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Protect the spine through exercise

by Karen Kemmis, PT, DPT

Osteoporosis is a disease in which bones become fragile and more likely to fracture. In the US today, approximately 10 million individuals already have the disease, and an estimated 34 million more have low bone density, placing them at increased risk for osteoporosis and fractures. Of the 10 million Americans estimated to have osteoporosis, eight million (80%) are women and two million (20%) are men (1).

Bone loss and osteoporosis most often occur in individuals ages 50 and older. As age increases, fracture risk also increases. Women can lose up to 20% of bone density during the five to seven years following menopause (2). Bone loss tends to progress at a slower rate in men, and it usually occurs at a later age than in women (3).

If not prevented or if left untreated, osteoporosis can progress painlessly until a bone breaks. Fractures most commonly occur in the hip, spine and wrist. The vertebrae are the most common bones to break. This is partly because the spine is predominantly made of trabecular (cancellous) bone. This trabecular bone, also called "spongy bone," is more susceptible to fractures in people with osteoporosis (3). Approximately 550,000 spine fractures occur each year due to osteoporosis (4).



Courtesy of CAAWS - Mariann Domonkos Photography

In all people, the front portion of the vertebrae has thinner bone than the back portion. Therefore, putting pressure on the front of the bone during spine flexion can cause a compression force to the front of the vertebrae, which results in a fracture (called a wedge fracture).

People with osteoporosis can experience a vertebral fracture because of:

- too much pressure placed on the bone during a fall,
- a full twisting motion of the torso to a point of strain,
- lifting or carrying a load that is too heavy for a fragile spine, and

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- flexing or rounding the spine, such as when doing a toe touch, a curl sit-up or picking up an item from the floor with straight legs.

A simple movement such as coughing can cause a vertebral fracture in some people.

When a fracture occurs, people may feel a sharp pain that doesn't get better while others do not have any obvious pain at all. Some people only realize there is a problem after a noticeable amount of height is lost.

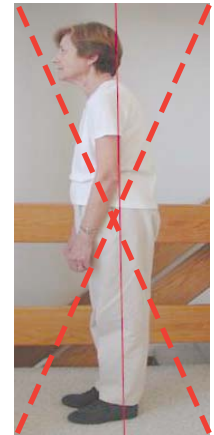
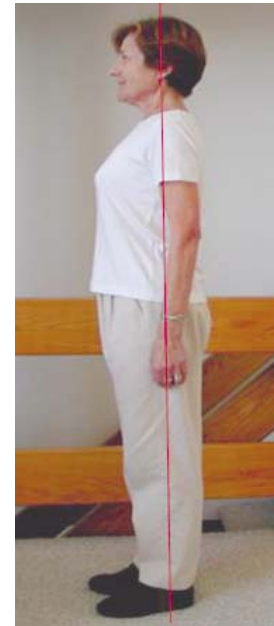
Posture changes

Compression fractures of the vertebrae (spine bones) can cause height loss and kyphosis, a forward curve of the spine that causes a person's posture to look stooped or hunched. As more vertebrae fracture, the spine becomes more curved (5,6). Kyphosis is sometimes called a dowager's hump.

In addition to the possible pain, height loss and posture changes, spine fractures can also lead to decreased quality of life, anxiety, depression or decreased self-esteem, increased kyphosis that worsens over time, decreased mobility and energy, problems sleeping, fear of future fractures, falls, difficulty breathing, stomach pains or digestive discomfort and increased long-term morbidity and mortality (6,7,8,9,10).

Protecting the spine

Fortunately, there are many steps individuals with osteoporosis can take to protect the spine from fractures and kyphosis, such as ensuring they have sufficient calcium and vitamin D intake and using prescribed osteoporosis medications. Another important step is maintaining a regular exercise program.



Good posture

- ears over shoulders
- shoulders over hips
- hips over the knees
- knees over the ankles

Weight-bearing exercises such as jogging, walking and aerobics, and resistance exercises such as lifting weights can help adults maintain bone density by adding stress or load to the spine. These exercises can also improve muscle strength and prevent falls, which helps to reduce the risk of fractures (11,12,13).

Given the prevalence of osteoporosis in older age groups, it's likely that many of your clients already have osteoporosis or risk developing the disease. By integrating modifications to protect the spine into an exercise program, you can help participants protect their bones as they work to improve physical function.

While people with osteoporosis are at the greatest risk of fracture, broken bones can occur in people with low bone density (also called osteopenia). Because it is difficult to predict which individuals are

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more likely to fracture, it is best to apply the same exercise modifications for people with osteoporosis to individuals with low bone density.

If you have any questions about the activity that is appropriate for an individual, do not proceed until that person has consulted with a health care provider. The safe approach is to begin exercise at a low intensity and progressively increase to moderate intensity levels (14). Individuals at increased risk of fracture may need further evaluation prior to initiating a vigorous exercise program (for example,

people with diagnosed osteoporosis or those who have a medical condition or are taking a medication that causes bone loss).

Participants who have been diagnosed with severe osteoporosis, have a history of low trauma fractures (such as from a fall from standing height or less), have lost more than 1 ½ inches from their maximal recalled height (possibly due to undiagnosed vertebral fractures) or are very frail should work with their health care

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Movement modifications

In addition to people with osteoporosis of the spine, some individuals with low bone density (osteopenia) of the spine who have other risk factors for fracture may need to make these modifications.

Avoid these movements	Modification
Forward flexion of the spine with rounded back or straight legs. Examples: toe touches	Hamstring stretches done by lying on back, reaching leg to a vertical position (possibly with use of a stretch strap).
Forward flexion of spine during core exercises. Example: crunches, sit-ups	Core strengthening done by lying on back, raising one leg at a time; possibly advancing to raising both if good spine position can be maintained.
Rotation to a point of strain. Examples: full golf swing or swinging a tennis racquet to a point of strain	Swing, but avoid the last few degrees of twisting. Note: It is important to maintain good trunk rotation. Stretching the spine in a rotation is safest when done lying on the back rather than sitting or standing.
Activities that increase the risk of falls.	Though balance exercises are important to decrease risk of falls, they may need to be performed with access to something stable (wall, sturdy chair, ballet bar) to touch lightly if needed.

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provider for appropriate guidance regarding exercise and safe movement. Obtain instructions from the therapist or physician before designing a program for these individuals.

You should also stop individuals from exercising if you suspect a possible spine fracture. Such individuals should see their health care provider right away for an examination. Signs of a possible spine fracture include back pain, a loss of 1/2 inch or more of height in one year, a height loss of 1 1/2 inches or more from a person's original height and stooped or hunched posture (15).

Exercises that benefit the bones

A well-rounded bone-healthy exercise program includes weight-bearing and muscle-strengthening exercises. Aging individuals should include balance exercises, posture exercises and functional exercises in their exercise program.

None of the suggested exercises should hurt in any way while individuals are doing them nor cause muscle soreness lasting more than two days. If soreness lasts longer, the individual may be working too hard and need to ease up. Exercises should be done in a pain-free range of motion. Lightheadedness or dizziness is a signal to stop and rest. If a person has any chest pain, he or she should stop exercising and see a health care provider immediately.

Weight-bearing exercises

Weight-bearing exercises include activities that make individuals move against gravity while being upright. While higher impact exercises, such as jogging, soccer and jumping rope have greater benefits for bone health, low-impact weight-bearing exercises are safer for people at risk of having a fracture. The same impact that

benefits bone density might cause a fracture in a person with a fragile spine. Some examples of low-impact exercises are:

- fast walking
- low-impact aerobics
- cardiovascular training using elliptical machines

Since biking and swimming are not weight-bearing activities, these do not help the bones. Encourage your participants to supplement them with weight-bearing activity and resistance exercise.

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Functional exercise: chair rise

Purpose: Helps with safely getting up from a chair to a standing position. It also helps to strengthen the legs. This exercise can be done once each day.

1. Sit on the front edge of a chair and rise to the standing position. Then gently sit back down without using the arms. It may be helpful to cross arms over the chest to prevent using them.
2. Keep knees and feet hip width apart at all times.
3. Use the strength of the legs to stand and sit.
4. If this can't be done without using the arms, place a pillow on the seat of the chair to make it a bit easier.
5. The goal is to stand and sit 10 times in a row. Once a set of 10 can be comfortably completed, remove the pillow or move the exerciser to a lower chair to make it harder.

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Resistance exercises

Resistance exercises (also called muscle-strengthening exercises) require individuals to move their body, a weight or some other resistance against gravity. These exercises help individuals maintain bone density, increase muscle strength and reduce the risk of falls (16). Resistance exercises include lifting weights, using elastic exercise bands or pulleys, using weight machines and lifting a person's own body weight.

Because we can't know a person's true risk of fracture, the 10-pound rule (avoid carrying babies and packages over 10 pounds) is commonly applied because these shifting/moving objects can place too much strain on the spine. Doing a biceps curl with a 10-pound or heavier weight with proper form, however, should not put any strain on the spine. Individuals may also be able to obtain clearance from their health care provider to lift more than 10 pounds.

Maintaining proper form during weight lifting will help individuals achieve the greatest benefit and reduce the chance of injury.

A well-rounded resistance exercise program includes:

- Biceps curls
- Triceps extensions and/or push ups
- Upper back rows
- Lat pulldowns
- Back extensions
- Leg presses
- Hip abductions
- Knee extensions
- Hamstring curls
- Calf raises
- Abdominal strength and core strengthening exercises, maintaining a neutral spine

Key point: Choose abdominal exercises that can be performed with a neutral spine (natural arch), such as leg lifts, and avoid those requiring spinal flexion, such as curl-ups. Core exercises done in the neutral spine position, such as front and side plank, are generally safe and beneficial.

For the upper body, chest presses can be included for a complete program. But, don't emphasize chest strengthening since these

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Seated isometric abdominal exercise



1. Sit in a chair with the back straight.
2. Pull abdominals up and in.
3. Try to lift the right knee while pushing down with the right hand.
4. Hold for two seconds and relax.
5. Repeat with opposite hand and leg.
6. Do 10–15 repetitions on each side to complete an abdominal strengthening set.

Exercises to perform

Movements	Examples	Purpose
Spine extension stretching	Lying prone, pillows or towels rolled under the hips/pelvis, hands at shoulder level, push gently through the arms to allow the back to arch. Do not stretch into pain.	To counteract the common postural fault of an increased thoracic kyphosis (rounded upper back).
Spine extension strengthening	Lying prone, pillows or towels rolled under the hips/pelvis, hands under the forehead. Lift upper back, keeping chin tucked, to work spine extensor muscles.	To increase strength required to maintain a safe, upright posture and to aid in doing daily activities, such as carrying and lifting, with proper spine posture.
Stretches for the shoulders and front of chest	Stand in a corner with hands on the wall at the sides, just below shoulder level. Step one foot forward, lean forward. Gently tuck chin for proper neck posture.	To help maintain proper shoulder/upper back posture; to maintain a normal thoracic curve without an increased kyphosis; to counteract the effects of gravity and common work/activity postures which promote rounded shoulders.
Core exercises	Full or modified front and side planks.	To increase trunk/back strength in a neutral spine posture to facilitate safe movements during daily activities (lifting, reaching, brushing teeth and vacuuming).

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exercises encourage rounded shoulder posture, which can increase the stress on the thoracic spine.

Perform 2-3 days per week; over the course of each week, work each major muscle group at least twice. If time is an issue, try exercising one muscle group each day. Aim for 10-15 repetitions for each exercise. Once a person can do more than 15 repetitions, increase the weight.

Balance exercises

Balance training and leg strengthening exercises can help decrease the risk of falls and therefore reduce the risk of fractures. Balance exercises are especially important for individuals who have fallen during the past year or for those who lose their balance while doing regular daily activities.

Balance exercises should be challenging. Close supervision is necessary for decreasing the risk of falls. Be sure safety is first and foremost.

Examples of balance exercises are:

- Standing with one foot in front of the other as if on a tight rope (tandem stance)
- Standing on one leg
- Standing on an unstable surface (stability disc or core trainer)
- Walking as if on a tight rope
- Side stepping
- Grapevines and carioca

Tai chi has been shown to improve balance and decrease the risk of falls, and is generally safe for aging adults. Lower-leg strength training exercises (as noted above) are also important for improving balance.

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Posture exercise: corner stretch



Purpose: stretch the shoulder, flatten the upper back and improve rounded shoulders
Perform twice on each side about 3 times per week

1. Stand in the corner of a room with arms bent at a 90 degree angle at shoulder level and hands touching the walls.
2. Step one foot forward, letting that knee bend.
3. Lean onto the front leg, bringing the head and chest toward the corner. You should feel a light stretch in your shoulders. Avoid over-extending the neck by looking at the corner at the level of the chest.
4. Hold for 20-30 seconds.
5. Stand up straight and switch feet. Repeat the exercise on the other side.

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Posture exercises

Good posture includes keeping the ears over the shoulders, the shoulders over the hips, the hips over the knees and the knees over the ankles. By stretching and strengthening the muscles in the upper body, abdominals, back and lower body, these exercises help to minimize kyphotic posture thereby decreasing the risk of vertebral compression fractures. Individuals who have rounded or “sloping” shoulders should focus on posture exercises (17,18).

Focus on stretching the front of the shoulders, the upper back into spine extension, hips and knees. Strengthen the upper back, abdominals and lower extremities to improve posture.

Functional exercises

Functional exercises are similar to the activities that individuals do each day. By helping people move safely during their daily activities, these exercises can help to decrease the risk of falls and fractures. Individuals who have trouble performing their daily activities (e.g., difficulty getting up from a chair or climbing stairs) should do functional exercises. People who have recently been inactive due to a fracture, surgery, an illness or other reason may also benefit from these exercises.

Functional exercises might include:

- Squats (to practice lifting from the floor with bent knees instead of bending forward at the waist)
- Chair rises
- Standing heel raises
- Climbing stairs

Modifications for yoga and Pilates

In recent years, the ancient mind-body practice of yoga as well as the core strengthening exercise program known as

Pilates have become popular forms of exercise. Both types of exercise involve some movements that are not safe for people with osteoporosis of the spine or those at increased risk of spine fractures.

While some movements in yoga and Pilates should be avoided, others can be performed with proper modifications.

Here are some examples of **movements to avoid** in yoga (19):

- Exercises that require bending forward from the waist (without modification), such as standing forward bend, head-to-knee pose and seated forward bend.
- Activities that involve rounding or hunching of the back.
- Twisting the spine to a point of strain, especially when in a standing or seated position.
- Poses that bear weight directly on the neck, such as headstand and shoulder stand positions.

Certain yoga poses or exercises can be **made safer** by adding props. For example:

- When doing seated poses or exercises, a person may need to sit on at least two firm folded blankets to avoid rounding or hunching the back.
- When lying down, place support under the head to keep the forehead level or slightly higher than the chin. This is especially important if posture is stooped or hunched.
- When doing forward bending exercises, such as standing forward bend, place hands on yoga blocks to avoid bending at the waist and limit

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the distance required when reaching toward the floor; forward bending exercises should be done by hinging at the hips and keeping a flat spine rather than bending at the waist.

- When doing balance exercises, position a person who feels unsteady near a wall or chair for hand support.

Many movements in Pilates involve flexion or bending, which causes the back to round into a C-curve by bringing the head and shoulders closer to the abdomen. People with osteoporosis or those at increased risk of spine fractures should avoid or modify movements with flexion.

The most common Pilates exercise that involves forward flexion is called “the hundred.” Because the flexed, or rounded, position of the head, neck and back are

not safe for people with low bone density or osteoporosis (20), a modified version of a similar exercise is shown below (6).

Suggest that individuals speak with their Pilates instructor about how they can further modify their Pilates program to avoid flexion of the spine and bending forward from the waist.

Movement matters for osteoporosis

Exercise and physical activity are important for bone health and overall health. Individuals with osteoporosis and low bone density should engage in regular weight-bearing and muscle-strengthening exercises to maintain bone density, improve muscle strength and reduce the risk of falls.

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Modification for “the hundred” in Pilates

Step 1: Start with the head down and back flat on the mat. Use a pillow under the head if the upper back is rounded. Keep knees bent and toes facing forward.



Step 2: Move legs to a “table top” position where hips and knees are bent to about 90 degrees, raising one leg at a time. Thighs are vertical and shins are parallel to the floor like a table top.



Step 3: While inhaling, imagine dipping the foot into a pool of water and touch the toe to the floor. Then exhale and bring the leg back up to the “table top” position. Keep the abdomen in, lower back on the mat and head down. Switch legs and repeat.



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Physical therapists with training and experience working with people who have osteoporosis are excellent resources when designing an exercise program. A physical therapist can design a safe and appropriate exercise program that helps improve posture, balance, muscle strength and the ability to move safely throughout the day. Individuals who have had one or more osteoporosis-related fractures should work with a physical therapist. Individuals with a diagnosis of osteoporosis can also benefit from working with a physical therapist.

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Resources

Bone Health and Osteoporosis: A Report of the Surgeon General
Research review, recommendations
US Department of Health and Human Services
www.surgeongeneral.gov/library/bonehealth/

Boning Up on Osteoporosis: A Guide to Prevention and Treatment
Clinician's Guide to Prevention and Treatment of Osteoporosis
Health Professional's Guide to Rehabilitation of the Patient with Osteoporosis
National Osteoporosis Foundation
www.nof.org/

Exercise and Osteoporosis
Continuing education course
American Council on Exercise
www.icaa.cc/profesional_education/ace/Exercise-osteoporosis.htm

Move It or Lose It: How exercise helps to build and maintain strong bones,
prevent falls and fractures, and speed rehabilitation
Research and guidelines for exercise
International Osteoporosis Foundation
www.iofbonehealth.org/publications/move-it-or-lose-it.html

Osteoporosis Information
Research, consumer and professional information
NIH Osteoporosis and Related Bone Diseases National Resource Center
www.niams.nih.gov/Health_Info/Bone/Osteoporosis/default.asp

The BEST Exercise Program for Osteoporosis Prevention
Book and continuing education course
www.icaa.cc/profesional_education/dswf/thebestosteoporosis.htm

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