

Prevention and Management of Osteoporosis through Exercise

by Diane E. Brodigan

This article summarizes the current knowledge of the prevention and management of osteoporosis through exercise. Years of research on osteoporosis have led to the following important conclusions:

1. There must be exercise stress exerted upon specific areas of bone weakness.
2. The muscles acting upon those areas of bone must be strengthened by specific exercises.
3. Endurance improvement should be accomplished through anti-gravity, weight-bearing activities that are continuous.

Specific areas of bone weakness in women over 40 years of age include the upper arm at the shoulder, the forearm at the wrist, the thighbone at the hip and the spine. These are the major sites of fracture in women over 50, but bone loss begins decades before. As soon as skeletal maturity is reached, usually by age 25 and certainly by age 30, the decline of bone density commences.

Trabecular bone (also called spongy bone), most likely to weaken first because of its high turnover rate, is found in the four locations above. Those fragile areas are at the ends of

long bones, with the exception of the spine, and do not have many muscle attachments acting directly upon them as do the shafts of long bones. The body of each vertebra of the spine consists almost entirely of trabecular bone, which makes it vulnerable to fracture. The upright position of the human spine relies upon correct posture, the alignment of one body part over another to maintain balance without musculoskeletal strain. For these reasons, posture is an important factor in weight-bearing activities.

Osteoporosis may be prevented or treated by physical activity that includes stress to specific areas of bone weakness. In order to strengthen specific bones, it is necessary to contract and strengthen the muscles which attach to those bones. When bone is stressed by the pull of muscle contraction, an electrical force known as piezoelectricity is created at stress points, and bone deposition occurs there.

Bone elements place themselves in the direction of functional force, and that is why specific exercise is superior to generalized activity in the building of bone mass. Body weight

carried by the skeleton (bone loading) and mechanical muscular contraction supply the force which produces bone hypertrophy (greater size and density). When muscle mass increases, bone mass increases correspondingly. The obvious benefit of larger, more dense bones is that there is more to lose later on in life, a greater "retirement fund." In a lifetime, women will lose 50% of their bone mass; men lose 10% of theirs.

Posture

Just as a more robust frame is protective as aging occurs, the type of posture assumed by that frame is also important. Often overlooked, correct posture contributes greatly to the prevention of certain spinal fractures.

When anterior wedging fractures occur in advanced osteoporosis, porous thoracic vertebrae (of the upper back) crush toward the front of the body. This causes the familiar dowager's hump, a forward-rounded spine. The lower back vertebrae of the lumbar spine become weakened and sustain compressional crush fractures which accentuate a sway-

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back appearance, an exaggerated lordotic curve. These areas of the thoracic and lumbar spine cause considerable pain upon contact with one another from above and below. Correct posture has the head, trunk and upper limbs aligned over the base of support, which is the two feet and the space in between.

When the body is in motion, posture must not be sacrificed for speed, because fatigue and injury from improper alignment may result. Maintain a straight spine with a natural low back curve. This posture of the trunk applies both to upright walking and to horizontal floor exercises for strengthening.

Different types of exercises are needed to promote strong trabecular bone in previously mentioned vulnerable areas of the skeleton. The legs, hip and spine benefit from the gravitational stress and muscle contraction of endurance activity. Important points are that it must be exercise that is upright, weightbearing, continuous, active and aerobic.

Aerobic (endurance) exercise is that which uses oxygen (steady breathing) for energy and is continuous rather than stop and go. Performed at a moderate pace, aerobic exercise uses fats for fuel and thus helps to control obesity. Walking and jogging are examples of aerobic exercises. The trunk may be strengthened by abdominal contraction and spinal (back extension) exercises.

Specific Exercises for the Hip and Spine

Endurance activities such as walking or jogging not only increase bone mineral density of the legs, hip and spine, but also provide cardiovascular improvement. Although a significant correlation has been found between aerobic capacity and bone mass, endurance exercise does not

have to be intense or strenuous. Benefits are evident with moderate aerobic activity performed for 30 minutes, three to four times per week.

Before any type of activity, whether it is a long run or raking leaves, the muscles must be warmed up first. Also, to avoid injury during and pain following exercise, a static stretch should be employed before and after exercise. (Older people should use a very mild intensity endurance program since benefits accrue with any increment of activity, even if one has been sedentary.) Moderation is the key to a successful and gradual integration of exercise habits into one's lifestyle.

While the hip and spine benefit from the gravitational and weight bearing stress of endurance activity, additional attention must be given to the abdominal and back muscles. The spine and back may be supported and strengthened by isometric abdominal contraction and back extension exercises.

Specific Exercises for the Upper Body

Gravitational pull, the loading of weight and muscle contraction stress the forearm, upper arm, shoulder girdle and chest through four specific types of exercise positions. The positions of tension, torsion, compression and bending may be seen on the exercise sheet. After the upper body is prepared by adequate warm up and stretching, these exercises initially may be performed for 10 minutes each day. Gradually increase to 30 minutes, three times per week.

The resistance exercise examples for the upper body (Resistance/ External Rotation and Horizontal Abduction) require a three-foot length of Thera-Band. This six-inch wide band of stretchable rubber is

used to promote correction of rounded shoulders and a forward humped back (kyphosis) by improving the surrounding muscles. Research has found that the preceding exercises produce the greatest increase in trabecular bone density in the upper extremities when performed between one and one-half and two hours per week.

Cautions

In order to minimize trauma in elderly osteoporotic women, physical appraisal is recommended before exercise is attempted. Caution should be observed when the exerciser has severe osteoporosis with spinal fracture. The goal then is to avoid further fracture, yet to continue with the benefits of exercise. The exercise sheet demonstrates several exercise positions that may cause further damage to the spine. Traditional toe-touching may be especially dangerous. Any exercises that promote excessive stretching or trunk flexion (forward bending) are to be avoided.

Extreme flexibility is not only unnecessary, it is unhealthy. Besides causing vertebral problems, it stretches nerve tissue and compromises the integrity of other joints that are overstretched, thus leading to injury. Sinaki (1984) found that trunk flexion exercises increased the rate of spinal fracture by 89%, compared with a 16% fracture rate from a back extension exercise group. However, osteoporotic women in the sedentary control group exhibited a fracture rate of 67% while doing nothing.

Aisenbrey (1987), Goodman (1985) and Snow-Harter (1987) agree that extension exercises are more appropriate than flexion exercises in the management of osteoporosis. Trunk flexion during abdominal strengthening exercise (curl up) may be eliminated by using isometric

contraction, as illustrated on the exercise sheet (Isometric Abdominal Contraction). In a partial sit up (curl up) the shoulders are curled off the floor in an isotonic contraction, but studies have shown that the isometric contraction (no joint movement) is just as productive.

During any type of contraction, the breath should not be held. Doing so will occlude venous return to the heart and will elevate blood pressure. Not only hypertensives, but all exercisers should practice normal breathing during exercises: exhale upon lifting (curling up or pushing up) and inhale while lowering the body. When a contraction is held for 10 seconds, it is imperative that normal breathing be practiced during that time.

Type of activity has a strong relation to the increase or decrease of bone mineral content. Swimmers and non-exercisers are usually at the lowest end of the bone density scale. The sports producing moderate amounts of bone density include running and soccer, and the athletes with the greatest amount of bone density are weightlifters and ballet dancers. These increases are due to extreme weight bearing in the former and muscular strength through endurance in the latter.

Favorite sports do not have to be abandoned, but provisions must be made to maintain bone density in addition to these pursuits. A variety of popular or faddish exercise activities have been promoted over the years as an easy access to fitness. Recent devices such as exercise tables, which produce passive, non-weight-bearing motion, do nothing to enhance bone density or the cardiovascular system.

Unfortunately, the importance of weight-bearing activity continues with age, while the inclination to engage in physical exercise declines. Lowered levels of physical activity

halt or reduce bone formation, and at menopause the reduction of estrogen contributes further to decreases in bone density. Thus, the greatest problem of older people is skeletal disuse.

Conclusion

The prevention of osteoporosis is usually both economically and physically feasible for most people, but education of the public is important. Exercise should begin in childhood, and calcium should be part of everyone's diet in order to prevent osteoporosis. The goal should be to accrue as much bone mass as possible before skeletal maturity is reached.

Women between ages 30 and 50 may benefit from brisk walking, jogging, dancing or any vigorous, aerobic activity. In a study done with young postmenopausal women (mean age 53), bone width and strength both increased in a walking group and in an aerobic dance group.

The value and necessity of regular, moderate activity in the prevention and management of osteoporosis continues to be documented. Copies of Melpomene Institute's bibliography and brochure on osteoporosis can be obtained by sending one dollar to cover costs of printing and a stamped, self-addressed envelope to the Melpomene office. ○

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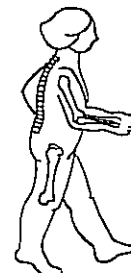
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Exercises for the Prevention and Management of Osteoporosis

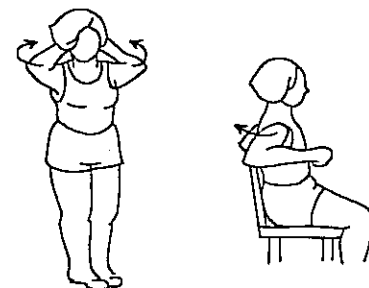
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Specific exercise is needed to strengthen common skeletal areas of osteoporotic fracture: the upper arm at the shoulder, the forearm at the wrist, the thighbone at the hip and the spine. While the spine and hip will benefit from weight-bearing activity, the upper body (arms) must be individually stressed. For these reasons, general exercise and swimming are not as beneficial for the increase of bone density. Correct posture is also essential to prevent certain types of fracture in porous bones.



Posture Correction. Sit straight and stand tall. Align your head directly over your spine. Trunk and limbs should be aligned over your base of support, which is your feet and the space in between. If you lean too far away from your base, you will become unstable and muscles may become strained. Maintain the natural curve of your low back at all times. Do not lock your knees.

Posture Improvement: Standing and Sitting. Stand tall, with hands behind head. Pinch your shoulder blades together and press palms against the back of your head. Resist the forward movement by contracting your neck muscles also. Slowly contract and hold for five seconds, while breathing normally. Release slowly. Besides improving rounded shoulders and back, these exercises may also be used to avoid or lessen pain from existing osteoporotic spinal fractures. Sitting or lying positions are better in this case. When sitting, try slowly to press elbows toward the back. Sit up straight and hold position for five seconds.



Back Lying. With your arms perpendicular to your trunk, bend elbows to 90 degrees and press them into the floor. Hold for five seconds, then relax.



Specific Exercises for the Hip and Spine should be:

1. Upright (standing);
2. Weight bearing;
3. Endurance (aerobic), such as walking or mild jogging;
4. Performed for 30 minutes, 3-4 times per week;
5. Muscle strengthening, such as isometric abdominal contraction and back extension.

Endurance Activity. Begin continuous walking with 10 minutes a day. Gradually increase to 30 minutes a day. Always warm up first and use static stretch before and after activity. Be sure to wear cushioned, low-heeled walking or jogging shoes. Legs, hip and spine benefit from working against gravity.

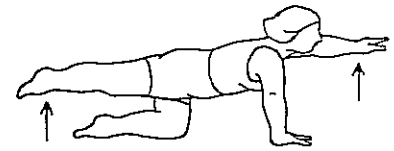


Isometric Abdominal Contraction. Lie on back and press lower back against floor and bend knees to 90 degrees. Tuck chin to chest and contract abdominal muscles. Hold position (while breathing normally) for 10 seconds. If osteoporosis is present, avoid rolling shoulders off the



floor; attempt to keep the spine straight and pressed into the floor. Strong abdominal muscles protect the back against strain. Remember: **Do not hold your breath.**

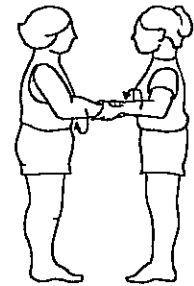
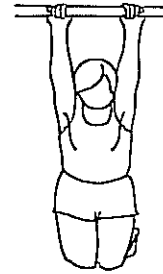
Back Extension. Begin on all fours. With back flat, lift one leg so that heel is level with the buttocks, but no higher. Contract buttocks and thigh, and hold position for 10 seconds. When your balance improves, lift opposite arm simultaneously with the straight leg. Strengthens the back, buttocks and hamstring (back of the thigh).



Specific Exercises for the Upper Body:

1. Weight-Loading: tension, torsion, compression, bending;
2. Resistance exercise with Thera-Band: improves rounded shoulders and back by strengthening supporting muscles.

Tensile Loading. Hang from a bar or pull on a doorknob for 10 seconds. Avoid this if you have a wrist, elbow or shoulder injury.

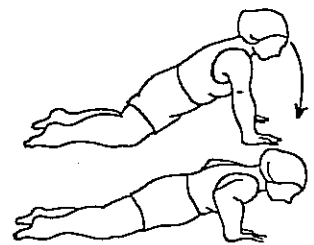


Torsion Loading. With a partner, bend elbows and grasp each other's wrists in position shown. Attempt to twist your arms in opposite directions against her resistance. Or, grasp a doorknob and twist wrist. Hold at maximum resistance for five seconds. Reverse direction.

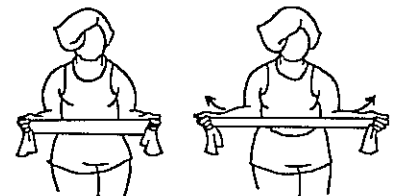
Compressive Loading: Sitting Push-Ups. With feet on floor, grasp edge of chair seat. Straighten elbows (but do not lock them) to raise yourself one-half inch off the chair. Hold your weight on your hands for 10 seconds, while breathing normally. Slowly bend elbows to lower yourself. Try hands in different positions: fingers pointing down, front or back. Bones become stronger and more dense when they must support weight and work muscles. **Avoid straining or holding your breath.** This may be difficult to do.



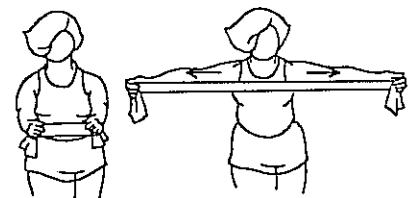
Compressive Loading/Bending. Begin on hands and knees with back flat. Contract abdominal muscles and buttocks to avoid a sagging back. Slowly bend your elbows to 90 degrees (if you can). Let your neck be a natural extension of your spine; do not hang your head. Push up by straightening your elbows. Try one arm alone, and use your fingertips. Or, place hands in different supporting positions: with arms crossed, with hands wider apart than shoulders, or "creep" hands forward and back while bending elbows. Try to keep your nose out beyond an imaginary line between your fingertips.



Resistance/External Rotation. Grasping Thera-Band, keep elbows pressed against your waist and slowly open forearms outward. Benefits shoulders and rounded back.



Resistance/Horizontal Abduction. Grasping Thera-Band, begin with arms straight out in front, about chest height. Slowly open arms to the side. Do not lock your elbows or fling arms apart. Improves rounded shoulders and back. Resistance stretch bands, such as Thera-Band, often can be purchased from the Rehabilitation/Physical Therapy department at your hospital. You will need about one yard in length. The red band is low resistance; the black is the highest resistance.



Positions to Avoid. Avoid slumping or forward bending of the spine when osteoporosis is present.