Does stretching increase ankle dorsiflexion range of motion: a systematic review

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CRD summary
This well-conducted review assessed the effect of static calf muscle stretching on ankle joint dorsiflexion. The authors concluded that calf muscle stretches (5 to 30 minutes) provide a small but statistically significant increase in ankle dorsiflexion of unclear clinical significance. The trials were of reasonable quality and the conclusions appear to be supported by the data presented.

Authors' objectives
To investigate the effect of static calf muscle stretching on ankle joint dorsiflexion range of motion.

Searching
The Cochrane CENTRAL Register (Issue 3, 2005), MEDLINE (1966 to August 2005), CINAHL (1982 to August 2005), SPORTDiscus (1830 to July 2005) and EMBASE (1988 to week 36, 2005) were searched for relevant trials. Non-English articles were included and the search strategy was shown. Searches were supplemented with recursive searches of the reference lists of identified trials.

Study selection
No specific inclusion criterion was stated regarding the participants, but studies including participants with any neurological disease that may cause spasticity of the muscle were excluded. The mean age of participants included in the trials was between 23 and 40 years. With the exception of one study in women only, all studies included women and men. None of the included trials included participants with lower limb injuries.

Studies were eligible if they compared the effect of static calf muscle stretching with no stretching. Emphasis was on the techniques used in home programmes. Studies that used the other leg as a control were excluded. Stretching technique could include weight-bearing or non-weight-bearing stretches with the knee flexed or extended. Trials involving devices to assist mechanical stretch (such as splints or pulleys with weights) were included, whereas those involving devices to assist the muscles' physiological ability to stretch (such as ultrasound or heat packs) were excluded. Of the included studies, four examined weight-bearing static stretch and one non-weight-bearing static stretch assisted by weight. The duration of the stretch was between 30 seconds and 5 minutes (one trial with four times 20 seconds with 10 seconds rest in between). The duration of the training ranged from a single session to 5 days a week for 6 weeks.

Studies were eligible if they assessed ankle joint range of motion on both weight-bearing and non-weight-bearing conditions (goniometers, electronic inclinometers). Measurements during walking or running were also included. The included trials measured ankle dorsiflexion both actively and passively, weight-bearing and non-weight-bearing, and with the knee extended or flexed. Most trials carried out measurements immediately after stretching, with the exception of one trial in which there was an interval of between 60 and 72 hours. More trials provided results for the active measurement of ankle dorsiflexion, so in trials providing with data from active and passive measurement, only data from active measurement were pooled.

Studies were eligible if they were randomised or quasi-randomised controlled trials. Crossover trials were excluded.

One reviewer conducted all the searches and two reviewers were involved in selecting the studies. There was no disagreement on study eligibility.

Assessment of study quality
Two reviewers independently assessed study quality using the PEDro scale. The factors assessed were: eligibility criteria specified; randomisation; allocation concealment; similarity of comparison groups at baseline; blinding of the participants, therapists and outcome assessors; at least one key outcome from more than 85% of participants; intention-to-treat analysis; results of between-group statistical comparisons reported for at least one key outcome; point measurements; and variability of at least one key outcome. The maximum score was 10. Inter-rater reliability was
Data extraction
Two reviewers independently extracted the data into standardised data extraction forms. It was not necessary to contact authors for further information.

Methods of synthesis
The studies were combined in a meta-analysis and weighted mean differences (WMDs) calculated for continuous outcomes. The data were subdivided by stretching time periods (≤15 minutes, >15 to 30 minutes, >30 minutes).

Studies were assessed for their clinical heterogeneity with respect to age, healthy participants and duration of stretching, and the data were combined when the studies appeared clinically homogeneous. Heterogeneity was assessed using the $I^2$ statistic: a fixed-effect model was used for $I^2 < 25\%$ and a random-effects model for $I^2 > 25\%$. Sensitivity analyses were carried out; these included only studies with blinded outcome assessors.

Results of the review
Five RCTs (n=318) were included.

The PEDro quality scores of the trials ranged from 3 to 6 (median 6), with an inter-rater reliability of 0.84 (95\% confidence interval, CI: -0.01, 0.98). None of the studies included allocation concealment or blinding of the therapists or participants.

Static stretching compared with no stretching significantly increased ankle dorsiflexion. The WMD between stretching and no stretching was 2.07° (95% CI: 0.86, 3.27) for 15 minutes or less of stretching, 3.03° (95% CI: 0.31, 5.75) for >15 to 30 minutes of stretching, and 2.49° (95% CI: 0.16, 4.82) for more than 30 minutes of stretching.

When considering only studies using blinded outcome assessment, the results were similar for 15 minutes or less of stretching and for >15 to 30 minutes of stretching, but the difference between treatments became non significant for more than 30 minutes of stretching.

Some heterogeneity was seen for trials using stretching between >15 minutes and 30 minutes (according to the plots, which conflicted with information in the text).

Authors' conclusions
Calf muscle stretches provide a small but statistically significant increase in ankle dorsiflexion, especially after 5 to 30 minutes of stretching. It is unclear whether this change is clinically important.

CRD commentary
This was a well-conducted review and meta-analysis with clearly stated inclusion criteria with respect to the interventions, outcomes and study design, but inclusion criteria for the participants were not specified clearly. The search involved a number of relevant databases, there were no language restrictions, and reference lists of identified trials were searched. Two reviewers independently carried out the study selection, validity assessment and data extraction processes, details of which were given. Both the quality and characteristics of the included studies were described. Blinding of the outcome assessors was a criterion for the sensitivity analysis. Heterogeneity was assessed but not further explored. The authors' conclusions are supported by the data presented.

Implications of the review for practice and research
Practice: The authors stated that calf muscle stretching is recommended where a small increase in ankle range of motion is thought to be beneficial.

Research: The authors stated that future trials of static stretching should include patient-centred outcome measures such as pain, function and perceived success. Additional trials are also needed to examine if there is a dose response. The quality of future trials could be improved by ensuring allocation concealment and carrying out intention-to-treat analyses.
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