Influence of ankle support on joint range of motion before and after exercise: a meta-analysis

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Authors' objectives
To evaluate the effects of different types of ankle support on ankle and foot joint range of motion (ROM), before and after activity.

Searching
MEDLINE and SPORTDiscus were searched from 1966 to 1997 for peer-reviewed studies published in the English language. The keywords used were 'ankle bracing', 'ankle taping', 'ankle brace and range of motion' and 'ankle support'. The bibliographies of identified studies were also examined.

Study selection
Study designs of evaluations included in the review
Controlled clinical trials were eligible. Randomised controlled trials (RCTs) and studies of counterbalanced design were included.

Specific interventions included in the review
Studies comparing an ankle support with a non treatment control both before and after exercise were eligible. The types of ankle supports examined were: taped, including supports using adhesive and elastic athletic tape applied in a general basket-weave formation; lace-up, which provided support using a soft canvas-like or nylon material; and semi-rigid, which provided support using a firm thermoplastic material comprised of a stirrup or posterior rigid support.

Participants included in the review
Only nonimpaired participants were eligible. Patients with chronically injured ankles were excluded. Both male and female participants were included. The mean age ranged from 21.1 to 26.5 years; the mean body mass ranged from 57.2 to 91.5 kg; and the mean height ranged from 166.0 to 186.9 cm.

Outcomes assessed in the review
Studies that evaluated ankle and foot ROM before and after exercise, with results reported as mean values and standard deviations (SDs), were eligible. The ROMs assessed were plantar flexion, dorsiflexion, inversion and eversion; these were measured using a video system, goniometer or electrogoniometer.

How were decisions on the relevance of primary studies made?
Researchers, who were not blinded to the study findings, compared the study information from coded sheets against the inclusion criteria. The number of reviewers involved was not reported.

Assessment of study quality
The authors did not state that they assessed validity.

Data extraction
The authors did not state how the data were extracted for the review, or how many of the reviewers performed the data extraction.

The following data were extracted and coded: age; height; mass; method of ROM measurement; the total number of participants; the number of participants per intervention group; dependent measures; treatment variables, i.e. control, tape, lace-up or semi-rigid support; and the time of evaluation, i.e. before or after exercise. The standardised mean change in effect sizes for inversion, eversion, dorsiflexion and plantar flexion ROM were calculated (see Other).
Publications of Related Interest).

**Methods of synthesis**

How were the studies combined?
A pooled standardised effect size and SD was calculated for each ROM, with correction for small sample sizes. A negative effect size represented a reduction in ROM for the intervention in comparison to the control condition. The authors considered an effect size of 0.5 to be small, 1.0 to be medium, and 1.5 to be large.

How were differences between studies investigated?
A mixed-model factorial analysis of variance was used to test for differences between the types of brace and the time of measurement (pre- and post-exercise).

**Results of the review**

Nineteen controlled trials (327 participants) were included, of which only two were RCTs.

Approximately 11 (48%) of the studies reported reliability coefficients concerning measurement of outcomes. Test-retest reliability, where reported, varied from 0.92 to 0.99 for inversion, 0.75 to 0.99 for eversion, 0.70 to 0.95 for plantar flexion, and 0.92 to 0.95 for dorsiflexion.

The number of participants per intervention or outcome group ranged from 6 to 22. The results were reported as mean standardised effect sizes with SDs.

**Inversion.**

Before exercise, the semi-rigid bracing (mean -2.97, SD=0.63) offered greater restriction of ROM than tape (mean -2.33, SD=0.38, p<0.05) and lace-up bracing (mean -2.18, SD=0.86, p<0.05).

After exercise, the semi-rigid bracing (mean -3.85, SD=0.64) offered greater restriction of ROM than tape (mean -1.07, SD=0.20, p<0.05) and lace-up bracing (mean -1.56, SD=0.29, p=0.05).

There was no difference between the mean effect sizes for tape and lace-up support.

**Eversion.**

Before exercise, the semi-rigid bracing (mean -2.69, SD=0.43) offered greater restriction of ROM than tape (mean -1.00, SD=0.21) and lace-up bracing (mean -1.40, SD=0.47). Lace-up offered more support than tape alone. Similar results were seen after exercise, but the level of statistical significance was unclear.

**Dorsiflexion.**

Tape braces (mean -0.94, SD=0.06) gave more support than lace-up braces (mean -0.51, SD=0.06).

There were insufficient data on the semi-rigid brace condition.

**Authors’ conclusions**

The greatest restriction of motion in the frontal plane was offered by the semi-rigid support condition, whereas taping offered the most support for limiting dorsiflexion ROM. Results from this review may help clinicians make rational decisions concerning the selection of ankle appliances for preventing acute or chronic re-injury.

**CRD commentary**

The aims were stated and the inclusion criteria were specified in terms of study design, participants, interventions and outcomes. By restricting eligible studies to peer-reviewed studies published in the English language, other relevant...
studies may have been omitted. In addition, there was no attempt to locate unpublished material, thus raising the possibility of publication bias.

The number of reviewers involved in the selection of studies was not reported. Validity was not assessed and no account of study quality was incorporated in the reporting of results. Some relevant data were presented in tabular format, although the methods used to extract the data were not reported. Statistical heterogeneity was not assessed, though the influence of type of brace and time of measurement was evaluated.

The authors’ conclusions follow from the results. However, the results should be interpreted with caution due to the very small number of participants evaluated for each outcome.

**Implications of the review for practice and research**

Practice: The authors state that lace-ups and tape braces are equally effective in providing support for the unimpaired ankle, and offer a compromise between mobility and restriction. The authors advocate the use of semi-rigid braces for the athlete who has a history of ankle injuries or has chronic ankle sprain.

Research: The authors did not state any implications for further research.

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**Other publications of related interest**


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