WELL

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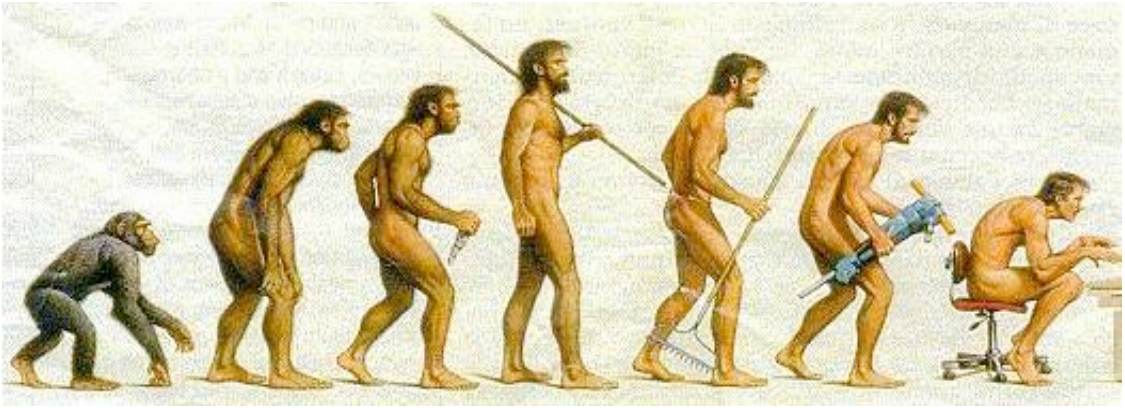
Size Matters!

by Guy LeMasurier, MSc

The Swiss Ball has emerged as the latest celebrity in magazines, newspapers and Internet fitness sites. Pumping up the Swiss Ball is a great idea, especially to improve posture, which has become a huge issue in the desk and computer-based workforce. Whether it's slouching at our workstation or sprawling at home on the Lazyboy, our posture could use some work. (See **Ball Chair at BodyTrends.com** for a useful article on posture at work and the use of the Swiss Ball.) Activity is being engineered out of the work place and that's where today's population spends most of its time. As a result, it is estimated that 90% of people experience some form of low-back pain in their lifetime, some chronic, some acute.



So, the Swiss Ball - sometimes called Therapeutic Ball, Stabilizing Ball or Big Round Thing - can provide some relief when it's used correctly.

> **Swiss Ball Fact:** First introduced by an Italian Toy manufacturer, the big colorful balls provided many new and inventive possibilities for clinical therapists in Switzerland. Hence the name Swiss Balls.

What I have not yet encountered is an article that explains the physiological principle behind using 'Heir Roundness.' I'm sure you've heard how it targets stabilizing abdominal muscles, strengthens the core, or how it's better than sit-ups and great for

treating your lower back. But how, and why?

It has everything to do with the size principle. Often referred to as Henneman's size principle because of the early work in the area of neuromuscular physiology by Dr. E Henneman, a well-known physiologist. Before I explain how Henneman's size principle relates to the Swiss ball and its effectiveness we need first to have a simple lesson in how muscular activity is coordinated.

A muscle (e.g. the biceps muscle) is made up of several groups of muscle fibers. These muscle fibers are connected to the central nervous system by nerves. A motor unit consists of a nerve and the muscle fibers innervated by that nerve. When we perform voluntary movement, higher centers in our brain engage these motor units to perform work. Motor units have two classifications, slow-twitch and fast-twitch (sometimes referred to as type 1 and type 2, respectively). This classification describes the characteristics about the nerve and the muscle fibers it controls.

Slow-twitch motor units have very excitable nerves and few numbers of muscle fibers. Slow-twitch muscle fibers are small in diameter and are not used to generate large forces. In addition, the conduction of the nerve impulse to the muscle fiber is relatively slow in slow-twitch motor units compared to fast-twitch motor units.

Fast-twitch motor units have nerves with low excitability and large numbers of muscle fibers. The fast-twitch muscle fibers have a large diameter and are used to develop large forces. In fast-twitch motor units nerve impulses are conducted rapidly and are consistent with quicker, more forceful muscle contractions where speed and power are critical to performance.

Henneman's Size principle speaks to the functional importance of how motor units are recruited (engaged to act) during exercise. The small excitable slow-twitch motor units are recruited when low levels of force are required, but as the force requirements increase the larger fast-twitch motor units are recruited. Therefore, as the force requirements increase the size of the motor unit recruited increases. Hence, the size principle.

As an example, if you were to lift a glass of water to your mouth it would mainly require the slow-twitch motor units in your biceps muscle to perform the task. However, if you curled a 20 lb dumbbell predominantly fast-twitch motor units would be recruited.

Finally, we must understand that all muscles are made up of a mixture of both slow and fast-twitch muscle fibers. The distribution and relative amounts of each fiber type in a muscle is a result of many factors including genetics, the structure and function of the muscle and the stresses the muscle is subjected to over time.

Muscles of the abdomen and the lower back are primarily postural muscles and are generally made up of a greater number of slow-twitch motor units. These postural muscles are predominantly used for maintaining posture and are required for slower less intense movements where speed is not critical. This is where the traditional sit-up

gets a bad rap.

When you see people performing traditional sit-ups the first 10, or even 20, may be quite controlled and smooth, however the movement often ends up looking erratic and painful with the exerciser using his or her arms to bend the head toward that almighty target, the knees. The problems with this movement relate to muscle recruitment, the loads imposed on our lumbar spine and the lack of involvement of stabilizing abdominal muscles.

First, because sit-ups require the movement of a large mass (most of the upper torso), predominantly fast-twitch motor units of the rectus abdominus muscles are used. (The rectus abdominus muscle is often called the 'six-pack' however it is really an eight pack as there are a pair below the belt line). Secondly, as you curl up towards the knees you increase the load penalty (spinal compression) on the lumbar spine (McGill & Axler, 1997). McGill and Axler (1997) also concluded that a variety of selected abdominal exercises are required to sufficiently challenge all of the abdominal muscles. Which brings us to the third point, that traditional curl up and sit-up exercises operate in a single (frontal) plane of movement and do not engage the other abdominal muscles to a large degree.

In a recent study by Vera-Gracia, Grenier and McGill (2000) they concluded that by performing curl-ups on a labile (moveable) surface it changed the level of muscular activity and the way the muscles co-activate to stabilize the spine and the whole body. Specifically, they found that the muscle activity was larger in the external oblique muscles compared with the other abdominal muscles. The findings suggest that much higher-demands are placed on the motor control system by performing exercise on a labile surface.

Here's where the Swiss ball bounces to the forefront. Many of the beginner positions/movements on the Swiss ball such as the 'table top', seated ball balance and leg bridge require little movement in any one plane but require a tremendous amount of stabilizing.

Table Top

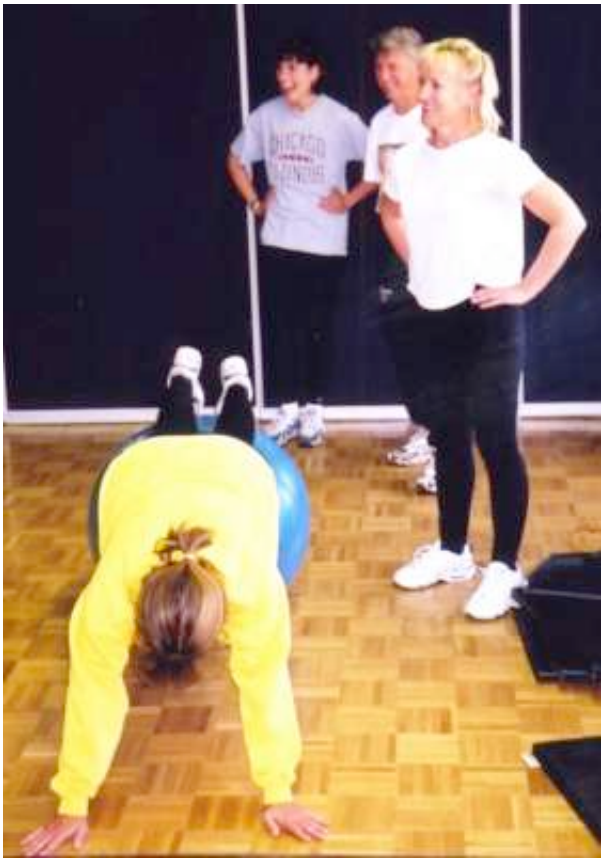
Leg Bridge

The Swiss ball provides a labile surface which requires you to make constant

corrections to maintain the position by activating stabilizing (core) muscles namely the external and internal oblique muscles, quadratus lumborum, transversus abdominis muscle and erector spinae muscles. The slow twitch fibers of the rectus abdominis muscles are still engaged, however the fast-twitch fibers are not engaged to the same extent as when a sit-up is performed and the rectus abdominis muscles are the prime movers.

If you are still with me at this point you have made it through the tough stuff and you can tell your friends that you understand neuromuscular physiology as it relates to isometric and concentric contractions on labile surfaces.

In my fitness seminar 'Belly, Balls, Bands and Back' I demonstrate how the Swiss ball can be used to improve stability in the lower back through some very simple exercises.



The Executive Committee has a ball at Waterton lakes Lodge National Park

For example, by just sitting on the ball with feet flat on the floor you will engage abdominal and lower back muscles to maintain position. I know people who use a Swiss ball in place of a chair at work. However, for beginners I suggest you keep you chair around until you have gradually increased your time on the ball. A simple progression from just sitting is to extend one leg until it is parallel to the floor, as

shown below.

This will wake up and engage those stabilizing abdominal muscles. (Rather like the differences between lifting free weights, which use considerable stabilizing musculature and lifting on a machine that only involves very specific prime mover muscles.)

Since these positions require stabilizing and little movement of large masses, it offers the advantage of engaging the smaller slow-twitch motor units that are often neglected in the traditional sit-up or curl up movements. In addition it engages a larger number of muscle groups when you have to stabilize your hips and lower back in all planes of movement.

You can still address those large fast-twitch motor units by working with a partner who can add resistance with a thera-band or some rubber tubing while you perform a curl-up on the ball. It is not uncommon for athletes to perform weightlifting exercise on the ball, placing their shoulders on the ball and forming a bridge while performing dumbbell flys.

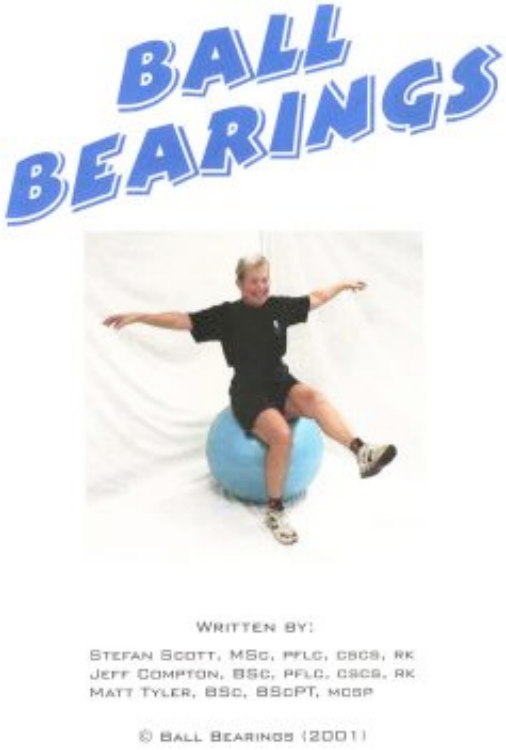
Try doing a shoulder press while sitting on the ball. The progression to a weightlifting exercise atop the ball can help develop strength and stability in the core as additional weight and the complexity of the movement will challenge a variety of lower back and abdominal muscles and the different motor units.

The wonderful thing about the ball is that it is lightweight, portable, inexpensive and offers a whole new dimension to workouts. It can be used in the home by a beginner (sit on it while you watch 'Survivor' or the 'West Wing') or the elite athlete. It is a soft, comfortable surface to perform exercises on and it's fun! Your imagination is your limitation to working with a ball. However, I do suggest you head to a gym or talk to a personal trainer preferably certified as a **Professional Fitness and Lifestyle Consultant** or by the **National Strength and Conditioning Association**.

So get on the ball, literally, and put yourself in a position that will benefit posture, strengthen your core muscles and help prevent lower back problems.

If you are looking to purchase a ball, head to the **BodyTrends.com** health and fitness site. Here you will find a **comparison of the different Swiss Balls** on a number of categories.

A great book to get you started on the ball and many more exercises to keep you going is 'Ball Bearings' by Jeff Compton and Stefan Scott of Edge Fitness. (You can purchse a copy for $15 + $3 shipping and handling, by sending a message to **guy@speakwell.com**.)



I do suggest you head to a gym and . . . not or . . . talk to a personal trainer.

Here are some popular links where you can find tips for using the ball and some photos of exercises.

C.H.E.K. Institute
Paul Chek is the swiss ball guru. Working with professional sports teams, universities, the armed forces and surgeons around the world, Paul Chek has brought the use of the Swiss Ball to popular culture. His site offers an exercise of the month for the ball. Check out his articles on the stability ball for in-depth instruction and education.

PT Strategies
This site has a few beginner positions and a text description. Balls and other rehabilitation equipment can be ordered.

Fitball USA
This site has products, exercise tips and information that is quite easy to navigate.

References

McGill, S.M. and Axler, C.T., 1997. Low back loads over a variety of abdominal exercises: searching for the safest abdominal challenge. **Medicine and Science in Sports and Exercise**, 26(6), 804-11.

Vera-Gracia, F.J., Grenier, S.G., and McGill, S.M., 2000. Abdominal muscle response during curl-ups on both stable and labile surfaces. **Physical Therapy**, 80(6), 564-9.

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