



# THE EFFECT OF AN ORTHOSIS ON TIBIALIS POSTERIOR ACTIVATION IN PERSONS WITH PES PLANUS

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## Introduction

Often the goal of an exercise program is to strengthen degenerated or weakened musculotendinous units. As such, it is imperative to determine which exercises selectively recruit the muscles of interest and the factors that may contribute to their activation. Resisted plantar foot adduction most selectively activated tibialis posterior (TP) in persons with a normal arch index (AI).<sup>1</sup> However, it is unclear what influence altered foot morphologies, such as pes planus, will have on TP activation during the same exercise. We hypothesized that the TP activation pattern would differ in persons with pes planus compared to previous reports, and that use of an arch correcting orthosis would promote a more normal activation pattern for TP.

## Purpose

To examine tibialis posterior activation during resisted plantar foot adduction exercise in persons with flat feet in two conditions: shod with an orthosis and barefoot.

## Materials & Methods

- Six asymptomatic subjects participated (age=25 ± 2; BW=71.7 ± 7.7kg; BH=177.8± 7.6cm; AI = 0.146 ± 0.014).
- Inclusion criteria: low AI (<0.160 which is two SDs below the mean AI of 0.190; AI = ratio of navicular height to truncated foot length).<sup>2</sup>
- Signal intensity (SI) of the tibialis posterior, tibialis anterior(TA),soleus(S),gastrocnemius(G),andperonei (P) was measured immediately pre- and post- exercise usingthefastrecoverysequencewitha1.5TMRI system. (TR=2500 ms, TE= 90 ms, TI= 140 ms)
- Under two footwear conditions, barefoot and shod with an orthotic insert, that were separated by one week, subjects were asked to perform resisted plantar foot adduction exercises (3 sets of 30 reps) with foot’s plantar aspect kept on the ground while resistance was provided by a black theraband angled at 45° from the floor (Fig 1a).
- Muscle activation was quantified using percentage changes of SI between pre- and post exercise. Repeated measures of a non-exercised muscle showed the change in SI to be < 5%. Muscle activation was defined as two times this threshold, i.e., a SI change >10%.

## Analysis

To determine whether TP was selectively activated during the shod and barefoot adduction exercise, a multivariate analysis of variance followed by paired Student’s t-test was performed for the SI of each of the five muscles assessed.

## Results

In the barefoot condition, 5 out of 6 subjects did not selectively recruit the TP, but instead co-activated one or more of the other muscles i.e., TP, TA, G, S, and P (Table 1). However, with shod condition, all the subjects selectively recruited TP in a pattern similar to that previously described for subjects with a normal arch (Table 1). The magnitude of percentage SI change of TP in the shod condition is nearly two times that of the barefoot condition.

	Barefoot	Shod & Orthosis
TP	29 (17)	54 (24)
TA	8 (8)	3 (5)
S	4 (7)	-1 (3)
G	15 (16)	0 (4)
P	3 (6)	-1 (6)
SA*	16.7 %	100 %

Table 1. Percentage SI change after resisted plantar foot adduction in two conditions (X ± SD). \*Percent of subjects with selective TP activation.

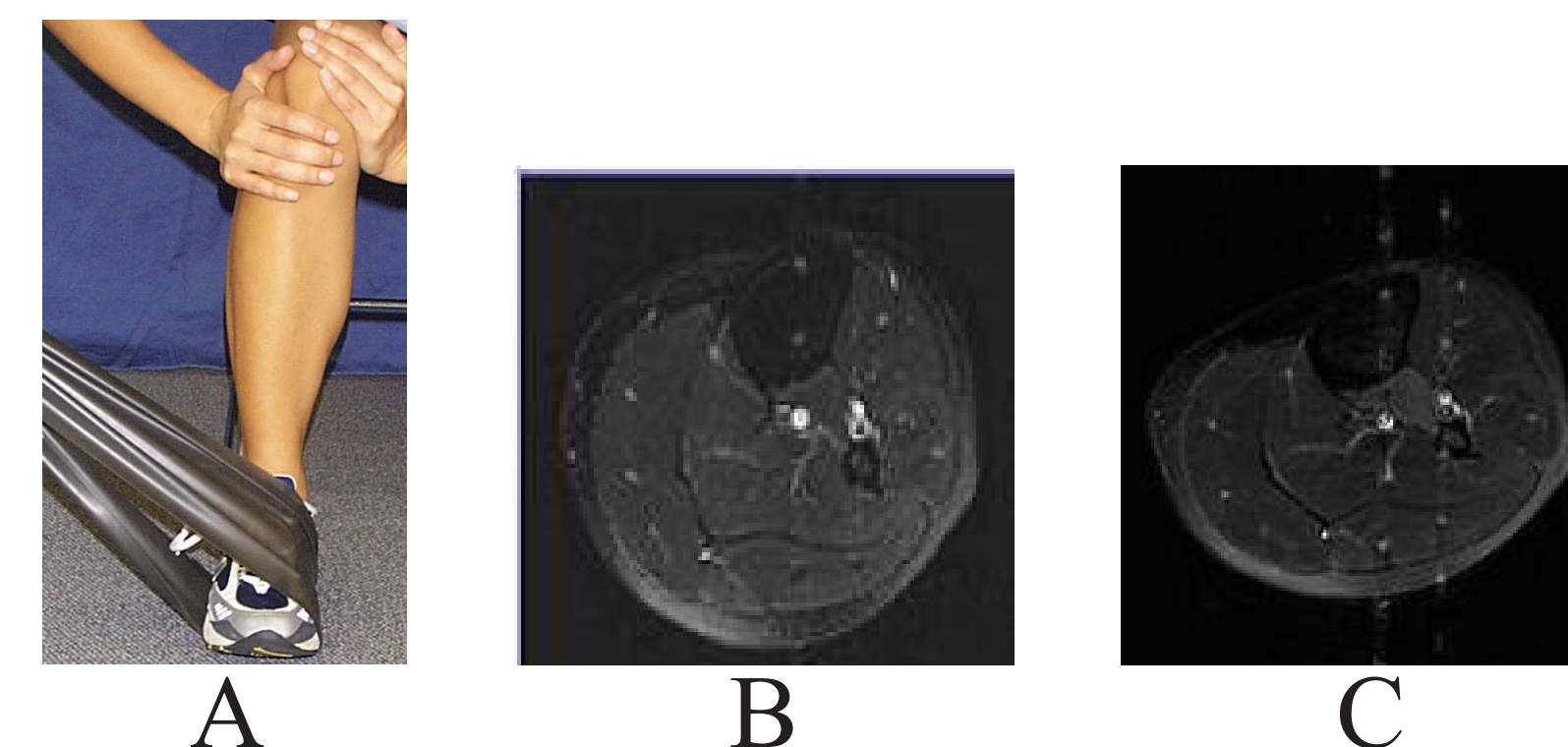


Figure 1. (a) Plantar Foot Adduction Exercise; Transaxial MRI of the left lower leg (b) before exercise, (c) after exercise.

## Discussion

While barefoot, the completion of the exercise protocol was achieved with muscle substitutions. The results of this study suggest that low arch may be a factor contributing to non-selective TP activation. Factors such as lever arm and increased tarsal stability may have contributed to altered activation in shoes and orthosis.

## Summary

The results of this MRI study suggest that foot morphology may play an important role in the selective activation of TP. If TP can be effectively recruited in people with pes planus by changing the arch height after wearing an orthotic insert, this procedure may expedite their rehabilitation process. Further research is needed to validate the rehabilitative effectiveness of foot adduction exercise for people with tibialis posterior tendinopathies.

## References

1. Kulig et al, Selective Activation of Tibialis Posterior: Evaluation by Magnetic Resonance Imaging, in press MSSE.
2. Williams DS and McClay IS. Measurements Used to Characterize the Foot and the Medial Longitudinal Arch: Reliability and Validity. *Physical Therapy* 80(9):864-871, 2000.