Core Stabilization:

Fact or Fallacy?

Medical Dogma or Passing Fad

Robert Burgess BEd, PT, PhD, Feldenkrais Practitioner

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The Feldenkrais Method: Better Body - Better Mind - Better Self

Core Stabilization (CS)

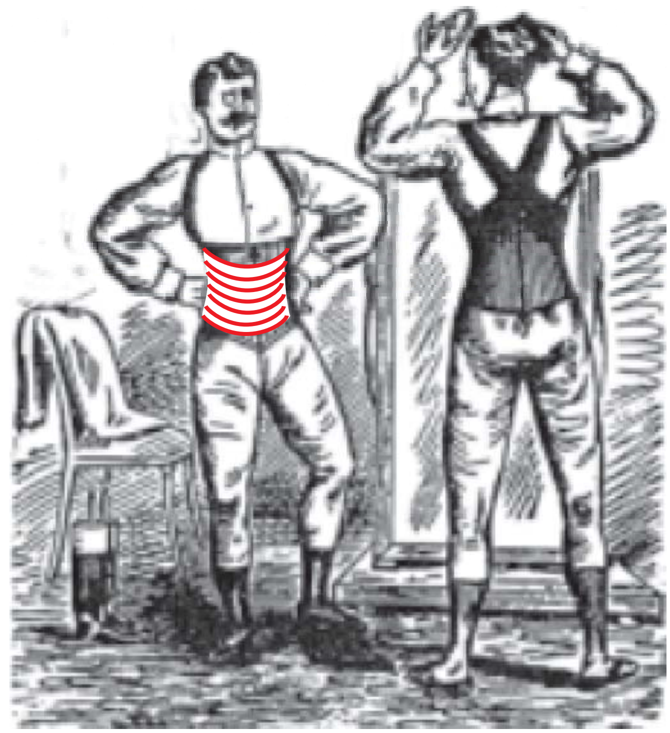
CS theory and practice is popular throughout the medical rehabilitation and gym worlds, but is it valid and is it efficacious? Is it merely a passing fad that will fade or does it stand up to the test of scientific research in theory and practice? We will examine the story and the facts of CS.

What is the Core?

The "core" has several definitions- it can be the deep muscles of the spine (namely the multifidus and transversus abdominis muscles), it can include all lumbar muscles, it can be the lumbar spine and musculature and it can be the hips, pelvis and lumbar spine. This is somewhat confusing but from the anatomy and research at the time, Richardson et al (1999) proposed that the transversus abdominis (TA) muscle acts like a rigid cylinder or corset surrounding the lumbar spine and being a stabilizing muscle. So the core, corset, multifidus and TA were proposed and defined as the primary players in CS.

Transversus Abdominis Muscle action delayed in LBP

Hodges & Richardson (1996) showed that when subjects raised one arm rapidly overhead, trunk muscles contracted prior to any actual arm action. This anticipatory postural activity is well known from Belen'kii et al 1967. In fact, the very first muscle action in raising an arm is the relaxation of the anterior lower leg muscles followed by a contraction of the calf muscles (Belen'kii et al 1967). TA was the first trunk muscle activated during this arm raising task (Hodges & Richardson 1996). Leg and trunk action (muscles contracting and skeleton motion) occur before the arm is moved as a prediction of what is needed to support the action and maintain balance. Subjects with LBP, however, had a delayed action of TA during the same arm raising task. From this original research Hodges and Co maintained that the TA muscle acted independently of trunk action, contracted bilaterally symmetrically and that both TA and multifidus acted tonically to stabilize the trunk (Richardson et al 1999). These findings lead this group to define TA and multifidus as the key stabilization muscles of the spine and has having a separate independent central nervous system control from other trunk muscles. **These deep muscles were special and specialized for stabilization as a rigid cylinder or corset of muscles**.



Transversus Abdominis = A Corset?

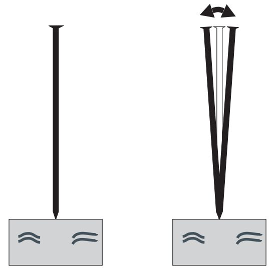
Rejected: Corset theory and Abdominal bracing theory

Hodges et al (1999) found that the trunk moved opposite to any arm action- *i.e.* the trunk was not a rigid base during arm raising but rather a mobile one. MacDonald et al (2006 - including Hodges himself), showed that the multifidi muscles act **isotonically, spatially and temporally** as required to produce trunk motion just like all other trunk muscles act in accordance with the intended action. They are not tonic muscles as proposed, they do not act to form a rigid holding of the spine but rather act to produce movement of the spine. Likewise, the **TA does not act tonically with a static holding nor does it act bilaterally and symmetrically** as maintained by Hodges & Richardson (1996) (Allison et al 2008; Morris et al 2012). It is also unlikely that these muscles have an independent motor control source in the nervous system since they act like all other trunk muscles to produce the intended action.

CORE STABILIZATION- FACT OR FALLACY?

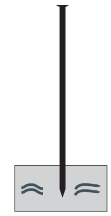
What is Stability?

Spinal stability means different things to different people as pointed put by Reeves et al (2007). But it shouldn't with well outlined definitions. Some simple examples will clarify different definitions for stability. First, consider a nail standing point down on a piece of wood. Is this a stable situation? Of course not. It falls everytime with no chance of a return to the initial state.



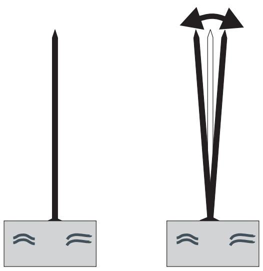
1. Nail point on Wood.

Thirdly, for a true solid stability we have the nail hammered into the wood. Stable yes, but mobility, no. And there is the conundrum- mobility versus stability in what proportion and how. Functional stability via motor ability versus structural, passive and rigid stability.



3. Nailed to the Wood.

Secondly, consider the flat head nail to be standing on its head on the block of wood. It is intuitively more stable because of the larger base. There is a greater range of disturbance or perturbation before instability is reached.



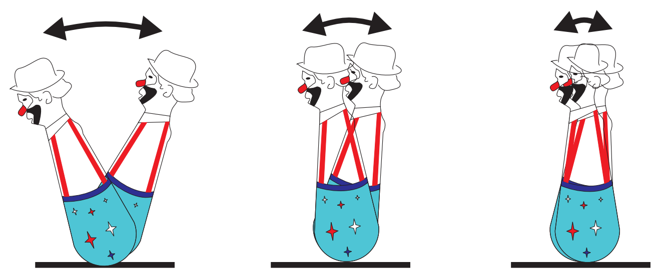
2. Nail head on Wood.

Case one and two above I liken to the **tight rope walker** not very stable but with expert skill, stability and mobility can be achieved. Whereas, in case three I am reminded of the stability sought after with a **spinal fusion.** Case one and two require considerable active skill (tightrope walker, not the nail) while the nail in the wood and spinal fusion rely on passive stability.

For a more complete discussion of balancing spinal segments for action and stability, see Reeves et al 2011. Essentially, spinal stability can be attained by skilled action involving all muscles in synergies rather than a fixed tonic contraction of some special muscles.

Engineering definition of Stability

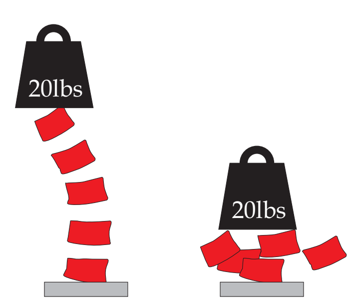
From the above three examples we see that stability has a range of interpretations from a passive structural stability like a nail standing on a piece of wood or a nail hammered into wood or a spinal fusion or the rigid 'motor control' TA corset theory versus a more functional active ability to control motion. Engineers like to use the example of a ball rolling on various curved surfaces. A deep concave surface represents a very stable and robust state while a less concave surface while still stable is less robust and finally, a flat or convex surface is unstable and does not control for a return to the initial state (from Reeves et al 2007). Reeves et al (2007) points out that a system is either stable or not, there is not range or index. 'Robustness' refers to how well a system can cope with disturbances. Another image, is the weighted clown. The clown can be tipped to a very large degree or a very small degree and always it returns to its original upright position. The clown is stable and robust and also demonstrates large and fine control of motion.



Lumbar Spine Stability

Spinal stability is achieved with the 3 systems- passive ligamentous system, active muscular system and the neural control system (Panjabi 1992, 2003). The passive system alone is vulnerable and has been shown by Euler modelling of the spinal column to collapse under less than 20lbs of load (Crisco 1989, cited in Panjabi 2003). All spinal muscles have been shown to be able to contribute to spinal stability (Cholewicki & vanVliet 2002; Kavcic et al 2004). So how to create stability of the lumbar spine? One definition for stabilizing the spine is to have muscles co-contracting (McGill & Cholewicki 2001). That is, an agonist producing a movement is opposed by the antagonist stopping or slowly the movement. However, this causes increased load on the joints. As described on page one, no muscles contract tonically, instead they act to produce the intended motion. So if there is no stabilization contraction, then there is no stabilization action by the spine. Does the spine have a specialized stabilization action separate from action itself? Further, does all LBP result from instability?

Lumbar spine with no muscles collapses under minimal load.



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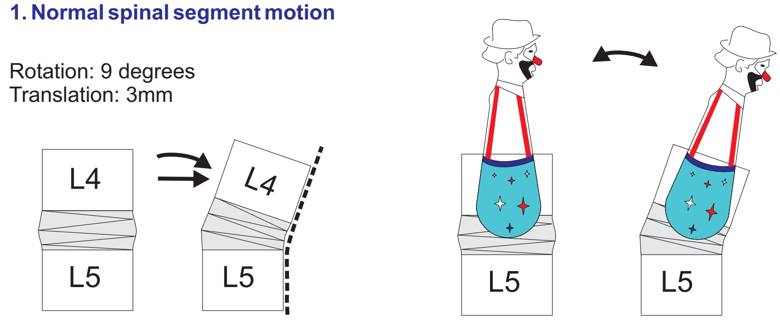
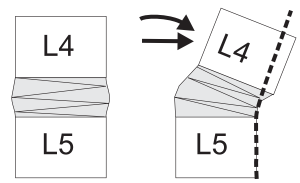
Spinal Stability Continued

Stability of one vertebral segmental unit, say L4/5, means that any motion in any direction will return to its original state without any damage or strain. The weighted clown illustrates this stability of L4 on L5. In fact, the actual deformation of the disc, ligaments, capsule and facet joints is not linear with least resistance centrally in a 'neutral zone (NZ)' and high resistance toward end of range or in the 'elastic zone' (Panjabi 1992; 2003). Under normal circumstances of action it may well be that the spinal unit motion is never greatly stressed. However, under extreme conditions or poor control, end range is reached once severely or many times minimally or moderately to finally cause pain and damage. This NZ model of spinal motion and instability could be controlled by CS in theory but equally, well coordinated action also could maintain motion within the NZ.

1. Normal spinal segment motion



2. Compromised spinal segment motion



Motor control:
Rigid Muscles versus Skilled Action

In the CS theory, muscles are the focus of attention- holding the TA to make for a rigid corset or learning to contract particular muscles (CS- TA and multifidus plus the diaphragm and pelvic floor muscles Richardson et al 1999) as developing 'motor control'. However, even as far back as 1889, it has been claimed that: **'The central nervous system knows nothing about muscles, it only knows movements'** Hughlings Jackson (1889). Mannion et al (2012) found that learning to contract the TA muscle enabled subjects to voluntarily know this contraction better than originally, however, there was no change in the automatic involuntary TA action during arm raising and no affect on LBP. Hence, when a therapist has success with CS for LBP, it is not because of the CS beliefs about TA control because TA and LBP is unaffected by voluntary TA contracting. Tummy tucking is a hoax, a futile distraction.
CS proponents claim that contracting muscles is motor control but Hughlings Jackson, Mannion and neuroscience claim otherwise, so I say:

Controlling muscles
is
NOT
Motor Control

It has to stop. To me it is an embarrassment to my profession. It is not science but pseudoscience.

Spinal Stabilization:
does it exist?

So here's the thing, if neither TA nor mulitifdus nor any muscle or muscles contract tonically and the trunk is not rigid but moves with arm action, then there is no stabilization contraction by any muscle and no stabilization of action. Action is just action.

Is there a Spinal Stabilization action?

There is no evidence for one. Stability is likely to be found built in to the action and not something separate.

CS: Does it work?

Fritz et al (2005) compared CS and spinal manipulation. **CS failed 75% of the time for LBP patients judged to be stiff**. Failed, 75% of the time. For LBP subjects determined to be hypermobile, CS had a 22% failure rate or a 78% success rate and hence in general CS worked only 51% of the time for CLBP (25 + 78/2 = 51.5%). **CS is no panacea for LBP in general**. Its success depends on careful application to one sub-group of LBP (see Hodges 2008).
But it is questionable if a hypermobile definition exists for CLBP. Hodges et al (2009) found increased stiffness in the lumbar spine in subjects with CLBP. CS does not work for a stiff back with LBP.
Many articles appeared comparing CS to general exercise and PT to find no differences (Koumantakis et al 2005, Cairns et al 2006, Rackwitz et al 2006) and finally the CS people conducted there own large comparative study to again find no difference between CS and PT (Macedo et al 2012).
So the great game changer with it's fancy claims turns out to be mediocre.

Summary: CS is Invalidated

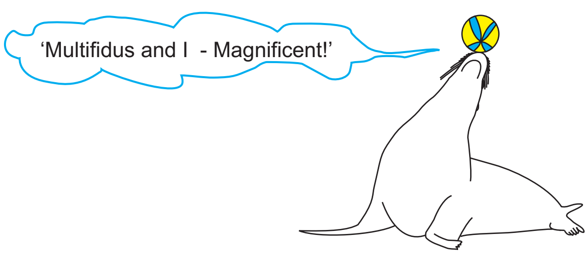
1. TA and Multifidus are NOT solely stabilizers. As shown by research the TA and multifidus do not contract tonically and hence do not have a special stabilization role for the spine. (MacDonald et al 2006, Allison et al 2008 and Morris et al 2012).

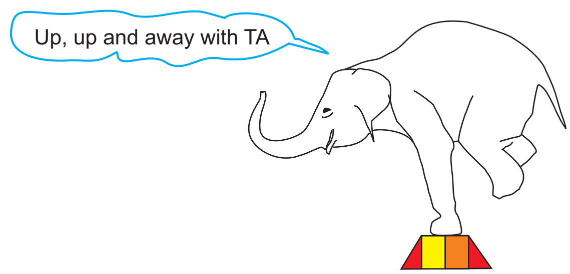
2. **There is no stabilization action by the spine.** So here's the thing, if neither TA nor mulitifdus nor any muscles acts tonically and the trunk moves with arm action, then there is no stabilization contraction by any muscle and no separate stabilization of action of the spine. Action is just action. Stability is likely to be found built in to the action and cannot be a separate entity controlled by the brain.

3. CS is no Panacea. CS has been touted for all LBP and as a preventive regime for athletes. Yet studies show for success with LBP a subgroup must be identified to distinguish between stiff and hypermobile subjects. When used for stiff backs with LBP CS fails 75% of the time. (Fritz et al 2005). Mediocre CS.

4. CS is no better than general exercises for LBP. Many studies have shown CS to be no different to general PT (Koumantakis et al 2005; Cairns et al 2006). Most recently, Macedo et al (2012) found no difference between CS and graded exercise for LBP.

5. Controlling muscles is NOT motor control. Despite the consistent claims that CS is 'motor control' for the spine, there is no scientific support for this claim. A crude simple example is to ask what muscles do circus animals need to know and contract to perform their tricks? This is a ludicrous example of muscles for motor control. Learning to contract and voluntarily control your TA has no affect on its automatic function and bares no relation to LBP (Mannion et al 2012)-it is a futile distraction that is likely costly to performance and possibly damaging.





6. CS can be dangerous. Co-contraction of spinal muscles increases spinal loads- just the thing to avoid. Anecdotally, I have seen many times that CS makes LBP worse and the tougher the LBP, the less CS has to offer. Many simple LBP cases get better on their own with no treatment- eg LBP in pregnancy (Bastiaenen et al 2006 see review of pregnancy and LBP by Lederman 2009). Hence CS would work in this group very well. In two work colleagues, their strict adherence to CS has lead to chronic LBP.

7. Evidence is evidence. Not only is there no evidence for a scientific validity of the theory and practice of CS, there is now mounting evidence against it. Core stabilization theory and practice is invalidated and should no longer be promoted or utilized.

Bottom line- the 4 M's of CS

Core stabilization theory was a reasonable proposal given the 1996 finding for a delayed TA in LBP and a seemingly bilateral tonic action for TA. CS practice also had early successes (O'Sullivan et al 1997; Hides et al 2001) but has since failed to live up to expectations. There is no tonic stabilizing muscular contraction in the lumbar spine. TA and multifidus are no more special muscles than the rest of the lumbar muscles. They all contract to produce movement.

Seems like there is no separate special tonic stabilizating muscular contraction or action for the lumbar spine.

No more CS. Misguided, Mediocre, Medieval and even Menacing (dangerous). True motor control has skeletal kinematics and kinetics as its 'core' rather than tonic muscular activity. Again, **controlling muscles is not motor control** and does not alter muscle action nor affect LBP. Physical therapy should stop calling CS motor control. Physical therapy should STOP using and promoting CS.

What is next? A true motor control approach.....

Next Issue:

The Feldenkrais Method for LBP.
A true motor control approach.

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