Academy of PHYSICAL MEDICINE

Broadcast Summary

The "Math" of Core Stability

With Matt Walden

About Matt Walden

- Trained as an Osteopath and Naturopath in the 1990's
- Completed a BSc(Hons) and a Masters in Osteopathic Medicine before proceeding to train in the CHEK System between 2001-2005
- Worked in professional sports by 2003
- Bought an early version of the Vibram Fivefingers in 2006, helped convince Vibram that their "sailing shoe" had applications in rehabilitation and conditioning.
- Contributed several chapters to various medical texts and has been the Associate Editor of the Rehabilitation Section for Elsevier's Journal of Bodywork and Movement Therapies since 2009
- Presented here and abroad to post-graduate, undergraduate and various medical groups and has been a part of the CHEK Faculty since 2006.
- Has written a chapter on Rehabilitation in the 2008 book entitled Naturopathic Physical Medicine
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Myth of core stability

• Research by Prof Eyal Lederman (www.cpdo.net) suggests that core stability training is no better in relieving back pain than any other form of exercise.

• "Core stability" training became fashionable in the early 90's. Despite claims made by some trainers, the use of Swiss Balls and other exercise devices do not "switch on" the core muscles.

• Transversus abdominis, often regarded as the most important muscle in the abdomen is arguably overemphasised.

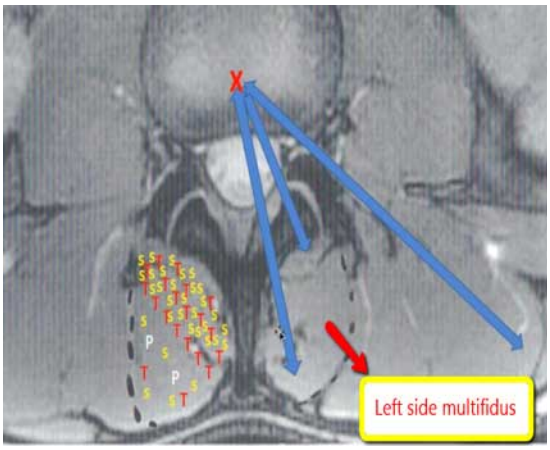
• Weak or dysfunctional abdominal muscle does not lead to back pain.

• The altered timing of muscle activation may be the consequence of back pain, not the cause, just as pain in the knee probably inhibits VMO rather than vice versa.

• Core stability was recognised as a flawed term early on and then it started being used colloquially. Several of Lederman's courses are about motor control, but those are all functional motor control (i.e. teaching/challenging people to improve their walking by various methods) – and they are not core stability training as understood by most people.

Math of core stability

Multifidus muscle



- The image above shows a slightly shrunken multifidus (left side).
- Within 24 hours of the pain coming on, the segment where the pain is shrinks to about 69 percent. Muscle cannot atrophy in such a short time, therefore this is likely to be neural inhibition, supporting Lederman's assertion that it is the pain that is actually inhibiting the muscle.
- Why only this muscle (and not others) is inhibited may be connected with the ratio of fast-twitch and slow-twitch fibres within the muscle.

• It is the muscle most studied because it is relatively easy to study – quite a big muscle and palpable. It is divided in two muscle groups – the superficial muscle group and the deep muscle group. The deeper fibres in the muscle have a higher level of spindle cells, providing information about what is going on in that segment.

• Research by an Australian group showed that back pain patients tend to have a delay in the onset of their activation of the multifidus muscles whereas asymptomatic patients do not.

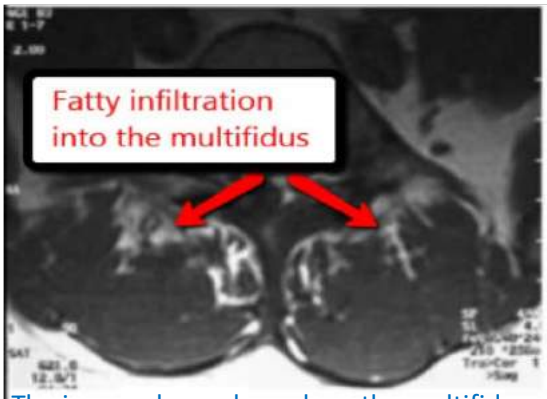
• Feed forward mechanism is about creating stability before a person moves i.e. the intention to move results in the transversus abdominis firing about 30 milliseconds ahead of the other muscles that are responsible for generating movement in the body.

• Disuse atrophy is caused when pain inhibits muscle use, and the muscle for some reason does not switch back on after the pain subsides.

- The same Australian group has published a book entitled "Therapeutic Exercise for Spinal Stabilisation in Low Back Pain" which underscored that if an inhibited segment is not rehabilitated then it cannot regain stability.

- Fatty infiltration does not happen when rehabilitation is done at the level where the pain is.

- There is very little research about fatty infiltration into the transversus abdominis.



- The image above shows how the multifidus can atrophy in chronic pain patients - with 10 percent of the muscle is infiltrated with fat. This occurs across a period of time.

Core exercises

- From a motor learning point of view, Lederman held that core exercises (e.g. using swiss ball, etc.) do not particularly have a strong carry over to activities of daily living and to sports.

- Exercises should rather target a specific muscle in order to activate it – focusing on increasing the neural drive to the tissues that have been inhibited or shut down by the pain.

- Lederman argues that core stability training is not useless, but that it is no better than any other form of exercise. All exercise engages the "core".

- There is no specific muscle that is more important than any other.

- The law of facilitation states that each time an impulse traverses a given set of neurons to the exclusion of others, the resistance to that impulse will be smaller on future occasions.

- Two important points about exercises done in supine position: a) they have no axial load (which aggravates spinal conditions); and b) there is no stabilisation

- The image above shows severe grade of atrophy with more than 50 percent of the muscle has fatty infiltration.

- The image above shows moderate grade of atrophy with less than 50 percent but more than 10 percent of the muscle having fatty infiltration.

requirement. But the aim is not really to achieve stabilisation of other joints but to promote neural drive to activate the muscle that is inhibited.

• Other research has shown that activating the transverse abdominis through exercises that are done while standing fire the muscles better.

• There are several research papers that support the notion of core stability being beneficial for patients but there are also those that question its effectiveness. It is recommended to look at meta-analyses and systematic reviews. Of the latter, the Cochrane systematic review concluded that there was no great benefit to core stability exercise and it was not more effective than other clinical intervention classes.

Motor control interventions

• Cochrane review concluded that there is no statistically significant difference between motor control interventions and general exercise programmes.

• Motor control has not been a part of osteopathic/chiropractic philosophy in the same way that it has in physiotherapy. It is useful to look at ways on how osteopathic philosophy can be applied to motor control, the field of the latter being very much muscular/skeletal in its orientation.

Inner & outer units; phasic & tonic muscles

• The inner unit is the intrinsic musculature closer to the spine or deeper in the abdominal wall, with a greater stabilisation role. The outer unit has a greater role in initiating movement.

• The neuromuscular system is classified into tonic muscles (primarily responsible for posture - slow-twitch dominant, more resistant to fatigue) and phasic muscles (primarily responsible for movement - fast-twitch dominant, powerful, but fatigue more easily).

• Once the inner unit of a particular segment is shut down, there will be an outer unit compensation to that. Stabilisation can still be achieved using the outer unit. But since the latter is more phasic in nature, it can get easily fatigued and cannot hold the body upright for very long.

• A 1992 study into tonic and phasic differentiation in infant development focused on how babies use their bodies through all the crawling phases, showing how neurons are fired in a specific way either more tonically when they are holding a given posture or more phasically when they are moving. The motor neurons ultimately differentiate the muscles into their adult functions and the fibres within the musculature into their different functions as well. Several rehabilitation exercises mimic infant development.

Muscle fibre types

Type 1	▪ Also known as slow-twitch fibres ▪ Very resistant to fatigue and are capable of producing repeated low-level contraction ▪ Often postural muscles i.e. neck and spine ▪ Athletes (marathon runners) have a high number of this type of fibre (through genetics and partly through training)
Type 2A	▪ A hybrid of Type 1 and 2 fibres ▪ Resistance training can turn **Type 2B** fibres into **Type 2A** due to an increase in the ability to utilise the oxidative cycle. ▪ Offers more power ideal for strength training but not as fatigue-resistant as Type 1.
Type 2B	▪ Can be turned to Type 2A fibre by resistance training ▪ Found in large quantities in the muscles of the arms ▪ Produces fast bursts of power and gets rapidly fatigued

Issues with meta-analyses and research reviews

• Statistical averages do not give a full clinical picture. For example, a meta-analysis of research papers on posture concluded that it is unimportant in back pain and chronic pain but reading the papers that were involved, they show that it does matter*.

Rehabilitating an atrophied muscle

• There is no particular point in time when it is too late to rehabilitate an atrophied muscle because the human body is designed to be always in the state of healing (i.e. trying to reduce inflammation) and state of adapting. If a demand is imposed upon the tissue, the body adapts accordingly.

• The absence of pain does not mean that the muscle is functioning optimally from a motor control point of view. It helps when patients are able to identify the level where they have the inhibition and pain to better guide the clinician in the reactivation and rehabilitation process.

• If the nervous system is involved in activating the muscles, then it has to be as trainable, just as the muscles are. There is a limited amount of neural drive available to operate the muscles simultaneously (e.g. the neural drive for the lumbar rectus when doing the bent over row exercise can be increased by doing the exercise in a kneeling position, which reduces the need for stabilisation).

* *A research and research methods critic pointed out that only 3 percent of all meta-analyses are actually worth the paper they are written on*

Segmental instability and osteophytes

• Segmental instability is a condition that develops when there is additional movement beyond the normal physiological movement between two segments in the spine (i.e. when a facet joint or disc degenerates that it can no longer support the body weight through that segment of the spine).

• Ageing is the biggest risk factor for osteophytes. But as soon as individuals have disc injury, they lose disc height compromising the disc itself which leads to losing the effectiveness of the passive subsystem. If this happens, they get more sheer at that level no matter how effective their muscles are. This often correlates with pain which then inhibits the muscles causing segmental instability.

Diagnosing back pain

• Ultrasound imaging is useful in making actual analysis.

• Look for striations across the back. Striation is like a micro shear that occurs through the spine – the skin literally gets a little crease at that segment. A spondylolisthesis often presents with a transverse loin crease. When there is segmental instability, a striation appears under loads when the segment is stressed.

Illustration of how to approach a patient with back pain (41:55 – 44:45 in the broadcast)

- Axially loading the spine aggravates the pain so it is recommended to find a pain-free position for the patient (i.e. either supine position or 4-point position). The latter is where the patient gets "intraceptive" stimulation to the transverse abdominis specifically (ie internal proprioception, though the patient might not be aware of it).
- Achieve neutral spine while in 4-point position with the aid of a neutraliser stick which should touch the 3 crucial points – sacrum, dorsal spine, and occiput. It is the position where the transverse abdominis is likely to activate reflexively on its own.
- Let the patient imagine that there is a thread from his/her navel through to his/her back and someone pulling it towards his/her back. The patient holds the position for 10 seconds, 5 seconds relaxed then repeat – the aim is 3 to 5 minutes of time under tension to actually activate and condition the tonic fibres.

• Use a stick to assess different movement patterns to see how a patient's back responds to extension, flexion, rotation, and slight bending (striation often appears in just one of those movement patterns). Mark the level where the striation is.

• Use a 'feeling command' rather than 'doing command'. (E.g. In examining the transverse abdominis, rather than saying *"I want you to draw your belly button towards your spine"*, convey a feeling command like *"Imagine a silk thread between your belly button and your spine and someone is very lightly pulling on that - creating tension through that"*. The latter creates a very light activation of the particular muscle group.

• Guide the patients in determining where to palpate to ensure that they are activating the right segment during their rehabilitation period.

The role of sit-ups, strength conditioning and core activation exercises

• Sit-ups target the rectus abdominis (including the obliques to some degree) and condition the abdominal wall. Most people do not need to do a lot of sit-ups but having a well - conditioned abdominal wall is useful to make them sit and move around upright.

• There is no such thing as bad exercise, only a badly prescribed exercise.

• For an exercise to be of value, it should be functional.

• Exercises should be specific to the needs of the patient for what they are going to (eg MMA or Judo players need strength conditioning exercises, such as activation of Type 2B fibres using a dumbbell across their chest over a Swiss ball).

• In patients with back pain, proprioception is lost. The neutraliser stick aids in providing feedback to patients. It helps them regain awareness whether or not they maintain the neutral position while doing their rehabilitation exercises because the pointy screw indicates correct lordosis depth.

• A person gets more stability by activating different groups of muscles altogether (i.e. rectus abdominis, transverse abdominis, erector spinae, etc). The same principle applies in stabilising the knee better by activating the entire quadricep group.

• Exercise prescriptions are always case specific and based on what aggravates the pain in patients.

Modifying the neutral spine

Illustration of bent over row exercise (1:10:17 – 1:12:05 in the broadcast)

- As individuals bend forwards, the back muscles switch on to stop them from falling forwards. But in order for those muscles to switch on, there must be a co-contraction of the abdominal muscles.
- The exercise as illustrated in the broadcast is not prescriptive. It only aims to show how to ascend the exercise to make it become more functional.
- To achieve abdominal contraction while in the neutral spine position (as shown in the picture), let the patients bend forwards until they start to feel a stretch in their hamstrings. Give them weights/loads (dumbbell or kettlebell) and then let them imagine that their elbows are being pulled up towards the ceiling by puppet strings. Let them row up like that and then back down. (3 minutes of this exercise under tension activates the core)

• In patients with a fixed deformity (e.g. thoracic kyphosis), the clinician may proceed with the usual protocol without the neutral spine component of it – assess the ranges of motion that are painful and pain-free.

• Give patients the right tools so they can mobilise their spines and strengthen their muscles that would hold their spine up afterwards.

• Prescribe exercise programme that patients can do in their homes but emphasise that they are clocked (i.e. they will be measured and assessed after a week) as this is going to be a great motivator for them.

Dynamic neuromuscular stabilisation (DNS)

• The DNS is developed by Professor Pavel Kolar, a Czech physiotherapist. It is a manual rehabilitative approach to optimise the movement system based upon the scientific principles of developmental kinesiology.

• As held by Kolar, the integrated spinal stabilising system is comprised of balanced co-activation between the deep cervical flexors and spinal extensors in the cervical and upper thoracic region (including the diaphragm, pelvic floor, all sections of the abdominals and spinal extensors).

• It is held that the intrinsic spinal stabilizing muscles provide spinal stiffness in coordination with the intra-abdominal pressure.

Illustration of rollout forwards using Swiss ball - a more ascended version of core stability exercise
(47:29 – 48:14 in the broadcast)

- As the patient move forwards, if the rectus abdominis overcomes the transverse abdominis, the abdominal wall pushes out visibly.
- Rectus adominis dominance is quite normal when a person is lifting heavy loads at about 60-70% of his/her maximal voluntary contractions.
- Rectus abdominis is a stronger muscle to overcome the transverse abdominis. With lighter loads, the latter holds the former in.
- When the transverse abdominis is either deconditioned or inhibited, a compensation pattern starts to develop. While the body can adapt to this accordingly, from a performance point of view it does not realize its full functional potential because it uses the wrong muscle (i.e. phasic) to stabilise.

Sample core activation exercise using a Swiss ball at neutral position (49:52 – 50:20 in the broadcast)

Simple progression/low intensity tonic activation exercise at neutral position (54:08 – 55:29 in the broadcast).