

## Muscle Activity During Gait in Fiberglass Casts and Prefabricated Walking Boots

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**Introduction:** Joint immobilization to limit muscle activity is a common therapeutic and post treatment event. There is potential time and resource savings if a manufactured walking boot is as effective as a rigid dressing. The walking boot has several advantages over a fiberglass cast. It takes less time to apply than a fiberglass cast, and is easier to adjust once in place. The walking boot can be removed easily should an area become tender or swollen, potentially reducing some of the complications associated with rigid dressings such as arthrofibrosis, adhesions, venous thromboembolisms and pressure necrosis<sup>3</sup>. The efficacy of rigid fiberglass casts in immobilizing the ankle joint is well documented, but the reduction in lower leg muscle activity during walking has not been investigated. There is some debate as to the use of fiberglass casts<sup>1</sup> or a prefabricated walking boot<sup>2</sup> in the conservative treatment of Achilles tendonitis.

**Statement of Clinical Significance:** Understanding the efficacy of fiberglass casts and walking boots may improve outcomes for conservative treatment of inflammatory conditions, reducing the need for surgical intervention and perhaps reduce health care costs.

**Methods:** Seven normal adult subjects gave their informed consent to participate in this study, which was approved by the Human Subjects Committee governing this institution. Each subject walked at their self selected speed while barefoot, while wearing a custom fiberglass cast (with cast shoe), and while wearing an Aircast Foamwalker walking boot. The order of conditions was randomized. Application of the fiberglass casts and the walking boot was performed by an experienced orthopedic surgeon. Neutral ankle position was confirmed by a goniometer. Surface EMG data was sampled at 2100 Hz from the medial gastrocnemius, soleus and peroneals. Ten strides from each condition were collected for each subject. Stance phase EMG data from each muscle was band pass filtered at 10-350 Hz, rectified and integrated. Stance phase integrated EMG (iEMG) activity was normalized to a percent of the barefoot maximum. The mean iEMG for the cast, walking boot and barefoot were compared for each muscle using a repeated measures ANOVA with Scheffe's tests post hoc.



Figure 1. Fiberglass Cast with shoe



Walking Boot

**Results:** The gastrocnemius, soleus and peroneals showed significant reductions in iEMG during stance phase in the walking boot compared with barefoot ( $p < 0.05$ ). For the fiberglass cast, only the peroneals showed a significant reduction in iEMG levels ( $p < 0.05$ ), with no significant reduction in gastrocnemius or soleus activity during stance phase.

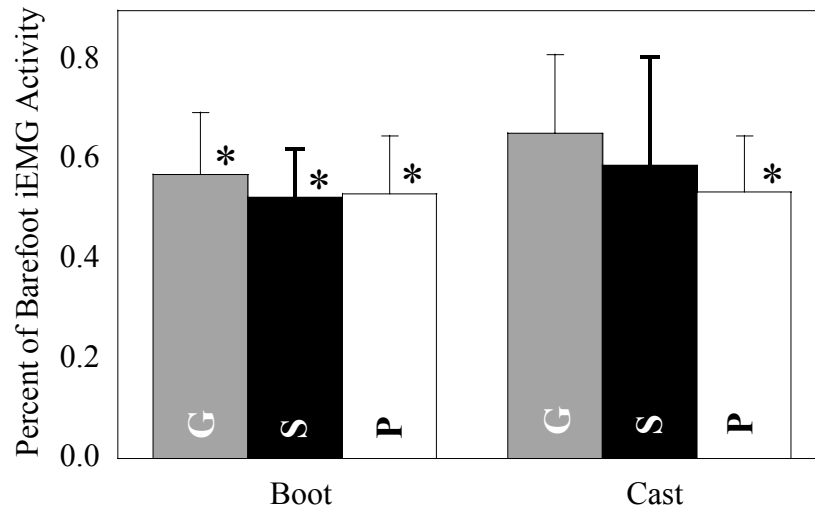


Figure 2. Mean integrated EMG levels during stance phase of walking of prefabricated walking boots and custom fiberglass casts. G = gastrocnemius, S = soleus, P = peroneals. iEMG levels are normalized to percent of barefoot levels during stance. Error bars are standard deviations. \* indicates significant differences at  $p < 0.05$

**Discussion:** A conservative treatment for Achilles tendonitis is to immobilize the ankle to rest the tissue if overuse is suspected as an etiology (Teitz, et al, 1997). For Achilles tendonitis, a fiberglass walking cast may not accomplish the level of reduced muscle activity desired, and the inflammation may persist. The application of a prefabricated walking boot showed significant reductions in iEMG activity during stance phase, and may improve outcomes for this conservative approach, reducing the frequency of surgical intervention. Therefore, the amount of rest a specific muscle has undergone may be overestimated if immobilization is accomplished by a fiberglass walking cast.

The cast shoe used on the fiberglass cast may interfere with the efficacy of the cast in reducing muscle activity of the triceps surae. The rocker bottom on the walking boot allows a more normal progression from loading response to mid-stance, whereas the cast shoe seems to disturb tibial progression more. Additional work is underway to determine if an improved rocker-bottom cast shoe would decrease muscle activity in the fiberglass cast during gait. In order to rest the Achilles tendon it appears important to disturb normal gait as little as possible.

#### References:

1. Teitz, CC, et al, (1997) *Instr Course Lect.* 46:569-82.
2. Myerson, MS, et al, (1999) *Instr Course Lect.* 48:1814-24.
3. Schepesis, AA, et al, (2002) *Am J Sports Med.* 30(2):287-305.