Journal of Science and Medicine in Sport 17 (2014) 568–573

Contents lists available at ScienceDirect

Journal of Science and Medicine in Sport

journal homepage: www.elsevier.com/locate/jsams

Review

Predictors of chronic ankle instability after an index lateral ankle sprain: A systematic review

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ARTICLE INFO

Article history:
Received 8 December 2013
Accepted 25 January 2014
Available online 6 February 2014

Keywords:
Ankle sprains
Joint instability
Sprain severity
Postural balance

ABSTRACT

Objectives: To identify the predictors of chronic ankle instability after an index lateral ankle sprain.
Design: Systematic review.
Methods: The databases of MEDLINE, CINAHL, AMED, Scopus, SPORTDiscus, Embase, Web of Science, PubMed, PEDro, and Cochrane Register of Clinical Trials were searched from the earliest record until May 2013. Prospective studies investigating any potential intrinsic predictors of chronic ankle instability after an index ankle sprain were included. Eligible studies had a prospective design (follow-up of at least three months), participants of any age with an index ankle sprain, and had assessed ongoing impairments associated with chronic ankle instability. Eligible studies were screened and data extracted by two independent reviewers.
Results: Four studies were included. Three potential predictors of chronic ankle instability, i.e., postural control, perceived instability, and severity of the index sprain, were investigated. Decreased postural control measured by number of foot lifts during single-leg stance with eyes closed and perceived instability measured by Cumberland Ankle Instability Tool were not predictors of chronic ankle instability. While the results of one study showed that the severity of the initial sprain was a predictor of re-sprain, another study did not.
Conclusions: Of the three investigated potential predictors of chronic ankle instability after an index ankle sprain, only severity of initial sprain (grade II) predicted re-sprain. However, concerns about validity of the grading system suggest that these findings should be interpreted with caution.

1. Introduction

Ankle sprain injuries, particularly sprain of the lateral ligaments, are among the most common lower limb injuries in the general[1,2] and athletic populations[3] as well as among military personnel.[4] High recurrence rate, along with residual impairments, are the consequence of ankle sprain for up to 54% of individuals.[5] The most common residual impairments include re-sprain, perceived instability and episodes of giving way (also referred to as functional instability), joint laxity (also referred to as mechanical instability), pain, swelling, a feeling of weakness and subsequently reduced level of physical activity.[5] These residual impairments, alone or in combination, are frequently termed chronic ankle instability (CAI).[6] Prevention of CAI, particularly re-sprain, is the main treatment goal for many studies of ankle sprain,[7] however, prevention is only possible if people at risk of developing CAI can be identified. That is, to determine the most effective prevention strategy it is essential to understand the underlying causes leading to CAI, and the factors increasing the risk of CAI.

History of a previous sprain is the most frequently reported risk factor for lateral sprain.[8–10] Basketball players with history of an ankle sprain were found to be five times more likely to re-sprain, although the reasons for the increased risk are unknown.[9] Hertel[11] suggested that ankle sprains cause various sensorimotor deficits that can lead to instability, and that the presence of instability increases the risk of further sprain. Many studies have investigated this theory, but the findings are inconsistent.[12–14] There are few studies of predictors of CAI, however two systematic reviews have evaluated closely related questions and some information can be derived from their findings. One systematic review found decreased dorsiflexion range of motion to be a strong predictor of lateral ankle sprain.[15] The second systematic review investigated the clinical course of acute ankle sprain,[5] finding only one study that

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1440-2440/$ – see front matter
http://dx.doi.org/10.1016/j.jsams.2014.01.005

reported on prognostic factors for development of CAI.[16] Based on this study,[16] athletes competing at a higher level of competition were at greater risk of persisting impairments after an acute sprain than athletes competing at lower levels. Severity of pain, number of re-sprains, as well as level of perceived instability and self-reported recovery after an acute lateral ankle sprain were found to be independent of the severity of the initial sprain. Furthermore, men were reported to have a greater risk of developing residual impairments than women. However, not all studies included in these two systematic reviews investigated the risk factors contributing to CAI after an index ankle sprain.

Research to date has tended to focus more on changes associated with CAI rather than predictors of CAI. Sensorimotor, functional, anatomical or biomechanical changes associated with CAI have been analysed in a number of systematic reviews.[14,17,18] Postural instability,[17,18] prolonged time to balance after a jump,[14] lower limb muscle weakness or muscle imbalance[19] were found to be associated with CAI. Whether these impairments cause CAI or develop as a result of CAI is not clear. Therefore, the objective of the present systematic review was to identify predictors of CAI (e.g., age, sex, body mass index (BMI), level of physical activity, balance, postural control, proprioception, motor control, severity of ankle sprain, perceived ankle instability, feeling of giving way, ligament laxity, pain, or swelling) after an index ankle sprain. Prospective studies investigating any of these variables as potential predictors of CAI after an index ankle sprain might enable health providers to design more effective treatments to prevent ongoing problems.

2. Methods

The study protocol was developed based on the framework outlined in the guidelines provided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement.[20] The protocol of this systematic review is registered on PROSPERO (registration number CRD42012002990).

Studies were included if they met the following inclusion criteria: (i) longitudinal design, (ii) follow-up length of at least three months since the sprain, (iii) participants of any age who had sustained an index ankle sprain only, (iv) measuring at least one of the potential predictors of CAI, (v) reporting on any re-sprain or residual symptoms after the initial ankle sprain during the follow-up period, (vi) published full paper; abstracts were included if the authors provided the raw data for further analysis. Papers where it was possible that at least some of the participants had suffered an index sprain were considered for inclusion, however if the data from this sub-group could not be isolated, then the paper was excluded.

For randomised controlled trials, we included the minimal intervention group (e.g. conservative treatment of lateral ankle sprains, such as modified footwear and associated supports, taping, adapted training programmes, and education). Randomised clinical trials were excluded if there was no minimal intervention group e.g., if surgery or immobilisation for more than three days were investigated.

Studies were identified through a search of the MEDLINE, CINAHL, AMED, Scopus, SPORTDiscus, Embase, Web of Science, PubMed, PEDro, and Cochrane Register of Clinical Trials to May 2013. Abstracts from the International Ankle Symposium (IAS) and International Foot and Ankle Biomechanics (i-FAB) conference proceedings, and bibliographies of eligible studies were hand searched. In addition, relevant experts were contacted to identify any unpublished studies that may exist and to review the list of identified studies for completeness. No language restriction was imposed, however, if a translation could not be arranged, the paper was excluded.

Key terms used in our search strategy are presented in Supplemental file 1. Search protocols were specifically designed to target prospective studies.

Supplementary material related to this article can be found, in the online version, at http://dx.doi.org/10.1016/j.jsams.2014.01.005.

All studies identified by the search strategy were screened against the eligibility criteria independently by the first author (FP) and by one other author (CH, JR or KR). Titles and abstracts were inspected and clearly ineligible studies were removed. Full copies of potentially eligible papers were retrieved. Any inconsistencies regarding inclusion of trials were resolved by consensus.

The following predictors, identified from previous studies of risk factors for lateral ankle sprain, were considered as potential risk factors of developing CAI: age, sex, height, weight, BMI, leg dominance, foot type, foot and lower limb alignment, ankle joint laxity, general ligamentous laxity, postural control, muscle weakness or muscle strength/power imbalance in lower limbs, lower limb muscle reaction time, range of motion at lower limb joints, physical fitness, gait biomechanics, and severity of symptoms after the initial sprain (e.g., pain, swelling, laxity, feeling of instability).

Any measures that assessed ongoing impairments associated with CAI after the initial sprain during the follow up period (e.g., re-sprain, swelling, pain, mechanical instability, perceived instability, feeling of giving way, or feeling of weakness) were considered as outcome measures.

Data were extracted independently by two authors (FP and CH) and confirmed by one other author (either JR or KR). Any discrepancies were settled by further discussion and consensus. Study characteristics extracted were study type, target population (setting, sex, age), sample size, inclusion criteria, follow-up duration, prognostic factors measured, interventions (if any) and all reported outcome measures.

Risk of bias and methodological quality of included studies were assessed using the quality assessment tool developed by Pengel et al.[21] This tool consists of 7 items rated as either 'yes', 'no' or 'N/A' (not applicable). Four items relate to control of bias (items 1–4), two to appropriate measurement of variables (items 5 and 6) and one to control of confounding variables (item 7). Two raters (FP and JR) independently assessed the quality and a third author (CH) resolved disagreements.

Study outcomes were statistically pooled if the studies were considered to be sufficiently homogeneous. For homogeneous studies, raw data were used in a direct logistic regression to assess whether the predictor variables increased the likelihood of re-sprain. If the studies were considered too heterogeneous, data were not pooled and the outcomes were described.

3. Results

The search strategy identified 8085 titles. Following title and abstract screening, 210 potentially relevant articles were identified, of which 16 met all the inclusion criteria. The data required for analysis were reported in two of the included studies.[22,23] The authors of the remaining 14 articles, which included participants with one or more ankle sprains, were contacted for data related to the participants with only an index ankle sprain. Seven authors replied, of whom only two were able to provide raw data for analysis.[24,25] Therefore, four studies[22–25] were included in this review (Fig. 1).

All included studies were prospective cohort trials, with follow-up periods that varied between 8 and 24 months. Participants were adults in two studies,[23,24] adolescents in one study[25] and children and adolescents in the fourth study.[22] In two studies the inclusion criterion was an acute index ankle sprain of less than two days duration.[22,23] The other two studies[24,25] included