Management of chronic lateral ankle instability: alternatives for diagnosis and treatment

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General discussion
The chapters in this thesis can be divided in studies about treatment (chapter 2 through 5) and studies about diagnosis (chapter 6 and 7) of chronic lateral ankle instability. These aspects of management will be discussed separately.

**Diagnosis**

In clinical practice, history and physical examination remain the corner stones for the diagnosis of chronic lateral ankle instability. Standard ankle radiographs are useful to evaluate concomitant osseous or structural ankle and foot pathology. An MRI scan may provide helpful information about soft tissues pathology but in case of pure lateral ankle instability it is not required.

Several tests and devices are available to evaluate functional ankle stability or ligament laxity but so far none of these has emerged as a gold standard that reliably and reproducibly quantifies the instability.

**Functional instability**

Functional lateral ankle instability is most often evaluated with physiologic measures that assess neuromuscular control: joint position sense, peroneal reaction time, magnitude of the activity of the peroneal muscles (EMG measurement), and balance tests. Although reliability of these test may be high, it remains the question whether these measures are useful to quantify disturbed neuromuscular control. Many authors have found differences between ‘affected’ and ‘not affected’ sides or subjects but this is not consistently so.

The study in this thesis comparing patients with unilateral chronic ankle instability to patients after an unilateral acute ankle inversion injury and healthy subjects with balance tests, shows no difference between the groups and no difference between the affected and not affected side (Chapter 7). A recent systematic review by McKeon et al showed that worse postural control evaluated with instrumented measures might predict future sprains but postural control is not useful to assess chronic lateral ankle instability.

A general concern with this type of tests is that differences found may be statistically significant at the group level, but they are usually small. A physiologic outcome measure showing consistently a statistically significant difference between ‘affected’ and ‘not affected’ may therefore be useful for scientific purposes comparing groups or longitudinal
treatment effects in one group. Since a clear cut of point between normal and abnormal is hard to establish, so far, they are not adequate for clinical use in individual patients. The same applies for the study in chapter 7 that was performed to evaluate balance measures as a possible predictor for the development of chronic instability after an acute ankle sprain. Even if a statistically significant difference was found, this would have probably been too small to use balance measures for differentiating between individual patients at risk and not at risk.

An alternative may be use of mainly history based ankle scores, e.g. the Karlsson, AOFAS or Good score. Although ankle scores are mostly used for the evaluation of (surgery for) chronic ankle instability with increased ligament laxity, they may also be used for the assessment of chronic functional ankle instability. The study in Chapter 7 actually shows a statistically significant and clinically relevant difference between the groups using the Karlsson and AOFAS score. This finding, however, needs further exploration.

**Ligament laxity**

To objectify increased lateral ankle ligament laxity, radiographic stress testing is most often used for research purposes but is also applied in the clinical setting. The Telos device is probably the most widely used apparatus for stress radiography. At the cost of the use of radiation exposure, the advantage of radiographic stress testing is that the displacement of the bony structures relative to each other can be measured. Apart from radiation exposure of the patient, the main problems with radiographic stress testing remain the chance of false negative results due to apprehensive muscle guarding and the difficulty to assess a cut of point between normal and abnormal values due to great variability in published data. Although stress radiographs are often used, they cannot be considered the gold standard.

To overcome the effect of apprehensive muscles guarding the Dynamic Anterior Ankle Tester was developed, showing good reliability in the initial evaluation with small groups. The clinical evaluation study that forms part of this thesis, however, shows a much lower reliability (Chapter 6). As it is not yet clear whether this is due to its design or its application, the device is to be reconsidered for further development. So far, the Ankle Arthrometer developed by Kovaleski and Hubbard shows the best in-vitro and in-vivo results. This is however a rather bulky device and reproducibility and validation remain to be assessed.
General discussion

Treatment

The studies on the treatment of chronic lateral ankle instability mainly evaluate surgical options. Two studies (chapter 4 and 5) specifically assess outcome of surgical interventions (capsular shrinkage and the Weber procedure, respectively). The systematic review about ‘Interventions for treating chronic ankle instability’ (chapter 2) was designed to include studies about conservative treatment as well and - apart from surgical treatment - conservative treatment is discussed in the review about ‘treatment of chronic ankle instability in athletes’ (chapter 3).

Conservative treatment

There is consensus in the literature that the initial treatment of chronic ankle instability should be conservative.\textsuperscript{1,29,64,65,89} The Cochrane review by Handoll et al of RCT’s about prevention of ankle sprains showed a beneficial effect of certain orthoses, especially in subjects with a history of ligament injury.\textsuperscript{29} They found no RCT-based evidence for the effectiveness of other preventive measures, including proprioception training or ankle disk and wobble board training. Trials evaluating interventions as treatment - rather than prevention - for chronic ankle instability were excluded. A second systematic review about the prevention of sprains by Verhagen et al showed a beneficial effect of tape and braces but also of proprioception training.\textsuperscript{93} No difference between previously injured or healthy subjects was found. The latter review was methodologically less rigorous; apart from six RCT’s, one non-randomised prospective and one retrospective study were included. Van der Wees et al performed a systematic review assessing the effectiveness of exercise therapy and manual mobilization after acute ankle sprain and for functional ankle instability.\textsuperscript{90} Exercise was found to reduce the number of recurrent sprains in both acute and chronic patients, but methodological quality of included studies was low as well. The systematic review by Loudon et al about exercise therapy for functional ankle instability provided a positive level B recommendation (based on lower level of evidence) for the benefit of some of these exercises.\textsuperscript{64} In a fifth systematic review, McKeon et al found a beneficial effect of training in preventing for ankle sprains, especially in subjects with a history of ligament injury. It was unclear whether in patients with established chronic ankle instability, functional stability improved with the exercises.\textsuperscript{69}
In the review ‘interventions for treating chronic ankle instability’ in this thesis, only one randomized trial, of low methodological quality, evaluating conservative treatment could be included.\cite{35} Six more randomized trials about exercise therapy, of which some were included by van der Wees et al, McKeon et al and Loudon et al, were excluded because of lack of clinically relevant outcome measures.

The systematic review in this thesis, in combination with the cited reviews, shows that there is no definitive, high-level evidence for the benefit of exercise therapy or the use of orthoses for chronic ankle instability.\cite{23,29,64,69,90,93} However, a positive effect of both treatment options is found by lower level evidence and by extrapolation of high-level studies about prevention of ankle sprains. This emphasizes the need for high quality, sufficiently powered and well-reported randomized trials. A contribution to this may be the update of the systematic review in chapter 2 that is currently performed.

A reduction in the number of recurrent sprains can be expected from the use of orthoses, whereas the most promising type of exercise therapy probably is balance training with an unstable device like an ankle disk, wobble board or balance board.\cite{29,64,69,90,93} An important improvement would be the use of clinically relevant outcome measures in studies evaluating exercise therapy. The laboratory measures that are often used in trials about conservative treatment may show statistically significant differences but they do not properly evaluate functional ankle stability.

**Surgical treatment**

The review in chapter 2 did not provide high-level evidence for the superiority of any surgical treatment. There is no RCT comparing conservative treatment with surgical treatment and most included RCT’s have a low methodological quality. Apart from the quality criterion, no clear advantage of any technique regarding improvement of functional stability was found by the individual studies as well. Therefore, the best evidence available remain the retrospective comparative studies by Krips et al, showing better functional results with an anatomical reconstruction as compared to non-anatomical reconstructions, at both short- and long-term follow-up, for both the general population and athletes.\cite{54,56-58}

No RCT’s about the surgical treatment of chronic ankle instability have appeared recently, whereas case series continue to be published.\cite{2,4,11,12,18,42,52,70,73,74,80,85} There may be several reasons for this reluctance to produce high-level evidence. Evidence based medicine has only recently gained popularity in (orthopedic) medicine, whereas the results of most
orthopedic procedures, including ankle ligament reconstructions, are only interesting after mid- or long-term follow-up. Case-series often report about patients that have been operated more than ten years ago, when the need for randomized controlled trials was not as well established as it is now.\textsuperscript{2,4,52} In other case series new procedures or modifications of old techniques are evaluated, that initially may need assessment of clinical outcome before a complex trial is started.\textsuperscript{11,18,42,74,85} Some techniques only apply as salvage procedure when other options are not possible anymore. Because of their infrequent use, a randomized trial is not feasible as well.

Chapter 4 and 5 of this thesis are both case series evaluating alternative surgical options for the treatment of chronic lateral ankle instability, one prospective study (arthroscopic capsular shrinkage) and one retrospective study (Weber procedure).\textsuperscript{21,22}

The study about arthroscopic capsular shrinkage (chapter 4) would have been most suitable for randomized evaluation, against an anatomic reconstruction, for example.\textsuperscript{22} Because the procedure was relatively new, it was decided to initially perform a prospective longitudinal study, to assess its efficacy and safety in the ankle first. Interesting about the results of the capsular shrinkage was the clear functional improvement, emphasized by the better postoperative neuromuscular control, whereas the reduction of ligament laxity, the primary purpose of the procedure, was only moderate. It was hypothesized that the functional improvement may have been related to the debridement of the ankle joint that was performed in all patients to gain access to the anterolateral capsule and ligaments. A study comparing capsular shrinkage with debridement alone would be required to verify this hypothesis.

However, with the mid-term results of capsular shrinkage for shoulder instability in mind, longer-term follow-up is needed to better assess its definitive effect on chronic ankle instability.\textsuperscript{19}

The retrospective study about the Weber procedure (chapter 5), using the plantaris tendon for reconstruction of the anterior talofibular ligament, shows long-term results that were almost as good as an anatomical reconstruction but appeared to be better than a non-anatomical reconstruction.\textsuperscript{21} The Weber procedure is an example of a technique that can be used as a salvage procedure for failed reconstructions or when an anatomical reconstruction is not possible because the ligament remnants are not amenable for direct repair. Information about the reason for applying the Weber procedure in the population of the current study instead of other techniques was not available for the majority of patients. Results of secondary
reconstructions after failed primary reconstructions may therefore not be as good as the results described in this study.

The results of the study, however, do show that reconstruction of the anterior talofibular ligament alone provides good long-term results in the majority of patients. This emphasizes the role of this ligament as main stabilizer against inversion and suggests that reconstruction of the calcaneofibular ligament is of minor importance.\textsuperscript{8,15}

**Algorithm for the management of chronic lateral ankle instability**

**Diagnosis**

History and physical examination remain the corner stones for the diagnosis of chronic lateral ankle instability.\textsuperscript{44,55,89,91} With a careful history, functional ankle instability can be well evaluated; the number of sprains thus far, in what situation sprains or giving way occur, the treatment received and to what extend the patient is limited by the symptoms.\textsuperscript{44,55} With chronic lateral ankle instability, physical examination is mainly used to assess the presence of increased ligament laxity.\textsuperscript{16,26,28,91}

So far, there is no test for functional ankle instability that can discriminate the pathological ankle from a normal ankle in individual patients and these tests play no role in the evaluation of chronic ankle instability in clinical practice.\textsuperscript{20,24,59,67} Standard radiographs are usually made to evaluate the bony structures and the presence of osteoarthritic changes, whereas additional radiological studies, like MRI or CT, are only necessary for the assessment of concomitant pathology or an alternative diagnosis.\textsuperscript{7,10,13,28,31,33,34,37,45,49,51,71,72,84,94} Stress radiographs may confirm the presence of abnormal laxity but will generally not provide information that affects the choice of management.\textsuperscript{7,28,92}

**Treatment (figure 1)**

Based on the studies in this thesis, combined with the studies by Krips, an algorithm for the treatment of chronic lateral ankle instability can be proposed.\textsuperscript{21-23,54,56-58} After the diagnosis of chronic lateral ankle instability has been established, the patients should first be subjected to appropriate conservative treatment.\textsuperscript{1,29,64,65,89} Although definitive evidence is not available, physical therapy, consisting of neuromuscular control exercises on an unstable device and strength training of the muscles involved in ankle and foot movement, combined with the use
of orthoses during high-risk activities, will probably lead to sufficient functional ankle stability and an acceptable activity level in a large proportion of the patients.\textsuperscript{23,29,64,69,90,93}

If conservative measures fail and increased laxity of the anterolateral ankle ligaments is present, surgical treatment is indicated.\textsuperscript{55,65,89} The best option available is an anatomical reconstruction of the ligaments by direct repair or imbrication.\textsuperscript{54,56-58} If the remnants of the ligaments preclude direct repair, the second choice is an anatomical reconstruction of the anterior talofibular ligament using the plantaris tendon, the Weber procedure.\textsuperscript{21} In case the plantaris tendon is not present, other autologous tendons may be used, e.g. a long toe extensor or the palmaris tendon.\textsuperscript{76,87} Techniques using the peroneal tendons are second choice compared to both options for anatomical reconstruction.\textsuperscript{21,54,56-58}

Arthroscopy of the ankle may be performed shortly before or at the time of reconstruction of the ankle ligaments to address concomitant intra-articular pathology.\textsuperscript{13,34,65,86} Considering the short term results, arthroscopic capsular shrinkage is a promising new technique for the treatment of chronic ankle instability, particularly in patients with mildly increased laxity and with concomitant intra-articular pathology that can be addressed with an anterior ankle arthroscopy.\textsuperscript{5,14,22,41,66,77} However, longer-term results are necessary to better assess its value as a treatment option.

If the anatomical reconstruction fails, re-reconstruction using the plantaris tendon, or its alternatives (e.g. the palmaris or a toe-extensor tendon), provides a good solution.\textsuperscript{21} In some patients, if a tendon is used for the primary reconstruction, there may now be sufficient tissue for direct anatomical reconstruction of the ligaments as well.

**Suggestions for future Research**

With regard to the diagnosis of chronic lateral ankle instability, both the assessment of functional ankle instability and ligament laxity need the development of reliable, reproducible and validated tests. For functional instability a dynamic instead of a static balance test is probably a better method. Alternatively, evaluation with history based ankle scores is an option. These types of tests and ankle scores may also be useful to identify patients that are prone to develop chronic lateral ankle instability after an initial ankle inversion injury.

According to the Cochrane systematic review in chapter 2, more ‘well designed and sufficiently powered’ randomized controlled trials evaluating the treatment of chronic lateral
ankle instability should be performed. Ideally, conservative and surgical treatment should be compared in a randomized trial. However, because there is consensus that chronic lateral ankle instability with increased ligament laxity is initially treated conservatively as well, this seems not feasible. Future studies about conservative interventions should include more clinically relevant outcome measures and longer-term follow-up periods to better assess their effect on functional lateral ankle instability. Specifically, training of neuromuscular control and the use of orthoses are of interest.

Regarding surgical treatment, longer-term follow-up of arthroscopic capsular shrinkage for chronic lateral ankle instability with increased ligament laxity is required to assess whether there is persistent functional stability and decreased ligament laxity, as was found with short-term follow-up. In case of successful outcome and since ligament laxity reduction was only moderate; comparison of capsular shrinkage to synovectomy alone is of interest. Subsequent comparison of capsular shrinkage to an open anatomic procedure is a topic to address. The comparison of anatomic to non-anatomic procedures can be evaluated with a well-designed randomized trial, but a systematic review based on case series is an alternative and easier to perform.
Figure 1 – Algorithm for the treatment of chronic lateral ankle instability
References


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