal calcaneocuboid ligaments at follow-up investigation. A ligament like structure is visible adjacent to the implanted anchor (*) 15 months after surgery. Right side, patient 2 (a). 59 months after surgery the reconstructed structure resembles a normal ligament. Left side, patient 3 (b). Reconstructed dorsal calcaneocuboid ligament is indicated between arrowheads.

Summary boxes

What is already known on this topic	What this study adds
1. Isolated calcaneocuboid instability is a rarely described condition.	1. Calcaneocuboid instability is an important differential diagnosis in patients suffering from giving way of the foot.
2. Isolated calcaneocuboid ligament lesions seems to be frequently overlooked.	2. Isolated calcaneocuboid instability involves (also) younger and sport engaged subjects.
3. Injury mechanism is similar for isolated calcaneocuboid and lateral ankle ligament lesions.	3. A forceful plantarflexion-inversion mechanism during sport initiated the injury in all patients.
4. Historically operative treatment of isolated calcaneocuboid instability was performed by: - tenodesis (3 cases) - arthrodesis (4 cases).	4. A new developed periost augmented repair for isolated calcaneocuboid instability restores mechanical and functional capacity: It is as effective as anatomic repair for lateral ankle instability regarding -subjective -functional -stress radiographic and -MRI evaluation.
5. Diagnostic principles for isolated calcaneocuboid ligament lesions have not been conclusively evidenced.	5. A diagnostic algorithm for isolated calcaneocuboid ligament lesions is presented
6. Giving way of mechanically stable ankles is attributed to a proprioceptive deficit.	6. Isolated calcaneocuboid ligament lesions must be considered as one possible (mechanic) cause of giving way in mechanically stable ankles.

Figure 1: