The bone clinic

Exercise recommendations for osteoporosis

A position statement of the Australian and New Zealand Bone and Mineral Society

BACKGROUND Individuals diagnosed with osteoporosis have a high risk of skeletal injury. Regular physical activity may contribute to preventing osteoporosis, but the efficacy of exercise intervention once the disease is established has not been rigorously investigated.

OBJECTIVE To provide recommendations focusing specifically on exercise goals for osteoporosis, taking into account evidence for maximisation and maintenance of bone strength and minimisation of trauma, and to identify the levels of evidence that support this.

DISCUSSION The primary benefit of exercise for adult bones is conservation, not acquisition. In elderly individuals, improved fitness and muscle strength contribute to the prevention of falls and a lower risk of fracture. Physical activity may also reduce the rate of bone loss. Exercise goals for osteoporosis should include pain reduction, increased mobility and improvements in muscle endurance, balance and stability. These are worthwhile end points because not only may they prevent falls but they may improve the quality of life. In conjunction with advice to increase dietary calcium, exercise plays a significant part in a lifestyle prescription for reducing fractures in later life. In postmenopausal women, although less effective than oestrogen for maintaining bone mineral density, exercise should be regarded as part of an overall treatment strategy.

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An optimal model for prevention of osteoporotic fractures includes maximising and maintaining bone strength, and minimising trauma.[1] Regular physical activity can contribute to each of these determinants, but with different outcomes over a lifespan. Physical activity is a determinant of peak bone mass.[2,3] Sufficient exercise during childhood and adolescence, particularly the prepubertal years, is more effective for increasing bone mass and strength than exercise in adulthood.[4–9] Whether benefits achieved before puberty are sustained into adulthood remains to be determined by appropriate longitudinal studies. Conversely, the primary benefit of exercise on the bones of adults is conservation, not acquisition.[6, 9–13] In elderly individuals, exercise can reduce the rate of bone loss[14–16] and improved fitness and muscle strength contribute to prevention of falls[17–19] and a lower risk of fracture.[20–22]

Disuse results in a loss of bone mass from the skeleton.[23–25] The minimum amount of activity needed to minimise such loss is unknown. Precise prescriptions of exercise in relation to osteoporosis must await the outcome of well designed, longitudinal studies. Based on available evidence, general recommendations for physical activity can be made according to the goal of the activity program and the fracture risk of the individual. For example, asymptomatic individuals with normal bone mineral density (BMD) have a low risk of fracture and could be directed to more vigorous exercise to help maintain bone mass. Patients with osteoporosis and/or a history of a traumatic fracture are at high risk. There is no evidence that vigorous weight bearing exercise will correct this condition, and it could theoretically cause more fractures.[26,27] In this group, modified physical activity will be necessary with a primary focus on minimising trauma, rather than building bone mass.

Figure 1. With minimal equipment, rhomboids and lower trapezius muscles can be exercised in a range of positions for improving posture. In this example the patient sits in a doorway with arms positioned as shown. While moving forwards gently, a stretch of the anterior shoulder and chest muscles is achieved. The patient is also encouraged to activate the rhomboid and trapezius muscles by pulling their arms a small distance off the wall and pulling their scapula down and inwards. After instruction on technique, such exercises can be continued at home.

Figure 2. Simple devices such as theratube can also be used at the clinic or at home to build muscle strength and endurance in postural muscles. As shown, postural education should be included with instructions for performing the exercise.

Exercise and osteoporosis

Primary goals should focus on:

- improved fitness
- muscle strength
- posture.

Physical inactivity, postural instability and muscle weakness are independent contributors to the risk of fracture.[20,28] *(Table 1)* Among older community dwelling women, greater physical activity is associated with a lower risk for hip fractures.[20–22] Moreover, improvements in muscular strength and endurance, balance and stability, reaction and movement time decrease the predisposition to fall.[17–19, 28–31] A combination of aerobic and resistance (strength training) exercises provides a balanced program which is safe.[32] *(Figures 1–4)*. Activities such as walking, tai chi, dance routines or exercise tapes for 20–30 minutes, 2–3 times per week can improve fitness, muscle strength and balance.[29,31,33,34] Free weights attached to the limbs, or rubber tubes attached to a secure object can be used for muscle training *(Figures 2, 4)*. For strength training, a single set program of 8–10 exercises, performed a minimum of two times per week is recommended over multiple set programs because it is less time consuming, more efficient and produces most of the health and fitness benefits.[12,35,36]

Targeted exercise programs have a greater impact than general programs for preventing falls[17,18] and they can significantly improve the quality of life and level of daily function.[37] To this end, postural exercises to increase back extensor strength, to correct forward head postures, and maintain and improve shoulder range of motion and trunk stability should be considered on an individual basis.[34,37] Individuals who are frail, severely kyphotic, or suffer from pain or poor balance may benefit from water exercise (hydrotherapy) or home based activities of low intensity *(Figure 4b)*.[31] Due to increased skeletal fragility, exercises should be chosen to avoid adverse events. Patients with a diagnosis of osteoporosis

Table 1. Exercise goals for osteoporosis

- Muscle strength and endurance
- Balance and stability
- Mobility and quality of life
- Prevention of falls

Table 2. Exercises to avoid in osteoporosis

- Dynamic abdominal exercises (eg. situps)
- Twisting movements (eg. golf swing)
- Trunk flexion
- Abrupt or explosive loading
- High impact loading

Table 3. Exercise for bone maintenance in adults

Aims

- Maintain muscle strength and fitness
- Maintain balance, stability and coordination
- Maintain bone mass

Methods

- Include upper, lower limb and trunk (site specificity)
- Maintain regular exercise or physical activity (benefits are lost if training is discontinued)
- Exercise 2–3 times per week for:
  - 15–60 minutes (aerobic) and/or
  - a single set of 8–10 exercises (strength training)
- Exercise at 70–80% functional capacity or maximum strength (exercise intensity)
- Perform weight bearing activities and strength training for aerobic conditioning, muscle strength and bone mass. Include exercises for balance, flexibility and coordination

Figure 3. Abdominal muscle strength and trunk stability are essential for good posture and can be progressively developed. Here, the patient lifts one leg while maintaining pelvic tilt and trunk stability. Dynamic exercises for the abdominal muscles should be avoided in patients with osteoporosis.

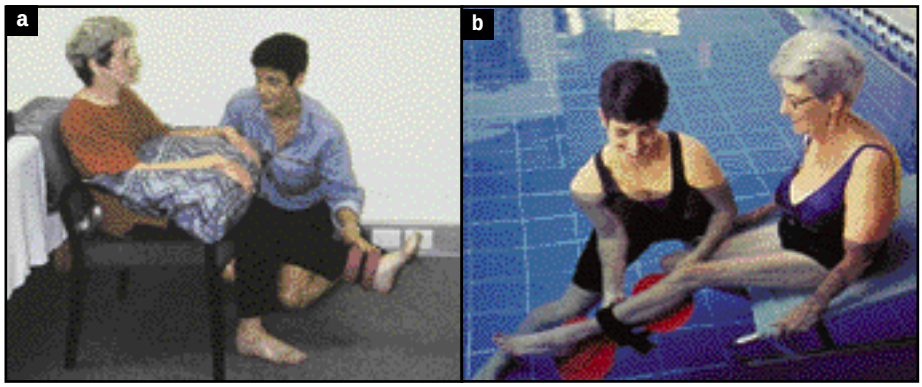

Figure 4. Quadriceps strength is an independent contributor to the risk of fracture in men and women. (a) Muscle strength can be progressively increased with simple knee extension exercises with small weights attached to the ankle. In this exercise, the pillow helps to prevent forward slumping by supporting the elbows during the exercise. (b) Individuals who are frail, severely kyphotic or suffer from pain or poor balance may benefit from water exercise (hydrotherapy). Paddles of different sizes are used to alter the amount of resistance.

should avoid dynamic abdominal exercises (trunk flexion) and exercise that requires twisting, explosive, or staccato movements. [27] *(Table 2, Figure 3)*

Exercise to maximise or maintain bone mass

In healthy adults, vigorous exercise programs and resistance training of moderate to high intensity can preserve bone density[10,16] or result in modest (1–3%) increases in bone mineral content at clinically relevant sites.[5,11–13,15,36,38] The positive effects of physical activity are site specific[4,7,39] and may also depend on moderate to high calcium intakes (>1000 mg/day)[40,41] but this is yet to be proven in randomised controlled clinical trials. Weight bearing physical activity is important for maintenance of bone mass[6,9,42] and activities that increase muscle strength are also safe and beneficial, particularly for bones of the upper limb.[12,36,39] An optimal exercise program should include activities for increasing strength, balance, flexibility and coordination of the upper and lower limbs and trunk.[32]

To influence BMD, physical activities of sufficient intensity undertaken two or three times per week may be sufficient frequency.[8,12,36] Training intensities between 70–80% of functional capacity, or maximum strength[5,12,16,36,38] can preserve bone density, but it remains to be determined whether these are optimal for influencing BMD. Low intensity exercise such as walking has minimal effect on BMD.[40] In adults, any skeletal benefit accrued from an exercise program will not be sustained if an individual returns to a sedentary lifestyle.[6,38]

Levels of evidence

A large volume of literature exists with respect to skeletal adaptations to exercise. Evidence for the statements made in this article were graded according to the NH&MRC system for assessing the level of evidence[44] and studies were included on this basis.

- Level 1 evidence is a systematic review of all randomised, controlled trials, and represents the gold standard: references 5, 7, 10, 11, 12, 13, 14, 36, 39.
- Level 2 evidence is obtained from at least one properly randomised trial: references 17, 26, 37.
- Level 3 is obtained from well designed trials without randomisation, or from well designed cohort or case control studies: references 3, 4, 8, 15, 16, 18, 19, 20 21, 22, 25, 28, 30, 31, 38, 40, 42.
- Level 4 represents the opinions of respected authorities based on clinical experience, descriptive studies or reports of expert communities: references 32, 33, 35, 43.

Conclusion

In conjunction with advice to increase dietary calcium, exercise plays a significant part of a lifestyle prescription for reducing fractures in later life. In postmenopausal women, it is less effective than oestrogen for maintaining BMD[14,43] and should be regarded as part of an overall treatment strategy.

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SUMMARY OF IMPORTANT POINTS

- Exercise for improving bone mass in normal adults may not be appropriate for individuals with osteoporosis.
- Primary exercise goals for osteoporosis should focus on preventing falls via improved fitness, muscle strength, posture, balance and stability.
- Targeted exercise programs have a greater impact than general programs for preventing falls.
- Frail individuals with poor posture, pain, poor balance and mobility or other comorbidities may benefit from water exercise.

REPRINT REQUESTS

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