

## The effectiveness of rotational stabilization in the conservative treatment of severe ankle sprains: a long-term investigation

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### Summary

Although conservative treatment has generally been accepted for acute ankle sprains, there is still some debate as to the best initial treatment. Persistent functional instability of the ankle, as reported in 10–40% of these patients, may be the result of insufficient stabilization of the ankle during ligament healing. The purpose of this prospective study was to determine the effectiveness of rotational stabilization on long-term functional outcome of severe ankle sprains using a special shoe. A total of 41 patients with a mean age of 28.1 years (range 16–48 years) was treated by immobilization in a stabilization shoe and physiotherapy for 6 weeks. Of these, 39 patients (95%) were available for follow-up after 6.1 years (range 5–7.5 years). The subjective result was found to be excellent in 23 patients (59%), good in 14 patients (36%), fair in two patients (5%) and poor in no patients (0%). The mean AOFAS-hindfoot score was 96.2 (range 90–100). One patient suffered from another severe ankle sprain 8 months after the first injury; after surgical repair, the follow-up was uneventful, and he has no restriction in his life or instability problems. All patients were able to return to their previous workplace, and all but two patients regained sports activity at the same level as before the injury. Apparently, the use of a stabilizing shoe with high rotational stabilization of the ankle permits a good to excellent result in a very high percentage of patients. Recurrence of instability, weakness and pain was less than that reported by others using braces that may not have protected the injured ankle sufficiently against rotational forces.

**Keywords:** ankle sprain; brace; conservative treatment; treatment

### Introduction

Wide variations exist in the recommended conservative treatment of acute ankle sprains. Immobilization in a short-leg cast or cast brace for 3–6 weeks, placement only on non-weight-bearing crutches for

3 weeks or simple bandages are some of the various proposals [1]. There is, however, general agreement that, after appropriate immobilization, rehabilitation becomes a significant factor in returning an injured ankle to full functional capacity. Physical therapy should be directed towards inversion–eversion strengthening and neuromuscular co-ordination. The goal is to decrease muscle weakness and re-establish protective reflexes.

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Although there is still some debate about the best initial treatment for an acute, complete tear of a lateral ligament, persistent functional instability of the ankle develops in  $\approx 10\text{--}40\%$  of these patients regardless of the type of initial treatment [2–9]. One reason may be that, as pain and symptoms of instability disappear after 2–3 weeks, patients do not strictly follow the recommended treatment until full recovery is achieved. Thus, ligament healing may not be completed and proprioceptive function not fully restored. Another reason may be the presence of subtalar joint instability, resulting from combined injury to both the anterior talofibular ligament (ATFL) and calcaneofibular ligament (CFL). Kjærsgård-Andersen *et al.* [10,11] found the CFL to be an important structure in the rotatory stabilization of the hindfoot. Finally, accompanying injury to the medial collateral ligaments of the ankle may also result in persistent rotational instability of the ankle. In this condition, conservative treatment should protect the ankle joint complex against rotatory forces. Most braces, however, were shown not sufficiently to stabilize the hindfoot against rotatory movement. Out of five widely used braces, only the stabilizing shoe (Figure 1) and, to some extent, extended taping were proved to neutralize applied rotational torque hindfoot in biomechanical testing [12]. Therefore, we are strictly using a stabilizing shoe for treatment of severe ankle sprains where injuries to the CFL and/or medial collateral ligaments are suspected (Table 1).



Figure 1  
Stabilizing shoe used for the patients in this study. This shoe has been adapted in the meantime, and it is available today in various models and soles.

The aim of this prospective study was to determine the long-term functional outcome of such treatment for severe acute ankle sprains.

## Materials and methods

### Patients

Of the 92 acute ankle sprains treated at our institution from January 1993 to December 1993, 41 patients (44.6%) fulfilled the criteria of not having sustained an ankle sprain and/or another significant injury before, and of not presenting any anomaly of the foot or a malalignment of the hindfoot. None of these patients had prior surgery. There were 25 male and 16 female patients, and the mean age was 28.1 years (range 16–48 years). A total of 28 ankle sprains (68.3%) occurred as a result of sporting events. The other cases involved work-related injuries (17.1%), injuries at home (12.2%) and injuries suffered in road traffic accidents (2.4%).

The preoperative diagnosis was made on the basis of the history and the results of physical examination, including specific manoeuvres, and plain roentgenography. All ankles manifested lateral pain, tenderness and swelling over the lateral ligaments, and 28 ankles (68.3%) also on the medial side, mostly below the medial malleolus.

### Treatment protocol

First measures after acute injury were local application of ice, elevation of the injured ankle and rest. When the swelling and pain had mostly disappeared, usually after 3–5 days, functional treatment was started by passive and active mobilization of the ankle joint, training of muscular strength and protection with a stabilizing shoe when walking. Full weight-bearing was allowed as soon as no more pain existed when loading the ankle. In very active persons, additional taping of the ankle was advised. The stabilizing shoe (Figure 1) was strictly worn during walking until 6 weeks after injury. Afterwards, we still recommended that the patient use it for walks on uneven ground, for high-risk sports activities and for professional work outside. Physiotherapy continued until muscular strength and proprioception were restored.

**Table 1**  
Treatment of acute ankle sprains

Degree of injury	Immobilisation	Protection	Duration (weeks)	Physiotherapy* (weeks)	Return to sports† (weeks)
I	No	Bandage, tape	2	2-4	4-6
II	No	Brace, tape	4	4-8	6-9
III	Yes	Plaster, stabilising shoe, brace	6	6-10	8-12

\*Sensomotoric (proprioceptive) training, strength of peroneal muscles (eversion force).

†Depending on rehabilitation/functional status of peroneal muscles and proprioceptive response.

### Follow-up examination

At the most recent follow-up, 39 patients (39 ankles) were available for re-examination. Two other patients could not be traced. The follow-up period ranged from 5 to 7.5 years (mean 6.1 years).

The AOFAS-hindfoot score [13] was used for assessment of the functional result. The subjective result was assessed using the following criteria: an excellent result consisted of being capable of full activity, including strenuous sports, without pain, swelling or giving-way of the ankle; a good result was defined as pain after strenuous exercise only, but no giving-way or feeling of apprehension; a fair result meant residual instability and some apprehension on stress tests; a poor result signified recurrent instability and giving-way during daily, non-sports activities, with episodes of pain and swelling.

### Results

At follow-up, 37 of the 39 patients (95%) were subjectively satisfied with the treatment and the functional result obtained. All patients were able to return to their previous workplace: within 6 weeks, 35 patients (90%); and within another 6 weeks, four patients (10%). All but two patients regained sports activity at the same level as before the injury. These two patients did not take up the former sport for reasons other than the ankle injury.

One patient suffered from another severe ankle sprain 8 months after the first injury, and surgical repair of the lateral ankle ligaments was performed. Since then, the follow-up has been uneventful, and he has no restriction in his life or instability problems.

The subjective result was found to be excellent in 23 patients (59%), good in 14 patients (36%), fair in

two patients (5%), and poor in no patients (0%). Three of the 39 patients (8%) complained of weakness, and two of these three patients complained of some pain during sports. Regardless of this, they were able to perform sports activities using a brace. On physical examination, 35 patients (90%) had no tenderness. Two patients (5%) had isolated tenderness in the region of the ATFL, and three patients (8%) had isolated tenderness on the anterior border of the medial malleolus. Two patients (5%) had tenderness on both lateral and medial sides of the ankle, and one other patient (3%) had tenderness in multiple areas. All three patients complaining of weakness showed tenderness on the anterior border of the medial malleolus. Clinically, anterior drawer tests showed increased instability to the contralateral side in two patients (5%) and a subtle difference in eight patients (20%). Inversion stress, however, did not reveal a significant difference from the opposite side. No stress radiographs were taken. The mean AOFAS-hindfoot score was 96.2 (range 90-100).

### Discussion

The mechanism of injury to the lateral ankle ligaments in inversion ankle sprains is one of progressive inversion of the plantar-flexed foot and ankle. As the injury progresses, the anterolateral aspect of the capsule is torn first, followed by sequential injury to the ATF and CFL. The posterior talofibular ligament (PFTL) is rarely injured unless complete dislocation occurs. In cadaveric sectioning studies, Johnson and Markolf [14] found the ATFL to be the primary restraint to inversion and anterior talar translation at all angles of ankle flexion. Strain-gauge analysis by several authors has shown the ATFL and the CFL to function in a synchronous fashion to resist inversion at all angles of ankle flexion [15,16].

At the time of the operation, Brostroem [4] found that all patients had a tear of the ATFL. He also found that 27% of these 60 patients had evidence of an injury to the CFL. More recent studies have demonstrated a higher rate of combined injuries to the ATFL and CFL than that reported by Brostroem [4]. Moller-Larsen *et al.* [17] found combined injuries in 59% of their 175 patients. Meyer *et al.* [18] found serious injury to both the CFL and the subtalar joint ligaments (the lateral talocalcaneal and the interosseous ligaments) in 32 of 40 patients (80%). In a prospective study of 153 consecutive ankles experiencing chronic instability, Hintermann *et al.* (in press) suspected clinical involvement of the medial collateral ligaments in 18 ankles. Arthroscopically, they could verify concomitant medial instability in as many as 56 ankles.

All these studies indicate that severe ankle sprains might be associated with more severe injuries to the lateral and medial ligaments than generally believed. They may also explain why 20–40% of patients with an acute ankle sprain will go on to experience chronic instability and subsequent disability after conservative treatment [3–9,19]. In the present study, however, 95% of the patients showed a good subjective and objective result, without residual instability and pain.

One possible explanation for the obviously better result in the present study might be that the stabilizing shoe was more efficient in protecting the injured ankle than other devices used. This may especially be the case with respect to rotational stabilization. Müller and Hintermann [12], in a biomechanical testing, found in six patients suffering from chronic ankle instability that only the stabilizing shoe and, to some extent, taping were able to neutralize applied rotational torque to the hindfoot. One may therefore assume that, by wearing the stabilizing shoe, the accompanying lesions of the medial ligaments healed completely in most cases, thus avoiding the occurrence of rotational instability.

Numerous clinical studies have shown the effectiveness of ankle orthoses and their effect on performance [19]. Recently, a study compared radiographically talar tilt in athletes with functional instability during an inversion movement [20]. A decrease in talar tilt was found when athletes were wearing an ankle brace compared with the unbraced condition. However, to our knowledge, no

study has proved the effectiveness of ankle braces against rotatory forces or anterior drawer moment in acute ankle injuries. To perform such a study would be extremely difficult as, in acute ankle sprains, injuries to the medial ankle ligament are very difficult to quantify by means of clinical examination and imaging methods (Hintermann *et al.*, in press).

One may argue that no stress radiographs have been taken in the present study to quantify the ankle instability. Among others [7,21,22], Rubin and Witten [23] reported a wide range of laxity in patients with normal ankles and called into question the validity of stress radiographs of the ankle. In accordance with others [20], we therefore believe that, when non-surgical treatment is considered for acute complete rupture of the ankle ligaments, stress-testing radiographs should no longer be used routinely.

The present study has several limitations. First, no randomized trial has been performed, and no control group was used to validate the effectiveness of the treatment. Secondly, strict inclusion criteria were applied to the patients on entry into the study, which was not the case in most other studies. The results obtained must therefore be applied carefully in daily practice. Nevertheless, they may indicate the need for rotatory stability to be provided by any orthosis used for the protection of an acute injured ankle.

### Conclusions

For conservative treatment of an acute ankle sprain, the use of a stabilizing shoe with high rotational stabilization of the ankle permits a good to excellent result in a very high percentage of patients. Recurrence of instability, weakness and pain was less than that reported by others using braces that may not have protected the injured ankle sufficiently against rotational forces.

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