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Original article

Assessment of joint position sense deficit, muscular impairment and postural disorder following hemi-Castaing ankle ligamentoplasty

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ABSTRACT

Introduction: Hemi-Castaing ligamentoplasty is a treatment for chronic ankle instability, accused of weakening a powerful stabilizing muscle: the peroneus brevis.
Objectives: To assess proprioceptive and muscular impairment following hemi-Castaing and impact on postural control.
Methodology: A retrospective series of 21 patients underwent clinical (Karlsson, AOFAS) and proprioceptive assessment with isokinetic assessment (evertors and invertors) on a Con-Trex® dynamometer and postural assessment on a Win-Posturo® force platform, at a minimum 6 months postsurgery.
Results: At a mean 18 months' follow-up, mean Karlsson score was 84 and AOFAS score 88. Ankle joint position sense error was less on the operated than on the healthy side. Evertor strength deficit with respect to the healthy side was 4.7% (ns) at 30°/s and 5.7% (ns) at 120°/s in concentric mode and 6.6% (ns) in excentric mode. After surgery, the evertor/invertor ratio was > 1 (in favor of the evertors). Postural values were significantly higher for the operated ankle.
Discussion-conclusion: Hemi-Castaing ligamentoplasty provided excellent clinical and functional results. It did not disturb the agonist/antagonist balance of the ankle muscles, and harvesting a half peroneus brevis did not impair evertor isokinetic force. Joint position sense was not impaired; indeed, deficits with respect to the contralateral side showed improvement.
Level of evidence: Retrospective study.

1. Introduction

The main consequence of ankle sprain is chronic ankle instability [1,2]. It is a functional syndrome inducing both mechanical instability [3], mainly due to ligamentous lesions causing laxity, and functional ankle instability (FAI), due to neuromuscular dysfunction [4] comprising proprioceptive, muscular and postural disorders [5]. Tropp et al. [6] followed by Baumhaueret al. [7] showed peroneus weakness to be an important component of chronic ankle instability.

Conservative treatment provides functional improvement in only 50% of cases of chronic ankle instability [8,9], showing limited efficacy when laxity is combined with instability; surgery is therefore frequent. The various procedures described can be divided into 2 groups: "anatomic" retensioning of the lateral capsule-ligament group, with or without associated lateral collateral ligament (LCL) reinforcement [10–12], and "non-anatomic" tendon substitution such as the Castaing technique, exerting a tenodesis effect on the subtalar joint [13–15]. Comparative assessment does not identify one particular optimal attitude [16]. Krips et al. [17] reported better functional results with anatomic techniques, although peroneus brevis ligamentoplasty is the second most frequent treatment for chronic ankle instability in France [18]. First described by Castaing et al. in 1984 [14], it was later modified as the hemi-Castaing procedure, using only a half peroneus brevis, so as to spare this muscle which has a unique stabilizing action on the ankle and subtalar joint. As peroneal muscle strength is impaired in chronic ankle instability [1,5,19–21], the relatively poor long-term outcome of the hemi-Castaing procedure may be attributed to further reduction in peroneus strength and especially to persistent ankle position sense disorder.

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To the best of our knowledge, there have been no reports of objective results for joint position sense, evertor force and postural stability following hemi-Castaing ligamentoplasty. The present hypothesis was that sacrificing a hemi-peroneus brevis significantly impairs the above functions. The objective of the present study was to analyze proprioceptive and muscular recovery and the impact on postural control following hemi-Castaing ankle ligamentoplasty.

2. Material and methods

2.1. Population

A retrospective study included 21 patients (9 female, 12 male; mean age, 30.6 ± 12.4 years), treated by the hemi-Castaing procedure.

The inclusion criterion was unilateral chronic ankle instability demonstrated by LCL lesions on pre-operative MRI. Minimum follow-up was 6 months. Exclusion criteria were other factors liable to impact balance: contralateral chronic ankle instability, whether operated on or not, anterior cruciate ligament tear, whether operated on or not, and neurologic or ENT balance disorder.

All patients were managed by hemi-Castaing ligamentoplasty [14]. Anterior talofibular ligament (ATFL) retensioning was systematically associated. Six weeks' postoperative non-weight-bearing was prescribed, with circular resin cast immobilization with the ankle held at 90°, followed by active-passive rehabilitation including muscle reinforcement and joint position sense training.

2.2. Clinical assessment

Functional results were graded, using the Karlsson [22] and AOFAS hindfoot [23] scores, as excellent (95–100), good (80–94), moderate (50–79) or poor (< 50). The Tegner activity scale [24] was assessed pre- and postoperatively.

2.3. Proprioceptive assessment

Joint position sense [25] was assessed on a Con-Trex® isokinetic dynamometer.

Patients were positioned supine, leg horizontal with a support to the calf, the knee in 80° flexion and the hip in 45° flexion. The talocrural joint was positioned in 15° dorsiflexion (Fig. 1).

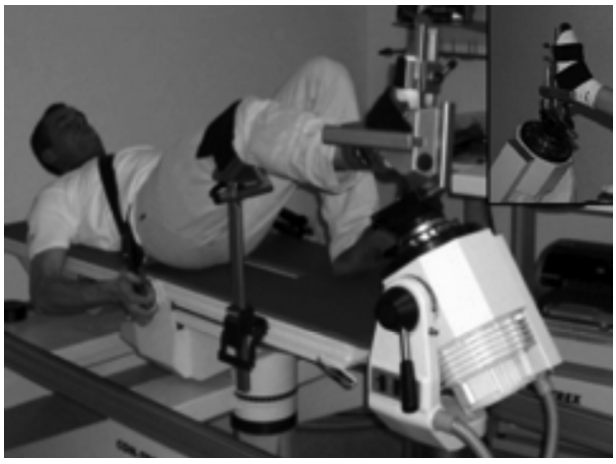

Fig. 1. Patient positioning on Con-Trex® dynamometer for proprioceptive and muscular assessment.

In line with the literature [26], joint position was analyzed at 10° and at 20° inversion, in random order. Patients were tested 3 times for each angle, with test order randomized.

Error (in degrees) between test position and the patient's subjective joint position sense was analyzed.

2.4. Isokinetic assessment

The Con-Trex® isokinetic dynamometer was also used for isokinetic assessment, as described in the literature [1,27,28]. The patient was positioned as previously. Muscle strength was assessed concentrically at 30°/s and 120°/s and excentrically at 30°/s, after warm-up.

Peak torque, normalized to body-weight, was assessed in Newton-meter per kg, and evertor/invertor ratio (E/I) was calculated at all 3 speeds.

2.5. Postural assessment

A Win-Posturo® force platform was used to analyze pressure center displacement.

Tests were performed under bipedal weight-bearing, eyes open and eyes closed, followed by unipodal weight-bearing, eyes open, with the contralateral limb in 70° flexion at the knee and 30° flexion at the hip. Upper limbs were in neutral posture along the body.

Tests lasted 1 minute, with 30-second pauses. When patients lost balance during a test, the test was discarded and started over again.

Pressure center displacement speed, area and length were analyzed.

2.6. Statistical analysis

Normal distribution of quantitative variables was checked on quantile-quantile Q-Q plots. The parametric paired-sample Student *t*-test was used to compare operated and contralateral ankles.

Pearson test assessed correlations between postoperative values and functional results.

The significance threshold was set at $P \leq 0.05$.

3. Results

3.1. Clinical assessment

Twenty-one patients were followed up for a mean 18 ± 8 months postoperatively. The operated ankle was the left one in 6 cases and the right one in 15. Pre-operative MRI found 8 isolated ATFL tears and 13 associated ATFL-calcaneofibular ligament (CFL) tears. At follow-up, 1 patient showed complex regional pain syndrome, which evolved satisfactorily. There were no scar-related complications, neuroma or dysesthesia.

Mean plantar flexion was 35° on the operated and 36° on the healthy side, and mean dorsiflexion 13° and 19° respectively. Mean Tegner activity score was 7.1 ± 3.2 pre-operatively and increased significantly to 8.7 ± 3.6 postoperatively. Mean postoperative Karlsson score was 84.2 ± 23.8, and mean AOFAS score 88.1 ± 16.2.

3.2. Proprioceptive assessment

Patients underestimated ankle position with respect to that expected on the test on both healthy and operated sides. Mean error in absolute values was 1.73 ± 0.73 at 10° and 2.48 ± 1.82 at 20° on the operated side and 2.03 ± 1.1 at 10° and 2.89 ± 1.87 at 20° on the healthy side (Table 1). The differences in error according to side were non-significant.