Exploring the Anatomy and Physiology of Ageing

Part 10 – Muscles and Bone

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This article explores the major changes that occur to muscle and bone as a result of normal ageing.

The skeletal muscles function primarily to facilitate conscious movement of the body. Additionally, contraction of the major muscle groups aids venous return of blood to the heart and generates substantial amounts of heat to help maintain body temperature.

The skeletal system provides support, protects vulnerable regions and allows physical movement via a system of levers and articular joints. The bones also function as storage areas for fat, act as mineral reservoirs and house the red bone marrow responsible for blood-cell production.

With age, the musculoskeletal components undergo progressive degeneration.

Age-related changes in muscle

Sarcopenia (atrophy and loss of mass)

Skeletal muscles atrophy and decrease in mass with age (Fig 1). This is known as sarcopenia and is reflected by a gradual decrease in body strength.

Maximal muscle mass and strength is usually achieved in the 20s and 30s and gradually declines into middle age. At around the age of 60, loss of muscle tissue accelerates, often leading to progressive weakness (Spirduso, 1995). In late old age, loss of muscle tissue from the limbs may be so prominent that they appear stick-like and little more than skin and bone.

Similarly, atrophy of the intercostal muscles leads to the development of deep furrows between the ribs, while loss of facial muscle tissue deprives the skin of underlying support and contributes to the loosening and sagging of the features.

The prominent loss of muscle tissue usually seen in later years is commonly referred to as senile sarcopenia.

Loss of strength in older people appears to be directly attributable to physiological and histological changes within the skeletal muscles (Fremont and Hoyland, 2007). These changes are outlined below.

Anatomical and physiological changes in aged muscle tissue include:

- Reduction in the number of muscle fibres;
- Reduction in muscle fibre size;
- Progressive replacement of active muscle fibres by collagen-rich non-contractile fibrous tissue;
- Increased deposition of fat at the expense of lean muscle tissue;
- Accumulation of lipofuscin (an age-related pigment);
- Mitochondria within muscle fibres becoming less efficient at releasing energy during metabolism;
- Reduction in blood flow to the major muscle groups;
- Reduction in motor neuron numbers.

Sarcopenia is aggravated in older people because of the reduced levels of circulating anabolic hormones, such as somatotropin and testosterone, which are usually in decline from middle age onwards (see articles on ageing of the endocrine and reproductive systems, parts 7 and 8).

As skeletal muscles are metabolically very active, sarcopenia is a major factor contributing to the age-related reduction in the metabolic rate. If calorific intake remains at the same level as in younger years, there is a much greater chance that the excess calories not utilised by lean muscle will be stored in the form of fat.

Skeletal muscles play a major role in supporting the body. Loss of muscle mass leads to a progressive reduction in the level of support afforded to the skeleton and contributes to the gradual changes in posture observed with age (Fig 2). The weakness that accompanies sarcopenia increases the chances of falls and fractures.

Age-related changes in bone

Maximal bone mass and density is usually attained between the ages of 25 and 30 and gradually decreases thereafter (Montague et al, 2005). The decalcification of bone...
Accelerates in middle age, particularly in women who are postmenopausal. Many factors are known to contribute to bone loss, including:

- Reduction in the levels of oestrogen in women and testosterone in men;
- Reduction in the levels of somatotropin (growth hormone);
- Reduction in calcium and vitamin D absorption;
- Slight increases in the levels of parathyroid hormone.

Loss of bone mass is exacerbated by the reduced activity levels often seen in older people. Bone-forming cells (osteoblasts) will only continue to deposit calcium efficiently when bones are put under the stress of weight-bearing exercise. However, the bone-digesting cells (osteoclasts) break down bone continually at a fairly uniform rate and therefore, in sedentary people, it is common for bone decalcification to become rapid.

Age-related loss of skeletal muscle mass also results in less load (both weight and contractile force) being exerted on the bones, which further contributes to bone decalcification.

The loss of calcium from the aged skeleton commonly leads to the bones taking on the porous sponge-like appearance indicative of osteoporosis. The vertebrae of the spine are particularly vulnerable and may become compressed and deformed, leading to the characteristic stooping curvature of the spine often seen in old age (Fig 2).

Decalcification may lead to bone-thinning, particularly in the flat bones. This is often apparent in the scapulae (shoulder blades) which, on examination, may have a threadbare ‘moth-eaten’ appearance. Demineralisation may be so profound that holes appear in these once solid sheets of bone.

Decreases in bone density are associated with an increased risk of fracture. Older women commonly show prominent loss of bone from the femoral neck, which may fracture when it becomes too thin to be able to support the weight of the body.

**Joint changes**

The cartilages within articular (synovial) joints play an important role as shock absorbers, as well as ensuring the correct spacing and separation of bones.

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**REFERENCES**


