Chapter 8: Exercise for Those with Disorders of the Skeletal System

Bone tissue

- Classified as compact or spongy bone
- Undergoes continual process of remodeling
  - Occurs because of osteoblasts and osteoclasts
  - Affected by hormones
  - Influenced by dietary intake and exercise
Structure of bone
<table>
<thead>
<tr>
<th>Hormone</th>
<th>Action</th>
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</thead>
<tbody>
<tr>
<td>Estrogen and testosterone</td>
<td>Inhibit apoptosis of osteoblasts and stimulate osteoblast activity thus increasing calcium deposition in bone; enhance apoptosis of osteoclasts and thereby inhibit osteoclast activity</td>
</tr>
<tr>
<td>Human Growth Hormone</td>
<td>Stimulates the lengthening of long bones by acting on the epiphyseal plate</td>
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<tr>
<td>Thyroxine</td>
<td>Stimulates release of additional hGH from pituitary gland, so it indirectly promotes bone lengthening. Nevertheless, since thyroxine stimulates epiphyseal plate ossification, it ultimately halts growth in length</td>
</tr>
<tr>
<td>Calcitonin and Parathyroid hormone</td>
<td>Primary function is to maintain normal blood calcium levels. Indirect effect on bone tissue. Calcitonin is released when blood calcium levels increase. Among its numerous functions, calcitonin stimulates osteoblasts. Parathyroid hormone is released when blood calcium decreases. Among its various functions, it stimulates osteoclasts and inhibits osteoblasts.</td>
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</table>
Anatomic and physiologic changes in the skeletal system

- Affects of aging on bone tissue
  - Loss of bone mass
  - Deterioration of intervertebral disks
  - Development of abnormal spinal curvatures (kyphosis)
Kyphosis
Anatomic and physiologic changes in the skeletal system (cont’d)

• Effects of aging on joints
  – Joint structure deteriorates
  – Synovial fluid production decreases
  – Tendons and ligaments lose strength and flexibility
  – Cartilage deteriorates
  – Range of motion decreases
Factors that affect flexibility of a joint

- Shape of articulating surfaces
- Stability and tension in associated ligaments
- Tension in surrounding muscles
- Joint use
**Sprains**

- Occur when soft tissues like ligaments are overstretched
- Symptoms include swelling, pain, and reduced ROM
- Minor sprains require rest, ice, compression, and elevation
- More serious sprains require medical attention
**Bursitis**

- Inflammation of the bursa sacs associated with joints
- Often results from overuse of a joint
- Responds to rest, ice, compression, and elevation
- Sometimes requires steroid injections
- Common in the shoulder, elbow, or heel of seniors
Arthritis

- Inflammation of the joints
- More than 100 forms exist
  - Osteoarthritis
  - Rheumatoid arthritis
Arthritis (cont’d)

- Osteoarthritis
  - Most common type of arthritis
  - Develops with time as joints are repeatedly used
  - Wears away articular cartilage at the ends of bones
Development of osteoarthritis
<table>
<thead>
<tr>
<th>TABLE 8-2  SYMPTOMS OF OSTEOARTHRITIS</th>
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<tbody>
<tr>
<td>■ Aching in a joint that worsens with increased activity and decreases with rest</td>
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<tr>
<td>■ Stiffness in joints for up to 30 minutes following long periods of immobility</td>
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<tr>
<td>■ Pain that occurs in waves with periods of bad pain followed by periods of relief</td>
</tr>
<tr>
<td>■ A crackling noise in the knee, particularly upon movement</td>
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<tr>
<td>■ Loss of range of motion around an affected joint</td>
</tr>
<tr>
<td>■ Affects a joint on only one side of the body (unlike rheumatoid arthritis)</td>
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<tr>
<td>Factor</td>
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<tr>
<td>-------------------------------</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Ethnicity</td>
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<tr>
<td>Obesity</td>
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<tr>
<td>Working conditions</td>
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<tr>
<td>Genetics and heredity</td>
</tr>
<tr>
<td>Anatomic abnormalities</td>
</tr>
<tr>
<td>Former joint injuries</td>
</tr>
</tbody>
</table>
Arthritis (cont’d)

- Rheumatoid arthritis
  - An autoimmune disorder
  - Develops as immune cells attack the synovial membrane
  - Symptoms come and go (active and inactive phase)
Rheumatoid arthritis
Osteoporosis

- Loss of bone mass in both compact and spongy bone
- Results in porous bones that are prone to fracture
- Leads to spinal deformities
Healthy spongy bone versus osteoporotic spongy bone
Osteoporosis with aging
**Precautions during exercise**

- Avoid high-impact activities
- Avoid explosive or twisting movements
- Be aware of balance problems
- Take note of comorbidities
- Avoid heavy weight lifting
Benefits of exercise

• Decreases rate of bone loss and increases bone mass
• Maintains and increases joint function
• Preserves and increases muscle strength
• Improves cardiorespiratory functioning
• Helps control weight
• Reduces pain from arthritis
• Improves mood
**Exercise testing for those with osteoporosis**

- Guidelines are the same as those for the general population
- For those with severe osteoporosis in the spine, use the cycle ergometer rather than the treadmill if walking causes pain
- Be aware that those with severe kyphosis might experience reduced ventilatory capacity that can hamper test results
- Avoid spinal flexion and stop exercise if pain develops
Guidelines for those at risk of developing osteoporosis

- Cardiovascular training
  - Begin with an 8- to 15-minute warmup that includes mild stretching; cool down for 8 minutes
  - Encourage weight-bearing activities such as walking, tennis, stair climbing, etc. on 3–5 days per week for 30–60 minutes each
Guidelines for those at risk of developing osteoporosis (cont’d)

- Resistance training
  - Encourage resistance training on 2–3 days per week
  - If intensity is moderate (60–80% of 1 RM), perform 8–12 repetitions
  - If intensity is high (80–90% of 1 RM), perform 5–6 repetitions
  - Use weight machines, bands, or calisthenics (free weights are riskier because they require balance)
Guidelines for those diagnosed with osteoporosis

• Cardiovascular training
  - Begin with an 8- to 15-minute warmup that includes mild stretching; cool down for 8 minutes
  - Encourage weight-bearing activities such as walking or stair climbing on 3–5 days per week for 30–60 minutes each
Guidelines for those diagnosed with osteoporosis (cont’d)

- Resistance training
  - Encourage resistance training on 2–3 days per week
  - Intensity should be moderate (60–80% of 1 RM) for 8–12 repetitions; increase load as tolerated
  - Use weight machines, bands, or calisthenics (free weights are riskier because they require balance)
Guidelines for those diagnosed with osteoporosis (cont’d)

- Flexibility training
  - Preserves joint functioning
  - Perform stretching exercises as prescribed for the general population
  - Be gentle and slow and avoid spinal flexion
Guidelines for those diagnosed with osteoporosis (cont’d)

- Overall, encourage functional activities (chair sit-and-stand, actual stair climbing, and balance activities) to improve activities of daily living
- Perform functional activities 2–5 days per week
- Avoid jumping, jogging, rowing machines, sit-ups, golfing, bowling, and certain yoga positions because of weak bones and increased risk of fracture
Sample exercises for osteoporosis

- Lateral pull-down using elastic tubing
- Back extension on a mat
- Shoulder press using elastic tubing
- Biceps curls using light dumbbells
- Triceps extensions using cables
Exercise testing for those with arthritis

- Ensure proper warmup before testing
- Do not test during acute inflammation
- Be prepared to modify or stop testing if pain or fatigue develops
- Treadmill testing is fine for those who can tolerate it
- Cycle ergometer is usually less painful
- Some sufferers tolerate 1 RM testing, but they might be limited by pain in affected joints
Guidelines for those with arthritis

- Avoid exercise during flare-ups
- Ask about medication use; some nonsteroidal anti-inflammatory drugs promote anemia
- Begin each session with a 5- to 10-minute warmup and follow with a 5- to 10-minute cool down
- Ease into exercise and progress slowly
- Pay attention to joint alignment
- Perform flexibility exercise first, resistance training second, and cardiovascular activity third
Guidelines for those with arthritis (cont’d)

- Flexibility training
  - Perform daily
  - Use a pain-free range of motion and perform static stretch of all muscle groups
  - Hold each stretch for 15–60 seconds
  - Repeat 4 times
  - Avoid overstretching
Guidelines for those with arthritis (cont’d)

• Resistance training
  - Perform 2–3 days per week
  - Include resistance machines, elastic bands or tubing, isometric exercises, or free weights
  - Initially use resistance equal to 10% of 1 RM and progress at a maximum of 10% per week as tolerated
  - Complete one or more sets of 10–15 repetitions/set
Guidelines for those with arthritis (cont’d)

• Cardiovascular training
  - Encourage walking, water exercise, or cycling in 5- to 10-minute bouts to accumulate 20–30 minutes of activity on 3–5 days per week
  - Gradually increase duration of bouts by 5-minute increments until 30 minutes is reached
  - Avoid high-impact activities, rapid changes in direction, and excessive repetitions
Guidelines for those with arthritis (cont’d)

• General guidelines
  - Include daily activities that focus on functional capacity
  - Cross-train to avoid overstretching joints
  - Avoid walking at high speeds
  - Allow 48 hours in between training sessions
  - Choose shoes that absorb shock
Sample exercises for arthritis

- Stretching exercises are the most important for preserving joint functioning
- Traditional resistance exercises and cardiovascular training are appropriate if the guidelines mentioned earlier are followed
Sample flexibility exercises for arthritis

- Gluteal wall stretch
- Outer thigh stretch
- Hamstring stretch using elastic band
- Chest, shoulder, and biceps stretch
- Triceps stretch
- Back stretch
Nutritional considerations

- Arthritis
  - Little evidence confirms a relationship between diet and the development or management of arthritis
  - A balanced, varied diet—which is appropriate for the general population—is best for this population
  - Most research has focused on the effects of diet on rheumatoid arthritis
**Nutritional considerations (cont’d)**

- Diet and rheumatoid arthritis
  - Balance energy intake with energy output
  - Include plenty of fruits, vegetables, and whole grains, which have antioxidants that help fight inflammation
  - Choose low-fat, low-saturated-fat, and low-cholesterol products to maintain healthy blood lipids; omega-3 fats might be therapeutic
  - Consume moderate amounts of sugar
  - Drink alcohol in moderation, if at all
Nutritional considerations (cont’d)

• Osteoporosis
  – Calcium and vitamin D
  – Potassium and magnesium
  – Vitamin C
  – Sodium
  – Proteins, carbohydrates, and fats
Additional considerations

- Smoking and bone tissue
- Alcohol intake and bone tissue
- Use of supplements and bone tissue
<table>
<thead>
<tr>
<th>TABLE 8-9  TIPS FOR INCREASING DIETARY INTAKE OF VITAMIN D</th>
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<tbody>
<tr>
<td>■ Consume various fruits, vegetables, and whole grains for overall health</td>
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<tr>
<td>■ Include vitamin D-fortified cereals in the diet</td>
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<tr>
<td>■ Consume vitamin D-fortified fat-free or low-fat milk</td>
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<tr>
<td>■ Add vitamin D-fortified yogurt and orange juice to the diet</td>
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<tr>
<td>■ Increase dietary intake of fish such as salmon, tuna, and mackerel; they are naturally rich in vitamin D</td>
</tr>
<tr>
<td>■ Include an occasional serving of liver or eggs in the diet; they naturally have small amounts of vitamin D</td>
</tr>
<tr>
<td>■ Use a vitamin D-fortified margarine instead of butter</td>
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</tbody>
</table>

*Source: National Institutes of Health. www.nih.gov*