Osteoporosis is a bone disease that occurs because of a loss of minerals to the bone, causing the bone tissue to break down. This occurs in most persons as they age. After the age of 30 bone tissue is not replaced, the bone mass begins to decrease and bones become weak and thin. Osteoporosis does occur more frequently in women at a rate of about four to one. This puts an individual at increased risk for fractures (broken bones).

**How it affects individuals with SCI**

Shortly after a spinal cord injury, a person’s metabolism changes. The body begins loosing large amounts of calcium and other minerals in the urine (demineralization). This happens no matter what the person’s age, sex or weight. This rapid loss of bone minerals continues during the first 6-16 months after injury. It then levels off during the next year to year and one-half.\(^1, 2\)

When weight is not placed on bones they begin to weaken. This is sometimes referred to as disuse osteoporosis. As a result of the spinal cord injury, the person can not stand and place weight on some of his/her bones. The bones of individuals with SCI become weaker in the lower limbs (legs, knees, and hips). Their bone loss does not usually occur in their spine and arms. This is related to the fact while their lower limbs do not bear weight, they do still place weight on their spine and arms.\(^3\)

Bone mineral density (BMD) was examined in physically active individuals with SCI and able-bodied individuals. The areas measured included the upper and lower limbs, hip and spine. BMD of both the hips and legs was significantly lower in the SCI group. The surprise finding was there was no difference between the two groups in the BMD of their spines and arms.\(^4\) Another study of women with SCI looked at the bone mineral density in their spines. The BMD was maintained or increased after injury in all age groups. The women did, however, have a significant decrease in the BMD in their hips and knees.\(^5\)

Jones\(^4\) compared his results to Sabo’s\(^6\) study which did find a loss of BMD in the arms of individuals with SCI. Jones found the BMD in the arms of the individuals with SCI equaled the able-bodied group. He attributes that to the fact that the individuals with SCI in his study were all highly active individuals. Jones states that exercise is known to increases bone building in able-bodied individuals. It just has not been clearly proven in the SCI population. He does believe their use of their upper limbs for activities of daily living and sports may play a part for them as well.

There may be other factors that influence the amount of bone loss in individuals with SCI. Some studies suggest the level of injury, if the injury is a complete or incomplete, age, and the length of time since injury may be signs if an individual is at risk for osteoporosis.\(^4, 7\)

Osteoporosis is a main concern for individuals with SCI with the risk for fractures (broken bones). A fracture can be costly in terms of treatment and decreasing a person’s mobility and limiting his/her function.
The National SCI Database reported in 1995 on the number of fractures recorded by Model SCI System Centers. They showed that 14% of individuals with SCI reported fractures at 5 years; 28% at 10 years and 39% at 15 years post injury.\(^7\) A Veterans Affairs Medical Center reported in a recent research study that 34% of their male patients had a fracture after SCI.\(^8\) A recent forum presented that 25% of individuals with SCI are at risk for fractures one year after injury, and half are at risk by 10 years post injury.\(^9\) With the increased risk for fractures for individuals with SCI steps must be taken to identify and manage osteoporosis.

**Diagnosing Osteoporosis**

It is important for individuals with SCI to talk with their doctor to see what tests or evaluations can help determine their risk for fractures before they occur. First, the doctor determines if there is a need for testing after talking to the person and reviewing their medical history. Issues such as pain after range of motion, frequent stress fractures, age, use of alcohol and cigarettes all need to be evaluated. Various blood tests, urine tests, x-rays and bone density tests can determine if an individual has osteoporosis. Some doctors and/or insurance companies may want a baseline bone density test done to monitor changes over time.

The bone mineral density (BMD) is usually measured using the Dual Energy X-ray Absorptiometry (DEXA) scan. The question when testing individuals with SCI is what skeletal sites should be measure/scanned? As mentioned, the bone density at the lumbar spine in individuals with SCI does not decrease because of immobility. Studies show that the longer a person is injured, the osteoporosis effects the hip and knee negatively but the spine is positively influenced.\(^{10}\) Because the majority of bone loss in individuals with SCI occurs in the lower extremity, the knee may reflect the state of bone health and the effects of different treatments.\(^{11}\) Another research study indicates that the measurement of the femoral neck (Hip) using BMD can quantify the fracture risk in SCI patients.\(^8\)

**Prevention & Treatment**

It is difficult to totally prevent bone demineralization after spinal cord injury. We know that individuals are at higher risk for osteoporosis following SCI. However, there is no “standard of care” to treat this problem. Standard treatment methods for osteoporosis have not been widely researched for treating a person with spinal cord injury. Each individual needs to be evaluated to determine if treatment is warranted.

**Exercise**

Physical activity is recommended to preserve or increase bone mass in able-bodied individuals. Jones’ study recommends intensive exercise to help preserve bone mass of the upper limbs in spinal cord injured males. This type of exercise did not stop demineralization of the lower body.\(^{12}\)

Individuals with SCI need to be cautious when they begin an exercise program. An increase in intensive upper body exercise may cause shoulder pain. It also could cause damage to joints that the individual uses to push his/her wheelchair or do transfers. A physical therapist can recommend an exercise program.

Various activities are under study as forms of exercise to build bone strength in individuals with SCI. These include weight bearing using a standing frame or harness; treadmill training; Parastep; and functional electrical stimulation. The results on the effectiveness of these different programs are mixed. Some of drawbacks to these activities are costs, the need to be done for long periods of time, and difficulty fitting it in to an individual’s daily schedule.\(^{12}\) There is also an increased incidence of fractures if bones are already thin. There have been no well controlled studies using physiological loads to examine the effects of these methods.\(^{13}\) (For further information on some of these programs and equipment see resource links at the end of this paper).

**Extra Calcium and Vitamin D**

These need to be included in one’s daily diet to help in preventing osteoporosis. Calcium helps build strong bones and vitamin D improves the
absorption of calcium. But for individuals with SCI, high levels of calcium and Vitamin D may increase the risk of urinary stones. There are no guidelines on the risks or benefits of calcium and Vitamin D supplements for individuals with SCI. Ott suggests a supplement of 1000 mg/day will be safe and beneficial if the excretion remains less than 250 mg/day and the individuals’ parathyroid hormone levels are in mid-normal range. It may be necessary to monitor calcium levels in the urine if supplements are used.

- **Stop smoking.**

  Cigarette smoking reduces the body’s ability to absorb calcium. This in turn can speed up bone loss in all populations.

- **Limit caffeine.**

  Caffeinated drinks act as a diuretic. They speed up the removal of calcium from the body in the urine by about 10 mg per day.

- **Avoid drinking** too much alcohol.

  This is linked to bone loss as well as poor nutritional habits.

- **Medications**

  A new class of drugs, bisphosphonates, can help prevent bone loss and increase bone density by 1 to 4%. These drugs are approved for preventing and managing osteoporosis in the general population. One of these new drugs, Alendronate (Fosamax by Merck) shows positive results with postmenopausal women in increasing their bone mass.

  Recently, in a single case study, Alendronate was used with a male with SCI. He had several previous fractures of his leg and ankle. He showed improvement greater than the average improvement observed in studies with women after menopause. This single case study does encourage further study in the use of this drug with individuals with SCI.

  Hormone replacement therapy (HRT) is sometimes used with women after menopause. HRT has been shown to prevent osteoporosis in these women. This therapy has not been studied in women with SCI who have experienced menopause or an unusual cessation of their menstrual cycle. Newer HRT studies however reveal cardiovascular risks in able-bodied women if taken for long periods of time.

  - **Protect the Bones.**

    Individuals with SCI need to protect their bones. When doing range of motion exercises, limit movement to stretches that are easily done. Do not force a joint or muscle to move past what is comfortable. Check with a physical therapist for exercises specific to an individual’s needs and abilities.

    Spasticity can put some force on the bones that helps to strengthen them. However strong spasms could cause a weak bone to fracture. Be cautious when transferring. Remove feet from heel loops or toe straps on the foot rests before transferring. If a person’s balance or strength is weak, he/she needs to ask for help to avoid falling.

- **Current Research**

  A current research project at the UAB Model SCI System is “Postmenopausal Sequelae in Aging Women with Spinal Cord Injury in Comparison to Aging Men with Spinal Cord Injury and Postmenopausal, Non-Spinal Cord Injured Women”. It is looking at some changes that occur in women with SCI after menopause. These changes are then being compared to those of the other two groups (men with SCI and postmenopausal able-bodied women).

  The goal of the study is to understand how menopause effects women with SCI. This will help to recognize and treat problems early. Some interventions might include medications, diet and exercise programs, and equipment and wheelchair adaptations. This study is also looking at the need for therapies soon after injury and if they can delay or lessen the later after effects of menopause.

  Another part of the study will look at the spines and posture changes in the postmenopausal women. The results will be compared with the other two groups to learn more about bone loss and how it relates to osteoporosis. Too often current tests only confirm that individuals with SCI have bone loss. However, there is no way to predict who is at higher risk for fractures. (For more information on this project contact Amie Jackson, MD at 205-934-3330).
REFERENCES


ADDITIONAL RESOURCES

Information on the various forms of exercise listed on page 2 can be found on the web site for the Spinal Cord Injury Information Network at www.spinalcord.uab.edu

Specific web pages are:

- Functional Electrical Stimulation
  www.spinalcord.uab.edu/show.asp?durki=21653

- Standing Frames
  www.spinalcord.uab.edu/show.asp?durki=29951

- Treadmill Training
  www.spinalcord.uab.edu/show.asp?durki=29499

- Exercise
  www.spinalcord.uab.edu/show.asp?durki=21668

For additional links on Osteoporosis
  www.spinalcord.uab.edu/show.asp?durki=21570