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## **Falls and hip fractures are not inevitable: A return to nature<sup>1</sup>**

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Abstract

Falls and hip fractures may not be inevitable, however, at present time they account for a significant portion of morbidity and contribute significantly to mortality in the elderly. This paper offers an evolutionary perspective with the concept of learned disuse as one of the major factors contributing to falls and hip fractures. The concepts are illustrated through experiential exercises. These exercises can be used both diagnostically and as preventive/educational approaches. Pragmatic recommendations are provided to reduce the risk of falls and improve strength and balance.

Keywords: Hip fractures, falls, balance, learned disuse

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*It was 3 am and I woke up, I had to pee. I got up and shuffled out of the room, turned right to go through the living room and tripped on the throw rug. I fell and crashed to the ground. A shearing excruciating pain ripped through my right hip.*

*I screamed.... and sobbed...*

*I couldn't get up. The scream woke my husband. He turned on the light, and saw me on the floor. "My hip," I kept crying... He dialed 911 and in 6 minutes and 12 seconds the firemen and the emergency response team were there. They loaded me onto the gurney and with the siren wheeling I was driven to the hospital. It was a broken hip.*

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*The hip fracture took almost 9 weeks to mend. And, even though I got physical therapy, I was weak and had lost all strength and stamina. It had become the turning point in life from living to waiting to die...*

Falls account for 70 percent of accidental deaths in persons 75 years of age and older (Fuller, 2000; Baker and Harvey, 1985). For many elderly, this becomes the beginning of the end. For some it is the pneumonia they get while lying down; for others, it is being resigned to moving only in a wheelchair. It is often the event that shifts being able to take care of oneself to moving into an extended care facility. Hip fractures in extended care facilities increase the medical costs. It is estimated that the medical cost of hip fractures in the USA exceeds 10 billion dollars annually (Carter, Kannus & Khan, 2001).

Hip fractures, more than 300,000 per year, are associated with the effects of aging--increased osteoporosis, loss of balance/increased postural sway, decreased mobility and strength, reduced visual acuity and increased use of prescription medications (Lord, 2005; Laughton et al, 2003). However, aging by itself may not be the sole factor. Many people who become old do not fall and do not have hip fractures. Possibly, increased falling and hip fractures are certainly the product of our industrial computerized age.

Lifestyles that reduce calcium intake, reduce physical coordination, reduce strength, reduce skeletal stress, decrease somatic awareness and balance will likely increase osteoporosis and instability, which contribute to increased falls and subsequent hip fractures. An underlying concept that contributes to imbalance and falling is **learned disuse**<sup>4</sup>; namely, individuals do not use their body appropriately because of their habitual life style. The tissue atrophies—illustrated in the popular phrase, “*use it or lose it.*” Even when function is reduced or seemingly lost, with training it may be regained, namely, *use it and it regenerates.* This dynamic process of growth during use and atrophy during disuse equally occurs in our brain tissue. Dendritic connections between the brain cells increase when developing new skills through challenge, novelty and use, and decrease through non-use. Consequently, many of our “aging illnesses” are less the result of aging than of non- and mis-use -- and of psychosclerosis (the hardening of the attitudes).

To reduce the possibility of falling, many pieces of the puzzle need to be addressed such as monitoring the use of medication and consulting with one’s physician about the possibility of over-medication and environmental modifications such as hand and grab rails and nightlights. What follows are some recommendations that may help to improve strength and balance thereby reducing the possibility of falling.

### **Major factors contributing to falling and return to health**

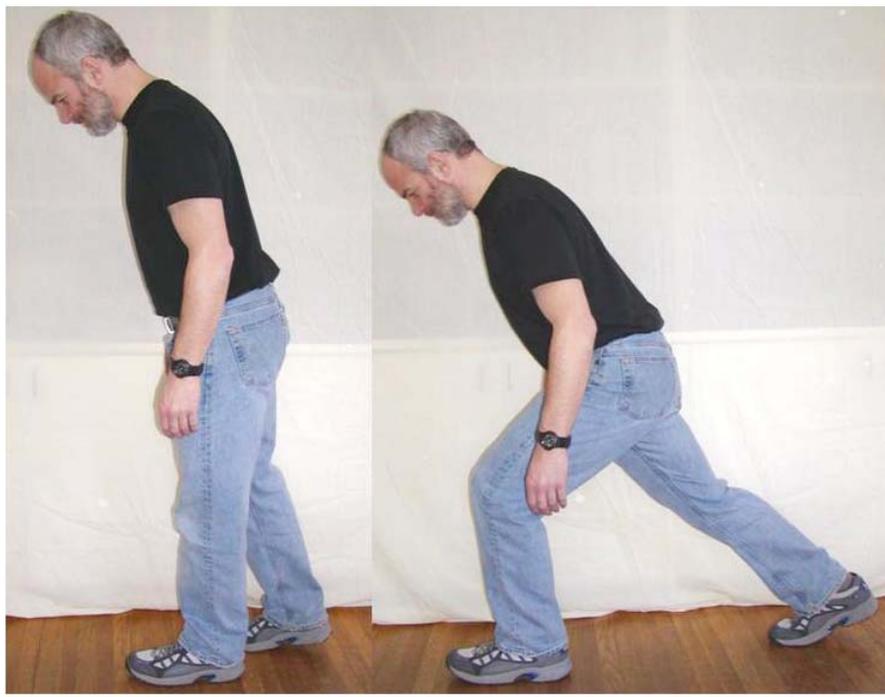
Strength, balance, stability, coordination and proprioception are elements that need to be developed and/or maintained to reduce the chance of falling. Loss of these elements is reversible and when the skills are developed, people are less likely to fall and break their

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<sup>4</sup> This concept is based upon seminal research and clinical studies by Dr. Edward Taub at the University of Alabama.

hips. For example, older people who practice Tai Chi have a significant reduction in falls and hip fractures as compared to those who do not (Wolf et al, 1996). In many ways we have to act more like children or like our pre-historic ancestors than like stately adults walking with rigid posture.

When observing children beginning to fall, one can observe how they catch themselves. They reach out with their other foot to catch the body before it topples over. However, older people are often fearful. They freeze and keep their weight on both feet so that their feet can not move. Performance of this recovery demands shifting the weight to the other foot, strength to lift the leg up and coordination to quickly place the foot forward so that the leg can act as a support and catch the movement of the body as illustrated in Figure 1. .



*Figure 1. Concept Exercise: Lunge for Stability*

*Stand straight up and then let yourself slightly lean forward as you feel yourself tilting, then shuffle your dominant foot about 10 inches forward. Note that if you were truly falling forward, the trunk would go beyond the 10 inches your foot has gone forward and you would fall.*

*Repeat the same exercise except as you lean forward lift your dominant knee up and above your waist height and reach your dominant foot forward and planting it far ahead on the ground. Even though the body was toppling forward you had enough time to catch yourself and thereby not fall.*

In most cases you experience a much better recovery from the possible fall when you lift your leg and lunge. For some people, this exercise is too challenging and a sequence of

skills needs to be learned, such as shifting weight to the other foot, shifting and pushing off from the big toe, etc.

The loss of strength and coordination is mainly due to learned disuse. Modern man has shifted to sitting most of the day (cars, computers and TV), which atrophies the muscles unlike our pre-historic hunting and gatherers ancestors, who had to walk and climb over rocks and roots during the day. They were continuously challenged by these natural obstacles and thereby developed and maintained their flexibility, strength and balance.

On the other hand, modern man has reduced his sensitivity and recovery to slight changes in balance. We now wear shoes and walk mainly on flat surfaces. We no longer feel with our feet or quickly change the pressure or location of our feet or toes to avoid injury. Our shoes, sneakers and boots insulate us from the changing texture of the ground while the predominant flat surfaces reduce our need to make balancing corrections. Yet, our ancestors walked barefoot over uneven surfaces and had to continuously monitor what was beneath the feet and rapidly adjust their balance as the surface changed. This increase in proprioception through stimulation appears to improve balance. For example, when the insoles of older people are externally vibrated often without awareness, there is significant improvement in balance control (Priplata et al, 2003).

As we reduce the skill of quick recovery in balance, we become more aware that we can fall and topple over. The anticipation and the terror that we could fall triggers fear. When we walk or move, we are usually unaware, yet we tighten our body and breathe shallowly in our chest. We become more like a stiff rod which stands erect but the moment it begins to topple, it keeps falling. Yet, if we could relax and lower our breathing and awareness into our bellies, we would increase our body's flexibility and recovery to small perturbations in balance as illustrated in Figure 2



*Figure 2. Concept Exercise: Balance and Breath*

*Do this practice with a partner. Stand with your back about one foot away from the wall. Have your partner face you and place his hands on your shoulders. Your partner stands with one foot behind the other. Simulate being fearful by gasping, shallow chest breathing and stiffening your neck shoulders and back. While in this position, have your partner rock your shoulders back and forth a few times.*

*While standing in the same position, now relax, think of a loving pleasant memory and breathe more slowly and more diaphragmatically. Allow your abdomen to expand as you inhale and decrease in diameter as you exhale, let your knees be slightly bent. While in this position, have your partner rock your shoulders back and forth a few times.*

*Repeat this same rocking exercise, except do not focus on the breathing patterns. Have the person focus his attention on the ceiling above his head while being rocked. Then have him focus his attention on feeling his feet and the ground beneath his feet.*

In most cases, stability and a sense of balance are increased when one relaxes, focuses on the ground beneath one's feet, breathes lower in the abdomen, and smiles.

As we become fearful and stiffen, our ability to respond smoothly to a complex environment is diminished. The habitual activation of the alarm/freeze reaction causes the body to stiffen, reduces rotational freedom, and undermines the rapid adaptation to

changes in balance. This means that as individuals rotate to follow a moving target, they have to move their trunk as a fixed unit thereby compromising their balance. The fear/stiffening response may be covertly triggered by visual changes associated with aging: the reduced ability to focus at varying distances and the decreased discrimination in low light levels. When fearful, our neck, shoulder and back stiffen while we hold our breath. The interactive process can be used as an early assessment and as a training exercise to improve balance as illustrated in Figure 3.



*Figure 3. Concept Exercise: Track Your Thumb*

*Stand erect with your feet a shoulder's width apart. Raise your arms forward and outstretched, with the palms touching and thumbs pointing up. Now while holding your left arm straight ahead, slowly rotate your right arm to the right, while tracking your right thumb. Rotate the arm as far it goes without discomfort. Then gently rotate the right arm back until it touches the outstretched left arm. Now drop your arms and relax.*

*Repeat the same procedure, except let your right arm stay straight ahead and rotate your left arm to the left while tracking the left thumb.*

Most people tend to hold their breath and stiffen as they rotate and look. In addition, they may begin to feel the beginning of instability or an increased sense that they could fall especially if their back limits smooth and flexible rotation.

These above concept exercises illustrate some of the conditions that lead to instability. At the same time, they suggest prevention strategies: increasing leg strength, mastering diaphragmatic breathing, being aware of the environment instead of being pre-occupied (having one's head in the clouds), increasing trunk flexibility and fostering the interaction of vision and balance. When one masters these prevention tools, confidence is increased and fear reduced -- a process that increases flexibility and stability.

## **Rehabilitation: Return to our prehistoric self**

Rehabilitation has many connotations these days, but it simply means to re-learn. We want to re-learn and train the body to recover in a fall; this means becoming more like our early ancestors. We need to practice all those skills and behaviors which we have unknowingly abandoned. Increasing physical activity is the major strategy for prevention as the World Health Organization states (Chan, Anderson & Lau, 2003):

*“Bones, like muscles, respond to stress by becoming bigger and stronger. Regular physical exercise places physical stress on the body, helps stimulate bone growth and preserve bone mass, and provides excellent general health benefits, the foremost being an increase in BMD (11–13). Therefore, for osteoporosis, the main goals of physical activity should focus on preventing falls by improving individuals' general health, balance, muscle strength, posture and postural stability.”*

Regain these skills by strengthening the muscles during the day, increasing feet and balance sensitivity, reducing fear of falling, learning to breathe lower and slower, encouraging the body to strengthen the bones and increasing Calcium intake. The following exercises will strengthen and increase coordination of the muscles that are needed to interrupt falls.

The general rules for the exercises are:

- Enjoy them and allow yourself to be playful and silly. Is it really important what others think?
- Do them with others, it is more fun.
- Do them everywhere especially in those situations where previously you sat or stood and just waited. For example, while standing in line at the grocery checkout, practice lifting one foot up and use the cart to aid balance.
- Exhale while doing the effort phase of movement, such as when standing up
- If initially you can only do an exercise one time, that is great. With practice 10 repetitions are possible.
- Do the practices progressively.

## **Increase core muscles fitness**

General fitness equally improves stability, especially when we strengthen our “core” muscles. While much discussion of fitness seems to be aimed at younger people, seniors can also greatly benefit from strengthening their core muscles. What we are talking about here for our purposes are what are also known as the “stabilizer muscles,” the smaller muscles in our lower back and abdominal wall which are responsible for helping us to maintain an upright posture. The muscles do not “stick out” when they are developed like the larger muscles groups do, but when they are strengthened, one will feel much more in balance. A very simple approach is using a big bouncy stability ball, such as you may have seen in your gym or at your neighbor’s home.

Many toy and exercise stores as well as ergonomic suppliers sell sturdy stability BURST RESISTANT balls of varying sizes that are fun and healthful to sit on. The cost ranges from \$25 to \$40. Inflate the ball so that it is soft and comfortable to sit on. When you sit on the ball, let your hips be slightly higher than your knees (the angle of your hip is about 100 - 110 degrees). Ball sizes may need to be increased or decreased depending upon how much you inflate the ball. Explore the following guidelines for ball sizes:

- If you are over 6'3" and have long legs use a 75 cm diameter ball
- If you are between 5'2" and 6'2" use a 65 cm diameter ball
- If you are less than 5'2" use a fully inflated 55 cm diameter ball or a partially inflated 65 cm diameter ball

Develop your core muscles and increase balance when you sit on the ball and explore the movements described in Figure 4.



*Figure 4. Concept Exercise: Sitting on a Stability Ball.*

*Just sit on the ball. That's right-- just sit on it. No sit-ups or crazy tricks. Enjoy bouncing, wiggling and rocking on the ball.*

*As you sit on the ball, with something nearby to steady yourself, pull your belly button in toward your spine and then release it. Move slightly from side to side by rolling the ball laterally ever so slightly. Just feel what happens with these core muscles. As you become more comfortable on the ball, begin sitting on it for longer time periods, eventually relinquishing the need for something to hold onto for support. Sitting on the ball trains your stabilizer muscles to become better at improving your balance and your proprioception. Remember to keep track of your ball as your friends may roll away with it. Even though you may suspect that your friends think that you are crazy, they will almost all want to use it.*

### **Increase hip and leg muscle strength**

To regain strength and flexibility, to catch ourselves as we begin to topple, to strengthen muscles and increase coordination in the muscle that help return us to an upright position, practice the following:

1. Reach up with your knees
  - Sitting knee lift. Sit upright in the chair and lift one knee up, repeat 10 times, and exhale with each lift. Repeat with the other knee. With practice, raise knee higher and higher.
  - Standing knee lift. Stand upright and with one or two hands hold on to a counter for balance and then lift one knee up. Repeat 10 times. Repeat with the other knee. With practice hold on with one hand and practice without holding on.
  - Prancing horses. Whenever you walk, think you are like a prancing horse. On each step lift your knees a bit higher. Practice whenever you walk.
  - Use the stairs: Walk the stairs instead of using an escalator or elevator. If possible take two or can you even take three stairs at a time.
2. Push off with your big toe. While walking, focus on pushing off with the big toe of the back leg. By pushing off, the gait swing and speed improves.
3. Practice foot lunge. Stand upright and hold on to a bar or counter top. Lift the knee up and reach forward with your feet. This is like taking a high step.

### **Increase awareness and balance**

1. Increase stimulation to your feet by walking barefoot over an uneven surface.
  - Walk barefoot on the beach or the grass
  - Walk on a plastic simulated pebble runner. This is a long runner with raised pebbles simulating a surface of pebbles. Walk barefoot on this surface. The more you practice the easier it becomes.
2. Train balance
  - Walk the cracks. Remember how you walked and balanced on the railroad tracks? Take every opportunity to be like a child to practice balancing. When walking, plan your footpath, it could be the cracks in the sidewalk, the line in the hospital, or the curb.
  - Be a stork. Stand and lift one foot, hold and see how you can balance.
  - Spend time sitting on a stability ball during activities such as watching TV

### **Gain confidence and reduce fear**

1. Practice breathing lower.
  - Put your hand on your stomach and let it expand as you inhale and become smaller as you exhale.

- While lying down, put a 5 pound weight on your stomach. As you inhale push the weight up and as you exhale let the weight come down. Repeat for 10 minutes
2. Practice small falls and recovery.
- Stand facing a wall and practice falling forward and then recovering. Make it more and more challenging.

### Increase bone strength

1. Increase weight bearing exercises as part of your daily activities such as carrying groceries to the car.
2. Eat enough calcium (about 1600mg daily) in your diet by increasing vegetable intake such as artichokes, kale, peas, broccoli, Brussels spouts, dark green lettuce, and collard greens. Avoid foods that leach calcium from the bones, such as a very high protein diet.
3. Get enough vitamin D through sunshine (yes, some sun is necessary), from your diet or about 1000 IU supplements (Vieth, 1999).

### Conclusion

Finally, combine all of these practices and enjoy yourself. Obviously, it is worthwhile to reduce the risks that could increase falling, such as removing loose rugs, wearing shoes with non-skid soles, etc. (Rubenstein et al, 2003). **Paradoxically, by removing the risks we also increase learned disuse.** Thus it is necessary to deliberately build exercise and adaptive movement into one's lifestyle. Enroll in physical activities and classes that intrinsically promote balance and fun. Go dancing, or participate in Tai Chi. Keep it simple and make a big step toward improving your health and reducing your risk of falling.

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