

Spinal stabilization training

The therapeutic alternative to weight training

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Introduction

Is strength training in a gym the tonic that it is advertised to be? Is it safe for people with back pain? Does therapeutic exercise involve training stability and coordination along with strength and endurance?

Rehabilitation is usually assumed to involve strength training. In fact, in gyms and so called 'health-clubs' strength training along with cardiovascular exercise are the preoccupation of the fitness minded individual. But, strength training without proper coordination and joint stability may in fact cause repetitive strain to joints and thus predispose to injury down the road.

Rehabilitation focuses on more than just strength. It emphasizes joint mobility, muscle flexibility, coordination, balance, endurance and strength. All of these are important for improving spinal stability. But an overemphasis on strength without proper coordination or flexibility can be a great clinical error in preventing back injuries or reinjuries.

The spinal stabilization system

According to Panjabi (1992) the spinal stabilization system has three components – an active part which is muscular, a passive part which is osteoligamentous and a controlling part which is in the central nervous system. A dysfunction, injury, or disease of any of these components may lead to spinal instability. Spinal instability is defined as an increase in the neutral zone around a joint or a decrease in joint stiffness. When this occurs excessive muscular activity is required to prevent injury (Cholewicki 1993).

Cholewicki & McGill (1996) have explained that one of the most important ways the motor control system prevents buckling or injury of the osteoligamentous links is by co-contraction of antagonistic trunk muscles. Even though energetically costly such co-contraction has been shown to occur during most daily activities (Marras & Mirka 1990). In particular, these co-contractions are

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most obvious during reactions to unexpected or sudden loading (Marras et al 1987, Lavender et al 1989).

Cholewicki & McGill (1992) have shown that buckling can be isolated to a single vertebra. They observed this in vivo with videofluoroscopy at L2-3 in a powerlifter. They believe that intrinsic muscle co-contractions are the body's most likely defence against instability: 'Clinicians need to explore the effectiveness of motor control training as an adjunct to the muscle strength improvement for reducing low back pain episodes' (Cholewicki & McGill 1996).

Muscles act in two distinct ways to achieve the goals of the motor system. First, they act with prolonged tonic contractions providing stability under static postural demands. Second, they act with fast, phasic contractions for stability during dynamic situations. Tonic contractions utilize primarily type 1 'slow-twitch' muscle fibres, while phasic contractions selectively use type 2 'fast-twitch' muscle fibres. According to Janda (1983) modern, sedentary lifestyle overworks postural anti-gravity muscles (i.e. psoas, erector spinae) making them prone to tightness. Conversely, dynamic muscles (i.e. quadriceps and gluteals) are underworked and thus prone to inhibition and atrophy.

The spinal stabilization exercise approach

The goal of rehabilitation of the motor system is to improve spinal stability. This requires that activities of daily living or demands of employment are carried out with sufficient neuromuscular control to prevent injury or repetitive strain. This is a subconscious behaviour which can be trained. To accomplish this semi-automatic improvement in motor control, various therapeutic interventions have been hypothesized to be helpful (see Box). Examples include ischaemic compression of trigger points, manipulation of

dysfunctional joints, or exercises on rocker boards or gymnastic balls. Whatever methods are utilized, the end-point of care is the same – to improve subcortical reflex motor control of intrinsic muscles response to awkward or sudden, unexpected movements.

The signature phrase of the proprioceptive neuromuscular facilitation philosophy is 'proximal stability for distal mobility'. This is why strength is not trained unless motor control skill is demonstrated. While chiropractic adjustments and soft tissue muscle relaxation strategies may be powerful catalysts for this process, the most important therapeutic intervention is usually exercise training on labile surfaces (e.g. rocker boards, balance shoes, gymnastic balls). Sensory-motor (SM) training includes learning to make a 'small or short foot', developing balance skill on labile surfaces (rocker/wobble boards and balance shoes) and rhythmic stabilization techniques (Janda & Vavrova 1995). A recent study showed that the speed of activation of the gluteals could be quickly improved by an SM programme using balance shoes (Bullock-Saxton et al 1993).

Box Rehabilitation of the motor system follows a continuum of care	
1)	Stiff joints are mobilized/adjusted
2)	Tight structures are relaxed and <i>if necessary</i> stretched
3)	Kinaesthetic awareness of proper postural alignment is trained
4)	Speed of activation of stabilizing muscles is trained
4)	Endurance of static postural control is trained
5)	Strength of dynamic motions is trained.

Once the speed of activation of key stabilizers is increased, further coordination and endurance training of

stabilizers should take place. It has been shown that joint stability can be increased by training the co-contraction ability of agonist and antagonist muscles which lie on each side of the joint (Anderson & Winters 1990). This does not require a very strong muscular effort. Hoffer & Andreasson (1981) showed that efforts of just 25% of maximum voluntary contraction (MVC) could provide maximal joint stability. In fact, strong contractions activate type II phasic ('fast-twitch') muscle fibres instead of the type I tonic ('slow-twitch') muscle fibres required for endurance (Richardson & Jull 1995).

EMG studies have shown that the multifidus, along with the transverse abdominus, are the major muscles active during all trunk motions (Wilke et al 1995). The transverse abdominus was recruited prior to any other abdominal muscle when the trunk was subjected to sudden perturbations (Hodges & Richardson 1995). In a study looking at abdominal activity during upper limb movements, the transverse abdominus was the only muscle active prior to initiation of arm motions (Cresswell et al 1992).

Endurance training of back extensors, including the multifidus, has long been recognized as a crucial preventive of recurrent low back pain (Biering-Sorensen 1984). Now, it is also seen as preventive of first time episodes as well (Luoto et al 1995). To train the transverse abdominals and multifidus it is necessary to teach patients the kinaesthetic awareness to maintain a 'neutral spine' posture within their 'functional range' during the specified exercise. This requires training in anterior and posterior pelvic tilts as well as abdominal hollowing.

To perform abdominal hollowing the patient is instructed 'make your lower abdomen cave in' or to 'draw your navel towards your spine' (see Fig. 1). The 'hollowing' technique involves co-contraction of the transverse abdominus and multifidus. The patient can palpate

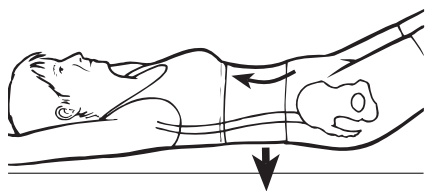


Fig. 1 Lower abdominal hollowing combined with lumbar spine flattening.

this just medial to their anterior superior iliac spine. This will increase conscious perception and help the patient to learn how to volitionally activate the muscles (Richardson & Jull 1995). This abdominal hollowing can be practiced in a variety of positions – supine, quadruped, seated, standing, etc. It will also be used during nearly all exercises to pre-position the lumbar spine into a safe ‘functional range’ or ‘neutral position’.

Once the patient is able to flatten the abdominals – without holding their breath – they are then asked to hold the position while they move their arms or legs into flexion or extension (see Fig. 2). For each person their ‘neutral position’ or ‘functional range’ will be different. This has been defined as the most painless and stable position for the task at hand (Morgan 1988). Typically it involves a co-contraction of deep abdominal and back muscles which stabilize the lumbar posture in a slight lordosis.

Once the kinaesthetic awareness and neuromuscular control for simple floor spine stabilization exercises is demonstrated, a gymnastic ball programme can be initiated. Back extension (superman), bridging and squatting exercises are a few examples (see Figs 3–5).

How long or often should exercises be performed? Generally, a minimum of a few minutes a day are necessary. Training may occur in just a few sessions, but it may also require up to 3 months or even longer. If a patient’s neuromuscular control is not improving in just a few sessions, before increasing the time of the workouts, re-assess for relevant functional pathology, such as

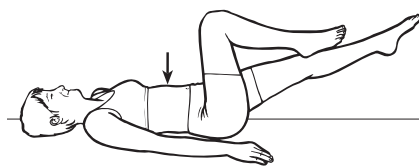


Fig. 2 Posterior pelvic tilt with alternating leg kicks.

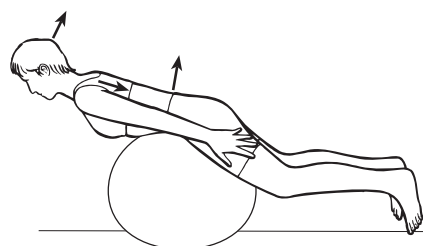
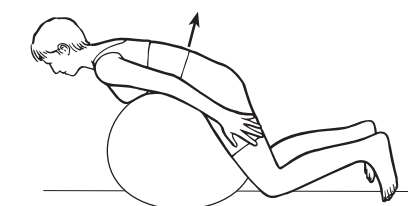


Fig. 3 Superman progression.

joint dysfunction, trigger points or abnormal movement patterns. If after treating the relevant key functional pathologies progress is still slow an increase in time up to 30 or 40 minutes may be required.

Motor learning occurs as an individual progresses through the following stages – first, *kinaesthetic awareness*; second is *conscious, volitional control*; and finally *subconscious automatization of improved posture and motor control habits*. For instance, initially *kinaesthetic awareness* of the abdominal hollowing or specific lumbopelvic movements is all that is trained. Then, the patient is asked to demonstrate *conscious control* of their lumbar spine’s ‘neutral position’ during various exercises. The final goal of motor learning is that the patient has an improved, central programme of how to use their spine in activities of daily living or their

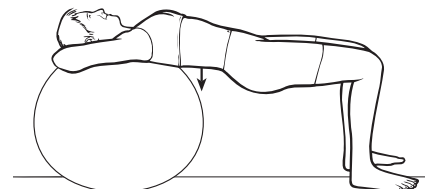
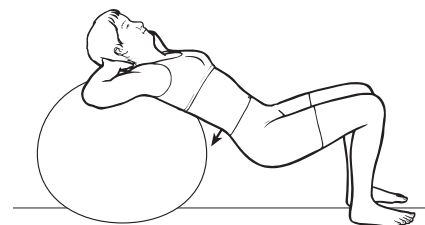


Fig. 4 Posterior pelvic tilt and bridge up.



Fig. 5 Squat.

demands of employment. This final stage of motor learning requires *an automatization of improved postural and motor skill habits*. Throughout this process the catalysts for improving motor control are manipulation of key dysfunctional joints or relaxation of key dysfunctional muscles.

A fully illustrated approach to spinal stabilization exercises for the chiropractor is presented by Hyman & Liebenson (1996). Additionally, a

patient booklet and 20-minute workout videotape is available (Liebenson & Oslance 1996, Oslance & Liebenson 1996). Research has validated this approach in some of the most challenging patient groups – lumbar radiculopathy patients who failed to respond to conservative care and were referred for surgery, and patients who had failed back surgery (laminectomies) (Saal & Saal 1989, Timm 1991). In the lumbar radiculopathy group nearly 100 sciatica patients who had failed conservative care and had objective documentation of relevant patho-anatomy were referred for surgery, but instead were given spinal stabilization exercises. Nearly 90% of them responded favourably. The failed back surgery study was a randomized controlled clinical trial with two groups of patients receiving passive care and two receiving active care. The active care groups outperformed the passive care groups. Also, the spinal stabilization/McKenzie low-tech exercise group responded better than the high-tech isokinetic trained group.

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