Enhancing Low Back Health through stabilization exercise

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Note: Dr McGill has recently authored the text book "**Low Back Disorders: Evidence based prevention and rehabilitation**" published by Human Kinetics publishers, (www.humankinetics.com), 2002, ISBN 0-7360-4241-5. This textbook synthesizes the material introduced here and is recommended as much more complete and authoritative resource material.

Background Perspective:

Appropriate exercise design for the low back cannot be achieved with pamphlets showing suggested exercises. Some people with a history of back troubles desire pain relief and spine stability (a health objective) while others may seek a performance objective (which may be counterproductive to optimal back health). Some people need more stability while others may need more mobility. Some exercises will exacerbate the back troubles of some people but the same exercises may help others. Because each individual has different needs, various assessment approaches can be utilized to aid in subsequent decisions for exercise design. Further, proficient exercise professionals will need an understanding of the issues, and of the myths and realities pertaining to each issue to form a foundation for the decision process. Obviously assessment tools and the many issues cannot be discussed in this short article. The focus here is to briefly introduce just a few selected issues followed with an example of a quantified and evidence based exercise program.

Rather than provide thin background material that will not be robust enough to assist the exercise design process (the book is necessary to serve that purpose) I have decided to offer some initial food for thought. There is no shortage of manuals and books offering wisdom on the topic of low back health. The authors of these have a wide spectrum of backgrounds, ranging from formal medical or rehabilitation training through to lay people who found an approach to alleviate their own back troubles and have become self-proclaimed prophets "believing" that others will benefit. Their intentions are honorable but their advice is rarely based on a sound scientific foundation. In my opinion, too many of these books offer inappropriate recommendations or even harmful suggestions. Years ago, as I began to develop our scientific investigations into various aspects of understanding low back problems, I would ask my graduate students to find the scientific foundation for many of the "common sense" recommendations I was hearing both in the clinic and in industrial settings. To my surprise, they would report that the literature yielded no, or very thin, evidence.

Examples of such "common sense" recommendations include -- if you are to perform a sit-up, bend the knees; if you are going to perform a lift, bend the knees and keep the back straight; reducing the load throughout the workday will reduce the risk of back troubles. In fact, the benefit of each of these have been shown to be highly questionable.

It is widely believed that stretching the back, and increasing the range of motion is beneficial, and reduces back problems – however the scientific evidence shows that, on average, those who have more range of motion in their backs have a greater risk of future troubles. Clearly there is a tradeoff between mobility and stability where the optimal balance is a very personal and individual variable. Indeed, the "stability/mobility balance" may shift during a progressive exercise program as symptoms resolve, or with advancing age, or as rehab/training objectives change. Another generally perceived goal of training the back is to increase strength, believing in the "no pain-no gain" philosophy. Strength has little association with low back health, in fact, many hurt their backs in an attempt to increase strength. It could be argued that this is an artifact, in that exercise programs intended to enhance strength contained poorly chosen exercises such as sit-

ups. Performing situps both replicates a potent injury mechanism (specifically posterior disc herniation) and results in high loads on the spine. **On the other hand, muscle endurance, as opposed to strength, has been shown to be protective for future troubles.** Further, for many, it is better to train for stability rather than stretching to increase range of motion.

Recent investigations into injury mechanisms have revealed that many back training practices actually replicate the loads and motions that cause the parts of the low back to become injured. For example, disc herniations need not have excessive loading on the back to occur, rather repeated forward flexion motion of the spine is a more potent mechanism. Thus, if full flexion or deviation is avoided in the spine, the risk of herniation is remote. But for most exercise professionals the link between injury and exercise needs to be better developed. Injury is caused by damage to supporting tissues. This damage reduces the normal stiffness in the spine resulting in unstable joints. Thus, while injury results in joint instability, an event characterized by improper muscle activation can cause the spine to buckle, or become unstable. There is no question that excessive loading can lead to back injury, but instability at low loads is also possible and problematic. For example, it is possible to damage the passive tissues of the back while bending down and picking up a pencil, or sneezing, if sufficient stability is not maintained. Some people recommend that during training, one should exhale upon exertion (when weight training for example, exhaling upon the lifting phase and inhaling on the lowering). In terms of grooving stabilizing motor patterns for all tasks, this is a mistake**. In other words, breathing in and out should occur continuously, and not be trained to a specific exertion effort – this helps to maintain constant abdominal muscle activation and ensure spine stability during all possible situations (of course the opposite is true for maximal effort competitive lifting where a valsalva manoeuvre with the breathe held is necessary – but performance training is not the emphasis here).** Further, specific muscle activation patterns are essential to avoid injury but have also been documented to become perturbed following injury. Pain is a powerful instigator in the deprogramming of normal/healthy motor patterns into perturbed patterns. The exercises and programs described here are based on the latest scientific knowledge of how the spine works, and becomes injured. In addition, they have been quantified for spine load, resultant spine stability, and muscle oxygenation, to name a few. These are only a few examples to begin a program. **The goals are to enhance spine stability through grooving motion and muscle activation patterns to prepare for all types of challenges.** Of course, other exercises may be required subsequently to enhance daily functioning, but once again, these will depend upon the characteristics and objectives of the individual.

Two other concepts must be emphasized at this point. First, training approaches intended to enhance athletic performance are often counterproductive to the approaches used when training for health. Too many patients are rehabilitated using athletic philosophies, or worse yet "body building" approaches designed primarily to isolate and hypertrophy specific muscles, and in so doing thwart progress. Many bad backs are created from using inappropriate performance philosophies. Identifying the training objectives is paramount. The emphasis here is on enhancing spine health – training for performance is another topic. Second, many of the training approaches that are used at joints such as the knee, hip, shoulder etc are mistakenly applied for the back. The back is a very different, and complex structure, involving a flexible column, with complex muscle and ligamentous support. The spine contains the spinal cord and lateral nerve roots, and whose musculature is intimately involved in several other functions including breathing mechanics, to give just one example. **Many of the traditional approaches for training other joints in the body are not appropriate for the back – either they do not produce the desired result or they create new patients.**

A daily routine for enhancing low back health

The following exercises have been chosen to spare the spine, enhance the muscle challenge, and enhance the motor control system to ensure that spine stability is maintained in all other activities. Each one has been quantified for these metrics. Having stated this, they are only

examples of well designed exercises and may not be for everyone – the initial challenge may or may not be appropriate for an individual nor will the graded progression be similar among all people. These are simply examples to challenge all of these torso muscles.

Cat-Camel:

We recommend that the routine begin with the cat-camel motion exercise (spine flexion-extension cycles) to reduce spine viscosity (internal resistance and friction) and "floss" the nerve roots as they outlet at each lumbar level, followed by hip and knee mobility exercises. Note that the cat-camel is intended as a motion exercise - not a stretch, so the emphasis is on motion rather than "pushing" at the end ranges of flexion and extension. We have found that 5-8 cycles is often sufficient to reduce most viscous-frictional stresses.

The cat and camel exercise is a motion exercise and not a stretch. Good form includes the integration of the cervical spine with the lumbar and thoracic spine. All three sections of the spine should be flexed and extended together.

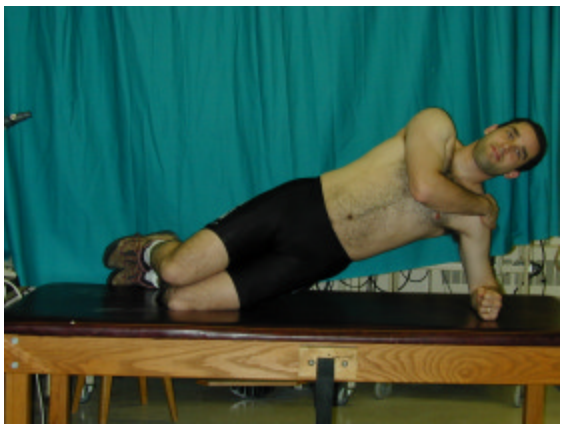
Curl-up:

The cat-camel motion exercise is followed by anterior abdominal exercises, in this case the curl-up. The hands are placed under the lumbar spine to preserve a neutral spine posture. Do not flatten the back to the floor. Flattening the back flexes the lumbar spine, violates the neutral spine principle, and increases the loads on the disc and ligaments. One knee is flexed but the other leg is straight to lock the pelvis-lumbar spine and minimize the loss of a neutral lumbar posture. Alternate the bent leg (right to left) midway through the repetitions.

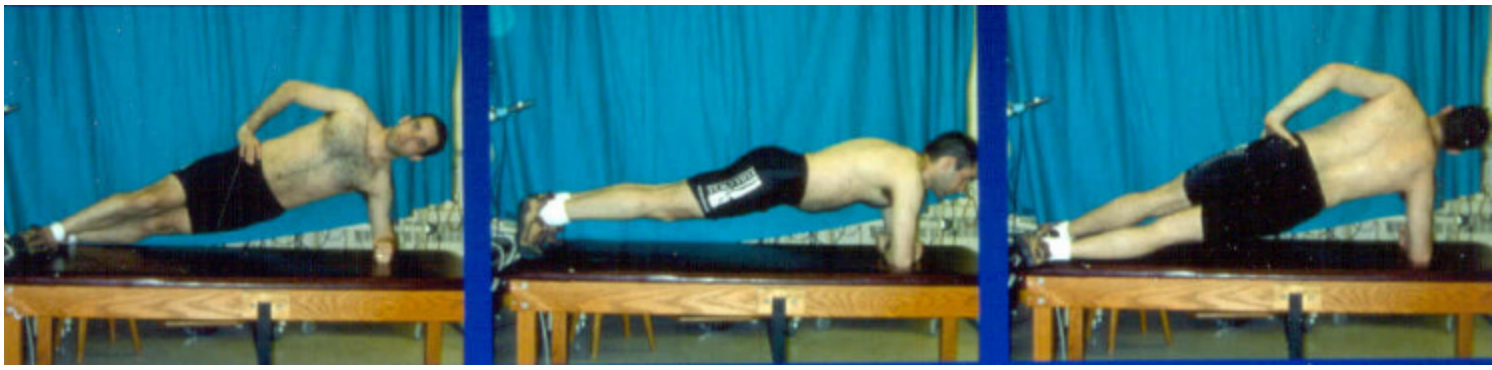
The curl-up is performed by raising the head and the upper shoulders off the floor. The motion takes place in the thoracic spine – not the lumbar or cervical region. To begin, the hands are placed under the lumbar region to support a neutral curvature. The exercise is made more challenging by raising the elbows off the floor. Even more challenging is first performing an abdominal brace (activating the abdominal muscles), and then curling up against the brace. Hold the posture for 7-8 seconds. Do not hold the breath but breath deeply. Do not increase the challenge by increasing the intensity of the abdominal brace. This will groove desirable motor patterns. Choose the most appropriate level of challenge.

Side Bridge:

Lateral and abdominal muscles (called quadratus lumborum, and the abdominal obliques) are important for optimal stability, and are targeted with the side bridge exercise. The beginners level of this exercise involves bridging the torso between the elbow and the knees. Once this is mastered, and tolerated, the challenge is increased by bridging using the elbow and the feet. Advanced variations involve placing the upper leg-foot in front of the lower leg-foot to facilitate longitudinal "rolling" of the torso (see figure) to challenge both anterior and posterior portions of the wall, and further groove stabilizing patterns which are transferable to upright tasks. These are superior exercises in terms of muscle activation, low spine load, and stabilizing patterns compared to exercises such as performing a sit-up with a twist, for example, that produce lower muscle activity levels and higher tissue loads.



The beginners side bridge is performed with support from the elbow and knees (left panel) while the more advanced variation using the elbow and feet is shown in the right panel. Maintain the abdominal brace, a neutral spine and breath deeply.



An advanced level side bridge involves holding the posture on one side for 7-8 seconds and the “rolling” over to the other, and repeating as endurance is increased. It is critical to lock the pelvis to the rib cage, via an abdominal brace, so that the spine remains rigid during the rolling. Finally, add deep breathing while in this posture. The rolling action with the breathing will prepare many people to meet any challenge with a stable spine.

Birddog:

The extensor program consists of leg extensions and the “birddog”. In general, we recommend that these isometric holds be held no longer than 7-8 seconds given recent evidence from near infrared spectroscopy indicating rapid loss of available oxygen in the torso muscles contracting at these levels - short relaxation of the muscle restores oxygen. The evidence supports building endurance with increased repetitions rather than holding time.

The back extensors (both the lumbar and thoracic are important) are challenged with the birddog. But only one half of these muscles are challenged at a time by lifting the alternate arm and leg. This reduces the spine load to about a half of that produced during traditional spine extension exercises such as roman chair extensions. Begin on the hands and knees and hold the posture for 7-8 seconds. Then lower the hand and knee, and “sweep” the floor with them and raise them again for the next repetition. This motion will enhance the stabilizing patterns. Switch sides as appropriate. The abdominal muscle are braced throughout.

Caveats for Exercise

1. While there is a common belief among some "experts" that exercise sessions should be performed at least 3 times per week, it appears low back exercises have the most beneficial effect when performed daily.
2. The "no pain-no gain" axiom does not apply when exercising the low back in pained individuals particularly when applied to weight training, and scientific and clinical wisdom would suggest the opposite is true.
3. While specific low back exercises have been rationalized in this guide, general exercise programs that also combine cardiovascular components (like walking) have been shown to be more effective in both rehabilitation and for injury prevention. The exercises shown here only comprise a component of the total program.
4. Diurnal variation in the fluid level of the intervertebral discs (discs are more hydrated early in the morning after rising from bed), changes the stresses on the disc throughout the day. Specifically, they are highest following bedrest and diminish over the subsequent few hours. It would be very unwise to perform full range spine motion while under load, shortly after rising from bed.
5. Low back exercises performed for maintenance of health need not emphasize strength, with high-load low repetition tasks, rather more repetitions of less demanding exercises will assist in the enhancement of endurance and strength. There is no doubt that back injury can occur during seemingly low level demands (such as picking up a pencil) and that the risk of injury from motor control error can occur. While it appears that the chance of motor control errors, resulting in inappropriate muscle forces, increase with fatigue there is also evidence documenting the changes in passive tissue loading with fatiguing lifting. Given that endurance has more protective value than strength, strength gains should not be overemphasized at the expense of endurance.
6. There is no such thing as an ideal set of exercises for all individuals. An individuals' training objectives must be identified, (be they rehabilitation, specifically to reduce the risk of injury, optimize general health and fitness, or maximize athletic performance), and the most appropriate exercises chosen. While science cannot evaluate the optimal exercises for each situation, the combination of science and clinical experiential "wisdom" must be utilized to enhance low back health.
7. Be patient and stick with the program. Increased function and reduction pain may not occur for 3 months.

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About the Author

Dr Stuart McGill is a professor at the University of Waterloo and a world renown lecturer and expert in spine function and injury prevention and rehabilitation. He has been the author of over 200 scientific publications that address the issues of lumbar function, low back injury mechanisms, investigation of tissue loading during rehabilitation programs, and the formulation of work-related injury avoidance strategies. This work has received several awards including the Volvo Bioengineering Award for Low Back Pain Research from Sweden. He has been an invited lecturer at many Universities, and delivered over 150 invited addresses to various societies around the world. As a consultant to industry, he has provided expertise on assessment and reduction of the risk of low back injury to various government agencies, several corporations, professional athletes and teams, and many legal firms.