Epidemiology

Long-term prognosis of acute lateral ankle ligamentous sprains: high incidence of recurrences and residual symptoms

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Abstract

Background. Acute lateral ankle ligamentous sprains (ALALS) are common injuries. This injury does not always have a favourable long-term outcome. Studies reporting the prognosis of ALALS after functional treatment are scarce.

Objective. To determine the prognosis of functionally treated ALALS, in terms of recurrent ALALS and residual symptoms.

Study design. Retrospective cohort study.

Setting. Patients were recruited from 20 family practices, nine physical therapy practices, the emergency departments of a regional hospital and a university hospital.

Patients. Adult patients with an ALALS caused by an inversion trauma were invited to participate in this study 2.5–5 years after their initial injury.

Independent variables. Functional treatment of the initial ALALS.

Main outcome measures. Acute lateral ankle ligamentous sprain recurrences and residual symptoms.

Results. A total of 44 patients were included, with an average follow-up period after the initial ankle sprain of 204 weeks (range 150–274 weeks). Eight patients (18.1%) had reinjured their ankle. Explicit pain around the ankle joint at physical examination was experienced by 45.5%. Clinical symptoms of anterior ankle impingement were present in 25% (all athletes), with radiologically confirmed tibiotalar osteophyte bone formation in 82% of them.

Conclusions. A large proportion of patients with ALALS experience recurrences and persistent symptoms after their initial ankle injury. The high percentage of patients with anterior ankle impingement syndromes illustrates the need for early assessment of this impairment in patients with persistent complaints.

Key words: Ankle injuries, impingement, long-term consequences.

Introduction

Acute lateral ankle ligamentous sprains (ALALS) frequently occur in everyday life and during sports participation. Incidence rates range from 2.2 to 7.0 per 1000 person-years (1–3). Acute ankle sprains are usually caused by an excessive inversion movement of the ankle, in which the lateral ligaments are stretched out (4). Depending on the...
severity of the sprain, the fibres of the ligaments are either intact or (partially) disrupted (5). The long-term outcome after an ankle sprain is often unfavourable, which is alarming considering the high frequency of this injury (6). Evidently, recurrent sprains and residual symptoms (e.g. pain, swelling, ankle instability and impingement syndromes) after ALALS can impact a patient’s everyday life. Even after years, the discomfort and lack of trust in the injured ankle can cause patients to make sacrifices, particularly in their sports performance level (7).

Despite the abovementioned indications of a poor prognosis of ALALS, studies focusing on the patients receiving only functional treatment are limited. Most studies reporting about the long-term consequences of ALALS include patients who received surgical treatment (as well) (8–11) or focus on immobilizing treatment (12–15). However, functional treatment after ALALS is currently recommended as the treatment of choice (5,16,17).

The objective of this study is to determine the long-term prognosis of functionally treated ALALS in terms of recurrent ankle ligamentous sprains and residual symptoms.

Methods
Participants
To examine the long-term consequences of ALALS, patients included in a clinical trial on the treatment of ALALS (18) were invited 2.5–5 years after inclusion in the clinical trial to participate in this cohort study. Between May 2006 and October 2008, patients were recruited from 20 general practitioner practices and 9 physical therapy practices in the Netherlands (region Utrecht), and from the emergency departments of a regional hospital (Zuwe Hofpoort Hospital, Woerden, the Netherlands) and a university hospital (University Medical Center Utrecht (UMCU), Utrecht, the Netherlands). Patients 18 years or older who were clinically diagnosed with ALALS caused by an inversion trauma were eligible for the trial. Patients were excluded if they sustained an ever-sustained sprain, multiple traumas, complicated trauma (including cartilage injuries, fractures and dislocation), or had a history of ankle surgery. Patients diagnosed as mentally ill or with dementia were also excluded. In the clinical trial, functional treatment consisted of a 4-week treatment with a soft ankle brace or athletic ankle tape.

Patients were eligible for the present cohort study if they had completed at least 1-year follow-up after the initial injury (because we were interested in the long-term prognosis). Patients from the clinical trial study who sustained ankle injuries other than ALALS (e.g. fractures, overuse injuries) during the 1-year follow-up period were excluded from analyses. These patients (n = 7) were also excluded from the current cohort study to prevent bias. A total of 136 patients (of the 157 in the clinical trial) were eligible for participation in the cohort study. The medical ethics committee of the UMCU approved the study protocol. All patients gave their written informed consent.

Procedures
This study was executed 2.5–5 years after inclusion of patients in the clinical trial. Patients were invited by email to fill out a short online questionnaire about their willingness and availability to participate in the current cohort study. When necessary, a reminder was sent after 2 weeks. In case of an incorrect email address, patients were contacted by telephone (when available) or by a letter sent to their home address.

A sports medicine physician at the UMCU invited the patients who were willing to participate for a clinical assessment. This assessment consisted of standardized history taking and physical examination to determine pain in everyday life, local tenderness around the ankle, swelling, ankle function and mechanical and functional stability. A limited ankle dorsiflexion, pain at the anterior and anteromedial ankle, pain at the talocrural joint, and diffuse swelling were defined as symptoms of anterior ankle impingement (19–21). In the presence of at least one of the clinical symptoms of anterior impingement, standard anteroposterior radiographs, lateral radiographs and an oblique radiograph were performed to detect the presence of osteophytes at the talus and/or anterior rim of the tibia. In the oblique anteromedial impingement view, the beam was tilted into a 45° craniocaudal direction with the leg in 30° of external rotation and the foot plantar flexed in relation to the standard lateral radiograph position (22).

Outcome measures
The primary outcome was the proportion of patients with a recurrence of ALALS. A recurrence was defined as a new inversion trauma of the same ankle, after the initial presenting injury in the clinical trial.

The secondary outcome was the occurrence of residual symptoms at the follow-up assessment by the sports medicine physician. These symptoms included: pain during walking, running, pivoting and/or jumping (Yes/No); local tenderness at physical examination of the ankle; swelling (Substantial/Moderate/Minimal/No); functional outcome (No limited dorsiflexion/ Limited dorsiflexion); mechanical and functional stability and the clinical presence of ankle impingement syndromes. Mechanical stability was defined as ligamentous stability. The manual tests used to measure ligamentous stability were the manual anterior drawer test (23) and the talar tilt test (24). Functional stability was defined as proprioceptive and neuromuscular stability. A clinical balance test, consisting of four one-leg stance tests, was used to identify functional stability impairments (25). Individuals were instructed to balance on a bare foot with the knee of their non-weight-bearing leg flexed 90° at the hip and their hands crossed over their chest, and remain as motionless as possible for 15 s without moving their arms or non-weight-bearing leg. The first one-leg stance test was conducted with the eyes open, the second with the eyes open and the knee in 45° flexion, the third with eyes closed and the knee in 45° flexion and last, and most difficult, with eyes closed and the knee in 45° flexion while raising the heel from the ground (standing on the forefoot). Both legs were tested identically. Successful accomplishment of the one-leg stance test was defined as being able to stand on one leg for 15 s.

Statistical analysis
The baseline characteristics of the patients and the outcome measures were presented using descriptive statistics. Non-parametric Chi-square tests or two-tailed t-tests were applied to compare baseline characteristics of responders and non-responders. A P value of less than 0.05 was considered to indicate statistical significance. All data were analysed using IBM SPSS Statistical software package (version 19).

Results
Study population
Of the 136 eligible subjects, 47 (34.6%) were willing to participate in the cohort study, including the assessment by the sports medicine physician (Fig. 1). Three responders with ankle/foot injuries...
other than recurrent sprain (inflammation of upper tarsal joint, two unknown injuries) during the follow-up period were excluded (see Fig. 1). As a result, 44 responders were included in the current analysis after a mean follow-up period of 204 weeks (range 150–274, SD ± 35 weeks).

Demographic and baseline characteristics
Some small non-significant differences between the eligible participants who responded and the non-responders were found. The responders were somewhat older at baseline (chi square test, mean 33.1 years versus 31.1 years in the non-responders, $P = 0.095$). Also, their reported recurrence rate measured in the clinical trial was higher than in the non-responders (chi square test, 23 versus 13%, $P = 0.15$). Other characteristics, like injury severity of the index injury, type of functional treatment of the index injury (tape or brace) and the percentage of sports participants were not statistically significant either. Therefore, both groups were considered comparable at demographic and baseline characteristics (see Table 1).

Re-injuries
Of the 44 responders, 8 (18.1%) reinjured their ankle after the initial ALALS from the trial, of which seven participated in sports and one did not. Of these eight responders, five reported a recurrence within 1 year after the initial ALALS. Five additional responders had complaints of recurrent ‘giving way’ without swelling and discoloration of the ankle (11.4%).

Residual symptoms
Of the responders, 29.5% still reported pain of the injured ankle during daily life activities at long-term follow-up (Table 2). At physical examination, 45.5% had explicit tenderness around the ankle joint, of which 85% at the region of the sinus tarsi. Clinical symptoms of anterior ankle impingement, e.g. focal anteromedial pain, exacerbated on dorsiflexion and limited dorsiflexion, were present in 11 responders (25.0%; all of whom were athletes).

Radiological evaluation
Of the 11 responders with a symptomatic anterior impingement, 9 (82%) showed clear anterior tibiotalar osteophyte bone formation at radiographic evaluation. One responder had already been operatively treated for persistent ankle complaints after the initial ALALS. Pre- versus postoperative radiological evaluation showed clear anterior talar bone formation in this person.

Discussion
In our cohort among 44 responders with ALALS receiving functional treatment, 18.1% reported re-injuries and almost one-third of the responders reported pain, while 45.5% had explicit tenderness around the ankle joint after the mean follow-up period of nearly 4 years. At physical examination, symptoms of anterior tibiotalar osteophyte bone formation were present in 11 of the 44 responders (25%).

The results of our study are in line with earlier studies (6,7,15). In a systematic review, Van Rijn et al. (6) reported that 3–34% of the patients with an acute lateral ankle sprain have suffered at least one recurrent ankle sprain during the follow-up period ranging

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**Figure 1.** Flow chart of ankle sprain patients from inclusion in a clinical trial to participation in a cohort study on long-term consequences (150–274 weeks after the first inclusion) of acute lateral ankle ligamentous sprains.

**Table 1.** Baseline characteristics of respondents willing to participate in a cohort study on long-term consequences (150–274 weeks) of ALALS compared to respondents not willing to participate in this cohort study

<table>
<thead>
<tr>
<th></th>
<th>Non-responders n = 89 (%)</th>
<th>Responders long-term study n = 44 (%)</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>51 (57.3)</td>
<td>26 (59.1)</td>
<td>0.844</td>
</tr>
<tr>
<td>Mean age, years (SD)</td>
<td>31.1 (10.6)</td>
<td>33.1 (14.0)</td>
<td>0.095</td>
</tr>
<tr>
<td>Sports participants, n (%)</td>
<td>76 (85.4)</td>
<td>39 (88.6)</td>
<td>0.607</td>
</tr>
<tr>
<td>Intervention during the CT</td>
<td></td>
<td></td>
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<tr>
<td>Brace, n (%)</td>
<td>44 (49.4)</td>
<td>24 (54.5)</td>
<td>0.579</td>
</tr>
<tr>
<td>Tape, n (%)</td>
<td>45 (50.6)</td>
<td>20 (45.5)</td>
<td></td>
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<tr>
<td>Injury severity*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild, n (%)</td>
<td>24 (27.0)</td>
<td>11 (27.7)</td>
<td>0.950</td>
</tr>
<tr>
<td>Moderate, n (%)</td>
<td>50 (56.2)</td>
<td>26 (57.4)</td>
<td></td>
</tr>
<tr>
<td>Severe, n (%)</td>
<td>15 (16.9)</td>
<td>7 (14.9)</td>
<td></td>
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<tr>
<td>History of ankle sprain injured ankle prior to index injury trial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, n (%)</td>
<td>36 (40.4)</td>
<td>12 (27.2)</td>
<td>0.294</td>
</tr>
<tr>
<td>No, n (%)</td>
<td>39 (43.8)</td>
<td>25 (56.8)</td>
<td></td>
</tr>
<tr>
<td>Unknown, n (%)</td>
<td>14 (15.7)</td>
<td>7 (15.9)</td>
<td></td>
</tr>
<tr>
<td>Recurrent ALALS after 1 year (measured in CT)</td>
<td>14 (13.2)</td>
<td>10 (22.7)</td>
<td>0.148</td>
</tr>
</tbody>
</table>

See Supplementary Table S1.
from 2 weeks to 3 years. Many patients (15–64%) still experienced residual symptoms such as pain and subjective instability 3 years after their initial ankle injury. Konradsen et al. (7) reported chronic complaints, swelling or recurrent sprains in 32% of the subjects after 7 years of follow-up. All patients in these studies were recruited from a hospital, which is different from our study. Our study population is probably more diverse. In a study among the general population in the Netherlands, Verhagen et al. (15) found a high incidence of ankle sprain recurrences (46%) and residual complaints (30%) after 6.5 years follow-up. The higher incidence of recurrences in their study might be explained by the inclusion in the study population of more severe forms of ALALS requiring further second-line hospital evaluation or by the longer follow-up period in their study.

Anandacoomarasamy and Barnsley (26) studied patients presenting themselves at a sport medicine clinic in Australia. In this study, 74% of the patients had at least one residual symptom when assessed 1.5–4 years after their initial injury.

In this study, ankle pain was mostly localized laterally, with the maximal pain at the sinus tarsi. This is an indicator of sinus tarsi syndrome. It is a common clinical entity characterized by persistent anterolateral ankle pain. In 70% of the cases, the anterolateral ankle pain occurs secondary to traumatic injuries to the ankle (27). In our study, sinus tarsi syndrome was clinically suspected in 38.6% of the respondents. To our knowledge, there are no other clinical studies comparable to ours regarding information about this syndrome after ALALS. Klein and Spreitzer (28), e.g. used an MRI to observe abnormal signals within the region of the sinus tarsi. They found abnormal signals on the MRI (1–48 months after trauma) in 39% of their patients with disruption of the lateral ankle ligaments. As we did not use an MRI in our study, it is not possible to conclude that the results of our study and those of Klein and Spreitzer (28) are comparable.

In total, 25% of the responders (n = 11; all were athletes) had symptoms of anterior tibiotalar osteophyte bone formation and were X-rayed. Nine of these subjects (82%) had radiologically confirmed anterior tibiotalar osteophyte bone formation (‘spurs’). It is thought that hyper dorsiflexion, repetitive (micro) traumata and ankle instability are possible causes for the development of these bone spurs in general (22). However, more than 50% of active athletes have ankle osteophytes without complaints. This indicates that radiologic changes are not necessarily symptomatic. Cheng and Ferkel (29) found asymptomatic spurs in the ankles of 45% of football players and in 59% of dancers. Subsequently, these spurs can become symptomatic when hypertrophic synovia, scar tissue or the anterior capsule is squeezed between the tibiotalar osteophytes (22,30). It is believed that recurrent trauma and decreased functional and mechanical ankle stability have a negative contribution to this phenomenon. Only 2 of our 11 responders with clinical signs of anterior impingement showed no radiologic tibiotalar spurs. Soft-tissue compression of the joint capsule is most probably the cause of their anterior impingement syndrome.

Signs of posterior ankle impingement were found in three responders (6.8%). These subjects also had symptomatic anterior ankle impingement. The aetiology of symptoms in those responders is probably the same, causing impingement of hypertrophic synovia both anteriorly and posteriorly. Much like anterior impingement, posterior impingement syndromes can manifest sub acutely after other ankle injuries or repetitive trauma with compression of soft-tissue components.

Another frequently seen residual symptom is ankle instability. This instability can be mechanical when laxity of the capsular ligamentous complex has been identified through physical examination, or functional, when patients complain about an unstable feeling (‘giving way’). Functional ankle instability is caused by deficits in proprioception, neuromuscular control, postural control and/or muscular strength (31,32). In this study 95.9% of the patients had good functional (active) stability in the one-leg stance test with the knee in 45° flexion and open eyes. This is in accordance with the results after 1-year follow-up (18). Performing the one-leg stance test with the knee in 45° and eyes closed, the results after 1 year of follow-up were however better than after a mean follow-up period of 204 weeks post initial ankle injury (29.3% had good functional stability after 1 year versus 15.9% after a mean follow-up of 204 weeks). This might indicate that the active stabilizers of the ankle diminish in their function with time, which highlights the need for a repeated execution of active ankle stability exercises. More research is needed to clarify the function of the active ankle stabilizers over time.

This study has some limitations. Our primary outcome was ankle sprain recurrences, which are self-reported by the patients and collected retrospectively. Prospective registration of ankle sprain recurrences would be more accurate, especially when recurrences are not only reported by patients but also verified by skilled physicians. To our knowledge, no study has ever taken such a rigorous approach. The number of responders included in our cohort study is relatively small (n = 44). There are no indications however that the responders included in this long-term study differ from the non-responders. We do not know if they already showed signs of anterior impingement and/or tibiotalar spurs before the initial ALALS. Furthermore, only those responders with clinical symptoms of anterior ankle impingement were examined with radiographs. Therefore, whether there is a causal relation between the initial ALALS and the presence of impingement signs at follow-up cannot be determined.

A major strength of our study is the measurement of the secondary outcome variables by a sports medicine physician.

Our study underlines the high percentage of patients dealing with recurrences and/or persistent symptoms after a frequently occurring ALALS (6,7,15). An impingement syndrome seems to be a less well-known residual symptom. As 25% of our responders were diagnosed...
with this syndrome, it deserves more attention in education aimed at physicians and physical therapists. Both patients as well as physicians should be aware of the fact that there is no such thing as an ordinary ALALS. Primary care providers, such as general practitioners and physiotherapists, should be aware of the clinical presence of ankle impingement syndromes in order to prevent long-term residual complaints.

In future research, it is relevant to evaluate the prognostic factors that contribute to residual symptoms in order to identify the population at risk for long-term complaints in an early stage. Subsequently, treatment adjustment and/or prevention strategies can possibly improve long-term outcomes.

**Supplementary material**
Supplementary material is available at *Family Practice* online.

**Declaration**
Funding: This study was partially funded by Nea International, manufacturer of the Push Med ankle brace.

Ethical approval: none.

Conflict of interest: The content of this report is solely the responsibility of the authors and does not necessarily represent the official view of Nea International. We declare that we have no conflict of interest. Prof. FJG Backx declares that Nea International has given unrestricted financial support to initiate and perform this study. Furthermore, Nea International offered the ankle braces (type Push Med) used in the intervention. We fulfilled this study without any influence or interference of the sponsor.

**References**


