Efficacy of ankle-foot orthoses on gait of children with cerebral palsy: systematic review of literature

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CRD summary
This review assessed the efficacy of ankle-foot orthoses on the gait of children with cerebral palsy and concluded that there were positive effects for a range of outcomes. In light of the paucity of experimental studies, lack of good-quality data and small sample sizes the authors' conclusions should be interpreted with caution, as recommended by the reviewers themselves.

Authors' objectives
To assess the efficacy of ankle-foot orthoses on the gait of children with cerebral palsy.

Searching
PubMed, The Cochrane Library, PEDro, OTseeker, LILACS and SciELO were searched to January 2006; search terms were reported. Reference lists of retrieved articles were searched to identify additional articles.

Study selection
Eligible studies of any design that assessed the impact of ankle-foot orthoses on the gait of children or adolescents with cerebral palsy associated (or otherwise) with other types of therapies. Excluded studies did not include ankle-foot orthoses as therapeutic intervention and gait as the outcome measure. Included studies were cross-sectional designs. Ankle-foot orthoses used in included studies were reclassified by the authors based upon the terminology of Alexander and King: solid ankle-foot orthoses comprised ankle-foot orthoses, rigid ankle-foot orthoses, fixed ankle-foot orthoses, solid ankle-foot orthoses and conventional ankle-foot orthoses; hinged ankle-foot orthoses comprised flexible ankle-foot orthoses, hinged ankle-foot orthoses and articulated ankle-foot orthoses; posterior leaf spring comprised posterior leaf spring and spring-type ankle-foot orthoses; dynamic ankle-foot orthoses; tone-reducing ankle-foot orthoses; and supramalleolar orthoses. Included outcomes comprised: lower extremity range of motion and muscle timing; energy expenditure; kinetic analysis; activity outcomes; kinematics and temporal-spatial gait characteristics; and standardised tests. The mean age of children in the included studies was 8.6 years (range 2.5 to 19 years); more than two thirds had been diagnosed with spastic diplegia.

Two reviewers independently selected the studies for inclusion in the review. All papers were assessed for inclusion by a third reviewer.

Assessment of study quality
Two reviewers independently assessed the quality of the included studies using a 10-point checklist based on the physiotherapy evidence database (PEDro) with the following criteria: random allocation, concealed allocation, baseline comparability, patient blinding, therapist blinding, assessor blinding, at least 85% follow-up, use of intention-to-treat analysis, between-group statistical analysis and point measures of variability. The highest possible score was 10. Disagreements were resolved through discussion or consensus with a third reviewer.

Data extraction
Data on outcome measures related to gait were collected in all studies. Two reviewers independently extracted data. Disagreements were resolved through discussion with a third reviewer.

Methods of synthesis
Studies were combined in a narrative synthesis grouped by outcome.

Results of the review
A total of 20 studies was included in the review (n=446, range 6 to 115): 18 within-group studies and two between-group studies. Total quality scores ranged from 2 to 4, most studies (17) scored 3.
Kinematics and temporal-spatial gait characteristics: The use of solid ankle-foot orthoses (seven studies), hinged ankle-foot orthoses (four studies), dynamic ankle-foot orthoses (two studies) and tone-reducing ankle-foot orthoses (one study) improved the ankle position during heel strike. Solid ankle-foot orthoses (two studies), hinged ankle-foot orthoses (one study), dynamic ankle-foot orthoses (one study) and posterior leaf spring (two studies) led to a reduction in equinus during mid stance with an increased dorsiflexion at terminal stance observed for both hinged ankle-foot orthoses (two studies) and solid ankle-foot orthoses (one study). Negative effects from the use of ankle-foot orthoses were noted (two studies). Solid ankle-foot orthoses (eight studies), hinged ankle-foot orthoses (four studies), dynamic ankle-foot orthoses (two studies) and posterior leaf spring (one study) yielded increased stride and step length, gait velocity and single support time. Solid ankle-foot orthoses (three studies), hinged ankle-foot orthoses (one study), dynamic ankle-foot orthoses (one study) and posterior leaf spring (two studies) yielded decreased cadence, compared with no ankle-foot orthosis. No change in cadence was reported for solid ankle-foot orthoses (two studies), hinged ankle-foot orthoses (two studies) and posterior leaf spring (one study).

Lower Extremity Range of Motion: Significant increases in passive ankle dorsiflexion (with knees flexed and extended) were noted for solid ankle-foot orthoses, hinged ankle-foot orthoses and posterior leaf spring (two studies). Hinged ankle-foot orthoses and solid ankle-foot orthoses were associated with improved ankle dorsiflexion at initial contact (three studies), swing phase (two studies) and mid stance (one study), compared with the barefoot condition.

Energy expenditure: Decreased energy expenditure was observed with hinged ankle-foot orthoses (three studies), solid ankle-foot orthoses (two studies) and posterior leaf spring (one study).

Kinetic Analysis: Solid ankle-foot orthoses (three studies), hinged ankle-foot orthoses (two studies), dynamic ankle-foot orthoses (one study) and posterior leaf spring (one study) were associated with increased plantar-flexor moment.

Authors' conclusions
For children with cerebral palsy positive effects of the use of ankle-foot orthoses were noted for passive and active ankle range of motion, gait kinetics and kinematics as well as functional activities related to mobility.

CRD commentary
The review question and inclusion criteria were clear. A thorough literature search was undertaken, but it was unclear whether language restrictions were placed on the search and whether unpublished studies were sought; language bias could have been present and some studies may have been missed. Study selection and data extraction were conducted in duplicate, which reduced the potential for error and bias. Appropriate criteria were used to assess the quality of the included studies and the process was undertaken in duplicate; most included studies achieved a PEDro score of only 3. Most included studies were small and contained less than 35 participants. Heterogeneity between studies made the decision to employ a narrative synthesis appropriate. In light of the study heterogeneity, paucity of experimental studies, lack of good-quality data and small sample sizes the authors' conclusions should be interpreted with caution, as recommended by the reviewers themselves.

Implications of the review for practice and research
Practice: The authors stated that clinicians should rely on their clinical experience and patient values to guide the clinical decision-making process on the use of ankle-foot orthoses.

Research: The authors stated that there was a need for high-quality experimental studies in this area and future studies should consider the use of severity classification system.

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