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Late-term reconstruction of lateral ankle ligaments using a split peroneus brevis tendon graft (Colville's technique) in patients with chronic lateral instability of the ankle

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Abstract We reviewed 14 patients with chronic lateral instability of the ankle treated by Colville's technique between 1996 and 2001. The mean patient age was 25 (20–35) years and all were men. The mean period between injury and surgery was 25 (18–32) months, and the mean follow-up was 20 (14–32) months. Twelve of the results were excellent and two were good according to the criteria of Chrisman and Snook. All patients returned to normal daily activity levels at an average of 6 months following surgery.

Résumé Nous avons examiné 14 malades avec une instabilité latérale chronique de la cheville traitée par la technique de Colville entre 1996 et 2001. Tous les malades étaient de sexe masculin et l'âge moyen était 25 (20–35) années. Le temps moyen écoulé entre la blessure et la chirurgie était 25 (18–32) mois. La suivi moyen était 20 (14–32) mois. Douze chevilles ont été notées comme excellente et deux comme bonne d'après les critères de Chrisman et Snook. Tous les malades ont retrouvé leur activité journalière à une moyenne de 6 mois postopératoires.

Introduction

Ankle sprains are among the most common musculoskeletal injuries, and the vast majority of these involve the lateral ligaments [12]. Despite appropriate primary treatment, these injuries have the potential of developing

chronic lateral instability [16]. While both nonaugmented and augmented methods can be used for late-term reconstruction, the lateral ligaments can be repaired directly by non-augmented methods and achieve a success rate of about 85% [5, 12, 14, 18, 23].

Tendon grafts are used in augmentation reconstruction techniques, and functional stability can be obtained in about 90% with either non-anatomical or anatomical techniques [2, 6, 9, 10, 11, 12, 13, 24]. Non-anatomical techniques limit subtalar joint movements, since the peroneal tendon is not advanced through the anatomical attachment sites of the lateral ligaments [7, 26]. But with the reconstruction technique described by Colville, in which the split tendon of the peroneus brevis muscle is advanced through the anatomical attachment sites of the calcaneofibular ligament (CFL) and the anterior talofibular ligament (ATFL), stability can be maintained without causing any loss of subtalar joint movements [9, 10, 11, 12, 18].

In this study, we assessed the results of Colville's technique in the treatment of chronic instability of the lateral ligaments of the ankle in young military recruits.

Materials and methods

Between January 1996 and December 2001, we treated 14 patients with chronic lateral instability of the ankle using Colville's technique. The mean age was 25 (range 20–35) years and all were men.

While the aetiology was an ankle sprain during amateur-level contact sports such as basketball or football in eight patients, another six suffered this injury during basic military training as part of an ankle sprain on rough terrain. All had been treated initially with a below-the-knee cast for 15–21 days. They denied any previous repetitive ankle injuries requiring either a cast or a bandage. The mean time between injury and surgery was 25 (range 18–32) months, and all patients presented with a feeling of instability of the ankle, frequent ankle distortion, swelling and pain. Nine patients had type IIb and five had type IIc lateral ligament injuries according to Trevino's classification [26].

Since candidates for surgical reconstruction of the lateral ankle ligaments should show increased laxity of the ankle, we used the TELOS device (Austin and Associates, Fallston, Maryland, USA) to obtain standardised stress radiographs in both ankles of all the patients, and these were taken both before and after operation.

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Fig. 1 The anterior displacement of talus (anterior draw) compared to the uninjured side

Fig. 2 The talar tilt compared to the uninjured side

Indications for surgery

We used the following as indications for surgery [9, 10, 11, 12]:

1. Laxity demonstrated by both the anterior draw stress test and the inversion stress test when compared to the uninjured ankle
2. Anterior talar displacement of more than 10 mm in lateral X-rays while applying 150 N of force with the TELOS device (anterior draw stress test), or an anterior draw of more than 5 mm when compared to the uninjured side (Fig. 1)
3. Talar tilt of more than 10° in anteroposterior radiographs during inversion stress, or talar tilt of more than 5° when compared to the uninjured side (Fig. 2)

Operative technique

Using a 10-cm lateral incision from the base of the fifth metatarsal to the lateral border of the fibula, the peroneal tendon sheath was opened and the peroneus brevis muscle identified. Half the peroneus brevis tendon (split graft) was released from the musculotendinous junction with a scalpel while leaving the distal attachment site intact. The anatomical landmarks as defined by Burks and Morgan were used to locate the precise attachment sites of the lateral ligaments during reconstruction [6].

Fig. 3 The schematic drawing of the Colville's technique

The split graft was passed through an osseous tunnel prepared at the site of attachment of the CF ligament to the calcaneus. It was then passed under the peroneal tendons and through an oblique tunnel in the distal fibula. The mouth of this tunnel was close to the anterior attachment of the anterior talofibular ligament. The graft was then sutured to itself after being advanced through the canal at the talar neck while holding the ankle in a neutral position and with the foot in slight eversion in order to adjust the tension of the graft (Fig. 3).

The ankle was then immobilised with a below-knee cast, holding the ankle in neutral and the foot in eversion. This cast was removed after 6 weeks, and isometric, resisted-range-of-movement and proprioceptive exercises were initiated. Each patient walked with an ankle brace for a further 6 weeks.

Pre-operative and post-operative ankle functions were classified using the five criteria of Ahlgren and Larsson [1], and results were assessed according to the criteria of Chrisman and Snook [24].

Statistical analysis

Statistical analysis was performed using the SPSS 11.0 software package (SPSS Inc., Chicago, Illinois, USA). Calculations between the means were performed with the Wilcoxon signed ranks test and the Mann-Whitney *U* test. The significance level was set at $p < 0.01$.

Results

The mean follow-up was 20 (range 14–32) months, and the measurements with the TELOS device were repeated 6 months after surgery. While the mean anterior talar displacement was measured as 11.8 (range 12–14) mm pre-operatively, it was found to be 1.6 (range 1–3) mm at 6 months. The mean anterior talar displacement was 2.5 (range 2–5) mm at the uninjured side (Table 1).

Mean talar tilt was 16.1° (range 12–20°) pre-operatively and 1.6° (range 0–3°) at 6 months. Mean talar tilt was 3.5° (range 2–5°) at the uninjured side (Table 1).

The differences between the pre-operative and post-operative values of both the talar tilt and the anterior draw tests were statistically significant in the Wilcoxon

Table 1 Summary of the results. *Op* operated, *Nonop* nonoperated, *Preop* preoperative, *Postop* postoperative

Patient no.	Side	Age (years)	Gender	Etiology	Classification (Trevino)	Time from injury to surgery (months)	Dorsi-flexion Op/nonop (°)	Plantar flexion Op/nonop (°)	Talar tilt Preop/postop/nonop (°)	Anterior drawer Preop/postop/nonop (mm)	Follow-up (months)	Functional levels (Ahlgren-Larsson) preop/postop	Results (Chrisman-Snook)
1	Left	20	M	Sports injury	IIIc	23	10/12	50/55	12/2/4	10/0/2	32	2/5	Excellent
2	Left	23	M	Sports injury	IIIb	18	16/18	65/70	18/0/2	12/1/1	14	1/5	Excellent
3	Right	22	M	Sports injury	IIIb	21	16/19	55/60	13/2/4	10/1/3	19	1/5	Excellent
4	Left	26	M	Military training	IIIb	30	19/20	55/55	20/0/4	14/2/1	25	2/5	Excellent
5	Right	24	M	Sports injury	IIIc	32	19/19	60/60	19/3/3	13/3/5	18	1/5	Excellent
6	Right	35	M	Military training	IIIc	26	20/21	50/50	16/0/4	11/1/4	20	1/5	^a Good
7	Right	23	M	Military training	IIIb	23	13/14	45/50	15/2/3	11/2/2	23	1/5	Excellent
8	Left	22	M	Military training	IIIb	20	16/18	45/45	18/3/3	13/2/2	19	1/5	Excellent
9	Right	27	M	Military training	IIIb	19	15/17	55/55	20/3/5	13/2/2	18	1/5	Excellent
10	Left	31	M	Sports injury	IIIb	27	16/16	45/50	16/2/3	12/2/3	19	2/5	Excellent
11	Left	24	M	Military training	IIIc	32	18/19	50/50	15/2/4	12/1/1	18	1/5	^a Good
12	Right	23	M	Sports injury	IIIb	19	12/13	55/60	15/0/3	10/3/2	19	2/5	Excellent
13	Left	21	M	Sports injury	IIIc	31	12/15	45/50	15/2/4	12/1/4	18	1/5	Excellent
14	Left	29	M	Sports injury	IIIb	29	13/17	45/45	14/2/3	12/2/3	18	2/5	Excellent
Range		20–35				18–32	10/20/12/21	45/65/45/70	12/20/0/3/2/5	12/14/1/3/2/5	14–32		
Mean		25	M			25	15.36/17	51.43/53.93	16.15/1.65/3.5	11.79/1.65/2.5	20		

^a Sural nerve injury

signed ranks test ($p=0.001$), thus indicating significant correction of the laxity.

While the mean ankle dorsiflexion was 15.4° (range $10\text{--}20^\circ$) at the operated side, it was 17° (range $12\text{--}21^\circ$) at the uninjured, non-operated side. In addition, the mean plantar flexion was 51.4° ($45\text{--}65^\circ$) at the operated side and 53.9° ($45\text{--}70^\circ$) at the non-operated side (Table 1).

Differences between pre-operative and post-operative values of both plantar flexion and dorsiflexion were not statistically significant in the Mann-Whitney U test ($p>0.05$), and this indicates no significant loss of ankle motion. Similar results were obtained when the measurements were repeated at 9 and 12 months post-operatively.

Ankle movements returned to normal and pain had subsided by the end of the fifth month post-operatively in all patients. There was neither recurrence in any of the patients nor did we observe any infections or skin problems. Two patients developed a sural nerve injury with permanent paresthesia, and we included these in the good result group (Table 1).

While the preoperative functional level was 1 in nine patients and 2 in five, according to the criteria of Ahlgren and Larsson criteria [1], this had changed to 5 in all patients at the end of their treatment (Table 1).

Twelve of the results were excellent and two were good according to the criteria of Chrisman and Snook [24]. All patients returned to their amateur level of sports activities (basketball or football) and their basic military training at an average of 6 months after surgical repair. No degenerative changes have yet been detected.

Discussion

There are more than 50 surgical techniques recommended for the treatment of lateral instability of the ankle [2, 5, 7, 13, 17, 24], and we believe that both the anterior talofibular and the calcaneofibular ligaments (CFLs) must be repaired in order to prevent recurrence and to correct completely the instability [8, 9, 10].

The reported reconstruction techniques can be divided into augmented and non-augmented groups. When presenting late, the lateral ligaments of the ankle should be repaired with a non-augmented technique. However, when enough ligament is available for repair, the Broström and Karlsson techniques are recommended. The Therman, Sjölin, Ahlgren-Larsson and Jarvela techniques are designed for use when there are insufficient ligaments to allow a stable repair [1, 4, 12, 16, 18, 23]. Anatomical reconstruction of the ligaments, the preservation of normal tibiotalar and subtalar joint movements, no problems resulting from using tendon grafts, and a small incision are all advantages of these techniques. The use of local, weak tissues with resulting insufficient stability, incomplete repair of CFL, and frequent problems of subtalar instability are the main disadvantages of non-augmented techniques. Broström reported a success rate of 87–95% in his series using a direct repair [26]. Ahlgren and Larsson reported 95% excellent and good

results 2 years after operation in their series of 83 patients using sub-periosteal flaps [1]. Karlsson et al. reported 132 excellent and good results out of 152 ankles treated with direct repair by shortening [18, 19]. Jarvela reported a success rate of 93% in his series in which he used the inferior part of the tibiofibular ligament for augmentation of the anterior talofibular ligament [16].

Tendon grafts are used for reconstruction in augmented techniques. The most common techniques are the non-anatomical Evans, the Watson-Jones, and the Chrisman-Snook, which make use of the tendon of peroneus brevis for reconstruction. The success rate is about 90% with these methods [13, 21, 24], but these techniques can be criticised as they use non-anatomical graft passage sites and are followed by residual limitation of subtalar joint movements and chronic pain. Sural nerve injury is also reported in 14 patients treated by the Chrisman-Snook technique [7]. The ATFL is repaired more efficiently than the CF ligament in the Watson-Jones technique, but the most frequent complication in 10–30% is reported to be limitation of dorsiflexion and inversion [26]. Even though both ligaments are reconstructed with the Evans technique, a 4% incidence of neuroma, pain in 83% and limitation of inversion in 30% are reported in the series [3, 26]. The biggest loss of inversion together with the lowest instability rate is reported with the Chrisman-Snook technique [15, 25].

In anatomical techniques such as those of Anderson, Burks and Morgan, and Colville, both the CFL and ATFL are repaired together [2, 6, 9, 10, 11, 12]. Anderson reported good results in all nine patients whom he treated with a plantaris tendon graft [2]. Colville reported that augmented reconstruction of the ATFL and CFL using the split tendon of peroneus brevis muscle gave good functional results in all his patients while preserving subtalar motion and eversion strength of the ankle [9, 10, 11, 12]. We observed in our study that with the Colville's technique of advancing the split tendon of peroneus brevis muscle through the anatomical attachment sites of the lateral ligaments of the ankle, the mean anterior talar displacement and the talar tilt decreased less when compared with the pre-operative measurements and were almost the same as of the uninjured ankle, indicating it is possible to achieve a stable ankle in almost 100% of patients. In addition, there was no limitation or loss of dorsiflexion or plantar flexion. These findings were parallel—perhaps even superior—to those of Colville [11]. However, since our series is small, an increase in the complication rate together with some unsatisfactory results might appear if more patients are treated.

Although it has been stressed that the sacrifice of the peroneus tendon weakens the ankle [22], our patients returned to their sports activities and basic military training 6 months after operation without any peroneal tendon weakness. We correlate this encouraging finding with the “split use” of the peroneus tendon, meticulous surgery performed by the same surgeon (AK), and appropriate physical treatment.

In the long-term, it seems that the results of anatomical reconstruction methods of the lateral ankle ligaments are superior to non-anatomical methods, as they achieve better stability and cause less degenerative arthritis [11, 12, 19, 21]. Krips has reported that after 30 years the Evans tenodesis did not adequately prevent laxity, thus allowing development and progression of osteoarthritis of the ankle and subtalar joints [20].

In summary, we believe that lateral instability of the ankle can be successfully treated with this anatomical augmented method as it is easy to perform and gives a satisfactory outcome. But since our patient number is limited, we are expanding our series and keeping our existing patients under review so as to assess late results.

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