

Length and force of the gastrocnemius and soleus during gait following tendo Achilles lengthenings in children with equinus

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Abstract

Nine subjects (12 sides) with cerebral palsy who walked in equinus were evaluated prior to and 1 year after surgical tendo Achilles lengthening. Gastrocnemius and soleus length [Gait Posture, 6 (1997) 9] and plantarflexor force [Gait Posture, 6 (1997) 9; J Biomech, 23 (1990) 495] were calculated. The length of the gastrocnemius and soleus increased significantly ($P < 0.01$) following the intervention. Force output of the triceps surae during push-off increased significantly (13.95 N/kg body weight (BW) preop to 30.31 N/kg BW postop; $P < 0.01$). Assessment of the force–length capacity of the triceps surae in candidates for tendo Achilles lengthenings may identify individuals at risk of residual weakness and iatrogenic crouch. © 2002 Elsevier Science B.V. All rights reserved.

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1. Introduction

Individuals with cerebral palsy may develop muscle contractures, and present with functional limitations related to altered joint motion. In spastic diplegia and hemiplegia, a contracture of the triceps surae may occur resulting in excessive ankle plantarflexion and toe walking. Reduced walking speed, decreased stride length, balance difficulties, and excessive ankle power absorption all accompany this equinus gait pattern. Correction of the ankle equinus to alleviate these problems is the goal of both surgical and non-surgical treatments.

Considerable debate has occurred concerning surgical correction of equinus gait in children with cerebral palsy. Gastrocnemius recession and tendo Achilles lengthening are two common surgical techniques used with the goal of restoring normal ankle motion and function. Gastrocnemius recession is reserved for individuals who are able to achieve adequate dorsiflexion with knee flexion, indicating that the soleus is at an appropriate length and not the cause of the plantarflexion contracture. Tendo Achilles lengthening is generally

performed when the equinus deformity persists with knee flexion to 90°, indicating that both the gastrocnemius and soleus are short. Some routinely lengthen only the gastrocnemius and avoid tendo Achilles lengthenings all together, believing that the risk of introducing excessive ankle dorsiflexion and iatrogenic crouch in some individuals is too great. However, rates of recurrence and development of calcaneus appear similar between both procedures in long-term follow-up studies [1–5], suggesting that factors other than procedure choice may affect outcomes. If an accurate method existed of identifying those patients whose surgical outcome might be detrimental, alternate treatments such as orthotic bracing, serial casting or botox injections could be considered in these patients.

The mechanisms leading to iatrogenic crouch following lengthening the tendo Achilles in children with cerebral palsy are not clearly defined. Perhaps overlengthening the triceps surae places it at a position on its force–length curve where adequate force generation necessary for plantigrade gait is impossible. Another possibility is that despite appropriate length following surgery, residual weakness of the plantarflexors may persist, resulting in a calcaneus ankle position and crouch.

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