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Neuromuscular assessment of trunk muscle function in loaded, free barbell back squat: Implications for development of trunk stability in dynamic athletic activity.

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Abstract

Traditional core stability training was developed as a method of treating and preventing back pain. It was however, seamlessly applied to healthy and athletic populations without scientific evidence supporting its efficacy. Traditional core stability focussed on isolating and training the anatomical region between the pelvis and diaphragm, using isometric or low load exercises to enhance spinal stability. Scientific research challenged this approach for healthy function and athletic performance, resulting in a more functional anatomical definition, which included pelvic and shoulder girdles. Hence, a revised definition of dynamic trunk stability; the efficient coordination, transfer and resistance by the trunk, of force and power generated by upper and lower appendicular skeletal extremities during all human movement. This led to an integrated exercise training approach to dynamic trunk stability. Although early evidence suggested loaded compound exercises preformed upright, in particular back squat, were effective in activating and developing trunk muscles, evidence was inconclusive.

Accordingly, the aims of this PhD were to investigate neuromuscular trunk function in loaded, free barbell back squat to understand training implications for trunk stability in dynamic athletic activity. Five research studies were conducted; 4 are published and 1 is being prepared for re-submission.

The literature review revealed evidence that back squat was an effective method of activating trunk stabilzers and showed that these muscles were load sensitive (study 1). A survey of practitioners reported an understanding and appreciation of the challenge against core stability training for athletic populations. Furthermore, perceptions were aligned with growing evidence for dynamic and functional trunk stability training (study 2). A test-retest neuromuscular study established *inter*day reliability and sensitivity of electromyographical measurement of trunk muscle activity in squats (study 3). Trunk muscle activation in back squat was higher than hack squat at the same relative, but lower absolute loads (study 4). Trunk muscle activation was lower in squats and bodyweight jumps in the strong compared to weak group (study 5). Furthermore, activation of the trunk muscles increased in each 30º segment of squat descent and was highest in first 30º segment of ascent for all loads (study 5).

In conclusion, this series of studies confirmed acute effect of squats on trunk stabilizers and demonstrated that external load increases activation in these muscles. Parallel squat depth is important in optimizing trunk muscle activation. Finally, high levels of squat strength result in lower trunk muscle activation in loaded squats and explosive jumps.

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