



A comparison of gait with solid and hinged ankle-foot orthoses in children with spastic diplegic cerebral palsy

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Abstract

This study compared the effects of solid and hinged ankle-foot orthoses (AFOs) on the gait of children with spastic diplegic cerebral palsy (CP) who ambulate with excessive ankle plantar flexion during stance. Twelve children with spastic diplegic CP wore no AFOs for an initial 2-week period, solid AFOs for 1 month, no AFOs for 2 weeks, and hinged AFOs for 1 month. Lower extremity muscle timing, knee and ankle joint motions, moments and powers, and temporal-distance characteristics were measured during ambulation for an initial barefoot baseline test, and with solid and hinged AFOs for the other two tests. Both orthoses increased stride length, reduced abnormal ankle plantar flexion during initial contact, midstance and terminal stance (TST), and increased ankle plantar flexor moments closer to normal during TST. Hinged AFOs increased ankle dorsiflexion at TST and increased ankle power generation during preswing (PSW) as compared to solid AFOs, and increased ankle dorsiflexion at loading compared to no AFOs. No other significant differences were found for the gait variables when comparing these orthoses. Either AFO could be used to reduce the excessive ankle plantar flexion without affecting the knee position during stance. The hinged AFO would be recommended to produce more normal dorsiflexion during TST and increased ankle power generation during PSW in children with spastic diplegic CP.

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1. Introduction

A common gait deviation in children with spastic diplegic cerebral palsy (CP) is dynamic equinus or excessive ankle plantar flexion during stance in ambulation without fixed contracture of the triceps surae muscle group [1]. Premature plantar flexion moments, and early onset and prolonged firing of the triceps surae muscle group are present during stance [2–4]. Excessive knee flexion and abnormal knee extensor moments during stance often accompany the equinus positioning [1,5].

Various ankle-foot orthoses (AFOs) have been used to correct the equinus gait pattern in children with spastic CP [6]. The solid or fixed polypropylene AFO has been tradi-

tionally used to decrease equinus positioning and prevent ankle plantar flexor contractures [7]. A disadvantage of the solid AFO is its limitation of normal movement of the tibia forward over the weightbearing foot resulting in decreased ankle dorsiflexion and early heel rise in stance [8,9]. The hinged or articulated polypropylene AFO with a plantar flexion stop has been increasingly recommended by clinicians to decrease equinus positioning [6]. Unlike the solid AFO, the hinged AFO allows the tibia to move forward over the weightbearing foot during stance resulting in more normal ankle dorsiflexion [6,8].

Few published studies have examined the differences between these two types of orthoses during ambulation. Middleton et al. [10] compared the solid and hinged orthoses in a case study of one child with spastic diplegia and found reduced knee extensor moments during early stance and more normal ankle dorsiflexion motion after midstance with hinged AFOs. Rethlefsen et al.'s [11] study comparing gait

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