Mechanical characteristic of muscle, connective tissue, bone and bone connection

Mechanical characteristics

The word "mechanical" usually refers to a machine. By **definition** mechanical properties in science is: "Characteristics that indicate the elastic or inelastic behavior of a material under pressure (force) , such as bending, brittleness, elongation , hardness and tensile strength. "
The human body itself can be viewed metaphorically as a working machine. The every day activities that surrounds our life requires more energy and physics that we would ever think so. Just by taking one step we use about 200 muscles, which requires a great amount of energy. Without even thinking about it our muscles, bones, ligaments, tendons and even cells are under constant movement and cellular activity.So why is it that if we fall on the ground we don't usually break our bone, and what keeps the human body from protecting itself from the environment, and what are some basic physics behind all this anatomy?

Connective tissues

There are four main types of tissues found in our body : Epithelial , Connective, Muscle, and Nervous tissue. Connective tissue is a fibrous tissue and it is the most common type of tissue that can be found throughout our whole body. The production of connective tissue is controlled by fibroblasts which are immature fiber producing cells. Connective tissue has 3 main components: Fibers, cells and extracellular matrix.

Functions of connective tissues

Energy storage, organ protection, it provides a framework for the body , it connects body tissues to each other, and more specifically it connects epithelial tissues to muscle tissues. There are more than one type of Connective tissue : adipose tissue, cartilage, bone and blood , and not all connective tissues are fibrous (ex. adipose and blood). There are also different types of fibers: collagenous fibers, Elastic fibers and reticular fibers.
The properties of elastic fibers are important because they allow the tissues to stretch and recoil which is important for our movement. GAG's (glycosaminoglycans) are also an important type of connective tissue because it resists compression by retaining water. A good explanation to picture this, is if u have a bottle of water that it capped, when stepping on it will resist compression and obtain its original shape.

Bone

Is a rigid organ that is the framework of our body. They support our organs as well as producting red and white blood cells. Bone is a type of connective tissue. There are more tissues however that can be found within bone tissues such as edosteum , periosteum , bone marrow, cartilage, nerves and blood vessels.
There are 3 main types of bone functions: mechanical, synthetic and metabolic. We are going to focus on the ***mechanical function***. There are 4 of them : 1. Protection (protecting organs, such as skull protecting the brain , or the ribs protecting lungs) 2. Structure (bones create a frame to support our body) 3. Movement (together with ligaments , tendons, joints and skeletal muscles, movement of our body is created.) and 4. Sound transduction (bones are important in the mechanical aspect of overshadowed hearing)

Mechanical Properties
The bone has a high compressive strength = 170 MPa
However a low tensile strength = 104–121 MPa
And an even lower shear stress strength = 51.6 MPa

Bone Connection

Bone connection is ligaments that connect bones to bones. It plays an important role musculoskeletal biomechanics.

Characteristics:
Viscoelasticity
The relationship between stress and strain is not constant but depends on the time of displacement or load.
Two forms of it:
1. *Creep* is increasing deformation under constant load.
2. *Stress relaxation* - the stress will be reduced or will relax under a constant deformation.
To represent the nonlinear elastic behavior of ligaments, Weiss came up with a formula which is the strain energy function: $W = F1 (I1,I2) + F2 (\sqrt{I4}) + F3 (I1,I2,\sqrt{I4})$

Muscles

There are 3 main types of muscles: skeletal, cardiac and smooth muscles.

Mechanical Properties
Short muscle is able to shorten and generate force. This relationship is a force- velocity relationship. The amount of force that the smooth muscle can generate depends of the muscle lenght. The muscle develops greater force when its elongated (due to connective tissue structures) A muscle develops less force when it is short. (because of it constractile structures contribute little active force)

Overall there is a formula which can be useful regarding the muscles. the formula of young's modules can give us a general formula used to calculate the elasticity by dividing the tensile stress by the tensile strain which than equals to F/ A0 over deltaL/ L0.

Links

Related articles

External links

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