UNSTABLE SHOE CONSTRUCTION CHANGES LOWER EXTREMITY MUSCLE ACTIVATION DURING THREE DIFFERENT SQUAT EXERCISES

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Introduction

In physical therapy, squat exercises and variations are very commonly used to strengthen lower extremity muscles. Wearing an unstable shoe construction can increase muscle activation during walking and running [Nigg, 2006; Bochdansky, 2008], however little is known about muscle activity changes when wearing an unstable shoe construction during squat exercises. Therefore, the aim of this study was to assess changes of the mean activation patterns of selected lower extremity muscles, during three different types of squat exercises, whilst using both an unstable shoe construction and regular training shoes.

Methods

Twelve healthy participants were recruited for this study (6m, 6w; mean±SD: age, 25±7 years; height, 1.71±0.9 m; body mass, 65±10 kg) from the local University community as a sample of convenience. Mean activation of the vastus medialis (VM), gluteus maximus (GM), tibialis anterior (TA) and gastrocnemius med. (GMM) of the dominant leg were monitored using a portable EMG system (MT400, Noraxon, US) during three different squat exercises with regular (RS) and unstable shoes (US): double-leg squat, wide double-leg squat and split squat. As an unstable shoe construction Masai Barefoot Technology shoes were worn. A 2-way rep. measures ANOVA was used to identify global changes in mean activation between both test situations.

Results

Total muscle activation for all exercises increased for vastus medialis by 9% (95%CI: 2.85% to 14.95%) and for tibialis anterior by 13% (95%CI: 6.10% to 19.10%) when using an unstable shoe ($p<0.05$). The gluteus maximus and gastrocnemius medialis failed to reach significance.

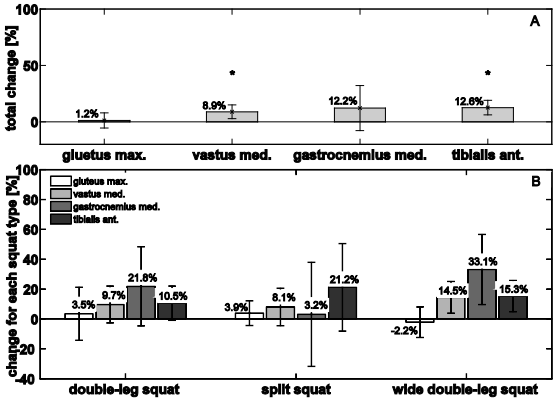

*Figure 1: Changes of mean muscle activation for all squats (A) and for each squat exercise (B) with 95%CI bounds. * $p<0.05$*

EMG	RS	US	2-way rep. ANOVA		
(µV)	Mean	Mean	Shoe	Exerc.	Inter.
GM	51.2 (37.6)	50.9 (37.0)	n.s.	0.004	n.s.
VM	245.8 (104.1)	268.3 (113.8)	0.004	0.005	n.s.
GMM	55.1 (22.4)	58.5 (20.6)	n.s.	0.000	n.s.
TA	171.9 (64.2)	192.8 (71.6)	0.002	n.s.	n.s.

Table 1: Two-way repeated measures ANOVA for mean (SD) muscle activation during all exercises with regular (RS) and unstable training shoes (US).

Discussion

Results show that the use of unstable shoe constructions in healthy participants lead to an increased muscle activation of the VM and TA when performing squat exercises. Increasing weight load next to unstable surfaces, may both be used, either separately or in combination, if the goal is to increase muscle activation levels during exercises.

References

Nigg *et al*, Clin Biomech, 21:82-88, 2006.
Bochandansky *et al*, Clin Biomech, 23:664-665, 2008.