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Transversus abdominis and core stability: has the pendulum swung?

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ABSTRACT
In the past decade there has been a focus on isolated transversus abdominis activation and how it contributes to lumbo-pelvic stability. This rationale has not only influenced the management of chronic low back pain (LBP); it has also been included in exercises for many other pathologies of the lower and upper limb and also for prophylaxis in pain-free subjects.

The rationale that the feedforward bilateral muscle activation of the transversus abdominis stabilises the segmental lumbar spine is based on the reports that, unlike other trunk muscles, transversus abdominis is activated independently of the direction of any spinal perturbation.[1 2] This finding implies that it plays an important role in spinal stability. The finding that individuals with low back pain or normal subjects with anxiety and stress appear to have altered timing of feedforward onsets of transversus abdominis reinforces the case for the presence of a motor control dysfunction.[3–6] It is often inferred that such a dysfunctional pattern corresponds to less than optimal core stability.

Such an inference – that altered timing of the transversus abdominis leads to poor core stability – is popular in the literature but on further inspection fundamental evidence is lacking.

Firstly, the literature very quickly generalises the research findings of unilateral transversus abdominis activation to a bilateral pattern. In rapid unilateral arm raising (the preferred research model) this assumption is not valid. The contra lateral side preactivates the deltoid but in most normal controls the ipsilateral side is significantly lagging.[1] This critical finding suggests that, although some studies show that bilateral activation of transversus abdominis is able to stiffen the spine,[7] such findings do not correspond to the unilateral arm-raising task. That is, although they may provide some evidence that the bilateral activation of the transversus abdominis provides some degree of spinal stiffening (albeit mostly in flexion), bilateral feedforward activation of transversus abdominis is not the normal activation pattern for unilateral arm raising.[1 2]

Secondly, when arm flexion is performed using alternate arms, the transversus abdominis (left and right) are clearly directionally specific.[1 8] The previous reports that transversus abdominis (left) is not directionally specific refers to the comparison of flexion and extension of the same (right) arm. This may reflect the difference in the strategy of arm movement, not the actual perturbing force acting on the spine due to the different directions of arm movement. The feedforward activation of the transversus abdominis on the contralateral side to arm movement is related to the rotatory torque acting on the spine and the degree of asymmetry between sides is related to the magnitude of this torque.[2]

As the name infers, transversus abdominis holds true to the concept of form and function since it is most sensitive to torques parallel to the muscle fibres. Transversus abdominis shows directional specificity based on the direction of the perturbation,[1 2] and under certain types of movement it is likely to be synergistically active with other leg and trunk muscles in a diagonal rather than the corset action.[1 2] Bilateral arm raising that generates a sagittal plane torque (ie, no significant rotatory torque) makes the transversus abdominis activation more symmetrical (corset-like) but also delays the activation.[2] Hodges *et al*[9] demonstrated that three of eight normal pain-free control subjects did not have feedforward responses in 70% of trials during bilateral arm raising. We propose that this is not due to "less than optimal stability" but rather a normal variation of motor control related to the lack of trunk rotation perturbation. Delayed activation of transversus abdominis in patients with low back pain may be more related to the lack of trunk rotation used in the arm raise by these subjects than to specific motor control problems with transversus abdominis. The activation pattern and onsets of this muscle just may be a better marker of this change in movement strategy than other trunk muscles. The isolated bilateral transversus abdominis activation training strategy, if it does provide a mechanical stiffness of the spine in pathological populations, is therefore more likely to be a compensatory control strategy than a correction of normal patterns of activation. This compensatory training strategy may be a cortical process to normalise movement control. This then re-establishes a normal asymmetrical transversus abdominis action during rotation tasks within a complex muscle synergy rather than correcting a single dysfunctional muscle.

It follows that, although bilateral transversus abdominis isolation has demonstrated some clinical utility, the assumption that it plays a significant and direct mechanical role in stability of the spine is unclear. Furthermore, the bilateral feedforward response is not a normal pattern in predictable rotation perturbations. The idea that this isolated muscle pattern should be taught prophylactically in normal pain-free athletes is at best controversial.[10] Whatever the clinical utility of the intervention, the mechanistic rationale cannot be based on the presumption that the directional invariant bilateral feedforward response of transversus abdominis is acting as a corset stabiliser and is the normal pattern for all spinal perturbations. Similarly, care has to be taken in the interpretation that all other activation patterns represent motor control dysfunction and that this can be translated into a mechanical inference that these individuals have less than optimal core stability. The evidence is just not there.

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