Module 2 : Anatomy – The Skeleton

In this module you will learn:

- The functions of the skeletal system
- The types of bones in the human body
- The effects of exercise on your bones
- What happens to the bones as we get older

When studying to become a fitness instructor/personal trainer, you will learn all about the anatomy of the human body.

Studying the skeleton is one of the foundations of your trade, you will need to know how the body is structured, the names of each bone, types of bones, importance of bone and joint health, detail of the spine and different terms of movement.

Without stating the obvious, each of your clients has their own skeleton and you must be fully aware of how this works. This is for many reasons; you are a teacher and must be fully aware of how to prevent injuries, avoid unnecessary stress on the bones and, if qualified, help the client prevent/heal bone and joint related conditions or medical problems.

2.1 Understanding the skeletal system

The skeleton is comprised of 206 different bones that provide 5 main functions:
• Support mechanism for muscle and tissue
• Protection for organs
• Movement with bones, muscles and joints
• Storing minerals and blood cells
• Growth

Skeletal System

2.2 Bones are formed by ossification
Some bones (such as the flat bones of your skull) in the body are formed in a similar stage to connective tissue.

The process is known as direct or intramembranous ossification.

Other bones are made up of cartilaginous matter, this is developed from future bone in the embryo which then dissolves and is replaced with other bone cells. This process is referred to as indirect ossification.

2.3 Skeletal support

Your bones and cartilage are the most solid materials in the human body, the 206 bones provide a frame for the soft tissues and organs in your body.

The five types of bones are long (femur), short (tarsal bones), flat (front bone of skull), irregular (vertebrae) and sesamoid (knee cap)

FACT
The hands and feet contain over half of the body’s bones
Source: livescience.com

2.4 Description of bone types

Long bones

Long bones function to support the weight of the body and facilitate movement.

Long bones are obviously some of the longest bones in the body, like your femur, tibia or humerus, but they also include some of the smallest, like metatarsals, metacarpals and phalanges.

The classification of a long bone means it has a body longer than its width, with growth plates formed at either end of a hard outer surface of compact bone.

They also have a sponge-like inner known as the cancellous bone that stores bone marrow.
Each end of the bone will be covered with hyaline cartilage that aids against shock absorption.

**Short bones**

Short bones are mostly as wide as they are long, their primary function is to give support and stability without considerable movement.

Carpals and tarsals are small bones (wrist and foot bones). Small bones usually consist of a thin layer of hard, compact bone that has cancellous bone on the inside parts, containing a substantial amount of bone marrow.

**Flat bones**

Strong flat plates of bone that provide protection to the vital organs. They also act as a base for muscle attachment.

An example of a flat bone is your shoulder blade, breast bone, and skull. Other examples of flat bones are pelvis and ribs. Anterior and posterior surfaces of compact bone give strength and support for the centre, which contains cancellous bone and bone marrow. When we reach adulthood, flat bones have the highest number of red blood cells.

**Irregular Bones**

Irregular bones do not match other categories and have irregular shapes. Examples of this are the mandibles, vertebrae and sacrum. They are usually made of cancellous bones with an outer layer of compact bone.

**Sesamoid bones**

Similar to irregular shaped bones and attached to tendons. The most commonly referred to example is your knee cap (patella). Other examples of sesamoid bones are the smallest of the carpals, pisiform, and your 2 smallest bones located at the base of the metatarsals. Sesamoid bones are usually found in tendons at the part that passes over a joint.
2.5 Protecting vital organs

The bone structure is aptly designed to protect your vital organs from unwanted damage.

Your skull protects your brain, the vertebrae protects your spinal cord and the thoracic cage protects your heart and lungs.

2.6 The anatomy of the spine

The spine is made up of 5 different areas and includes 33 vertebrae.

- Cervical spine forms the neck with 7 vertebrae
- Thoracic spine has 12 vertebrae attached to the ribs
- Lumbar spine has 5 vertebrae attached to lower back
- Sacrum consists of 5 conjoining bones
- The coccyx is made of 4 small bones, also referred to as the tailbone

What are Intervertebral Discs?

Each vertebrae of the spine is separated by intervertebral discs or flexible cartilage discs.

This allows for movement in the spine, supporting the area with a shock-absorbent, cushioning effect.
2.7 Mobility

Bones mimic levers when we move and provide us with solid structures that our muscles are attached to.

Joints create movement between bones and different ranges of motion. Joints are divided into three main categories which are — fixed fibrous cells (like the skull), cartilaginous (partially movable) and the synovial (freely movable) joint.

Freely moving joints are also divided into four main groups which are — the ball and socket (hip joint), hinge (elbows), pivotal (radius), and gliding (carpal joint in the wrist).

FACT

Every bone in your body is connected to another — except one. The hyoid bone located between the chin and thyroid cartilage
is not connected to any other bone.

Source: Livescience.com

2.8 Understanding the components of a synovial joint

Fibrous capsules surround the joints and strengthen ligaments. The stability of each joint is determined by the form of articulating surfaces and surrounding muscles and ligaments.

An example of this is the knee joint which is supported by 2 collateral and 2 cruciate ligaments. All joints are protected but some are more vulnerable than others, the hardest one to dislocate is the hip joint. The hip is well placed and protected, forming with the head of the femur and fitting neatly into the socket of the pelvis.

What is hyaline cartilage?

This protects and covers the end of bones when they meet a joint connection, thus allowing comfortable range of motion and movement. Hyaline cartilage is a hard but smooth material that does not have regenerative healing properties.

Tendons connect muscle fibres to bones, they are more elastic than ligaments and have greater tensile strength than muscles do.

Synovial membranes line the joint cavity walls, covering tendons and ligaments that pass through the area. The synovial membrane also produces synovial fluid that acts as a lubricant for joints.
2.9 The effects of exercise on your skeletal system

The condition of the bones can be improved by exercising and responding to mechanical stress.

Mechanical stress is usually formed by the resistance of skeletal muscle contracting at the joints, where the muscles pull at their point of insertion. From this process, mineral salts are deposited and more collagen fibres produced.

Both size and density of bones in the targeted areas can be increased, the changes in bone structure are stimulated by higher loads on the skeletal system, this process has been observed in greater bone mass or density in weight lifters than endurance athletes. Another example of this is tennis players who have greater bone density in their racket arm than the other.

Also, after legs suffer injuries and are placed in plaster due to breakage or fracturing, bones often lose calcium from the lack of resistance and mechanical stresses.

2.10 Benefits exist but approach with caution

It is beneficial to use exercise to support and maintain a healthy bone structure, but as a fitness instructor, one must be vigilant when dealing with children as their bones and muscles are still developing.
A child under the age of 16 should not be involved in sports or exercise that place high levels of mechanical stress on the body; immature or undeveloped bones are still weak and vulnerable.

2.11 Combat the ageing process

Bones go through two main changes as we get older.

Bones start to lose calcium and can cause conditions like osteoporosis. Also, as we get older the body produces less proteins, thus altering the genetic make-up of bones, creating problems like brittle bone disease.

You will most likely be working with clients from all age groups and backgrounds, so do all the research you can to fully understand your clients, as their health, safety and satisfaction is your main goal.

Module Summary

Lessons learned

- To become a fitness instructor you need to know all about the anatomy of the human body
- The skeletal system has 206 different bones that provide support, protection, movement, storage and growth
- About the different type of bones and their functions
- About how to improve the condition of the bones

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