

The structure and functions of the musculoskeletal system



UNTAMED
EDUCATION

1.1.1 Applied anatomy and physiology

Joints

Antagonistic Pairs

Skeletal System

Isotonic Contractions

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Range of movement

Synergists

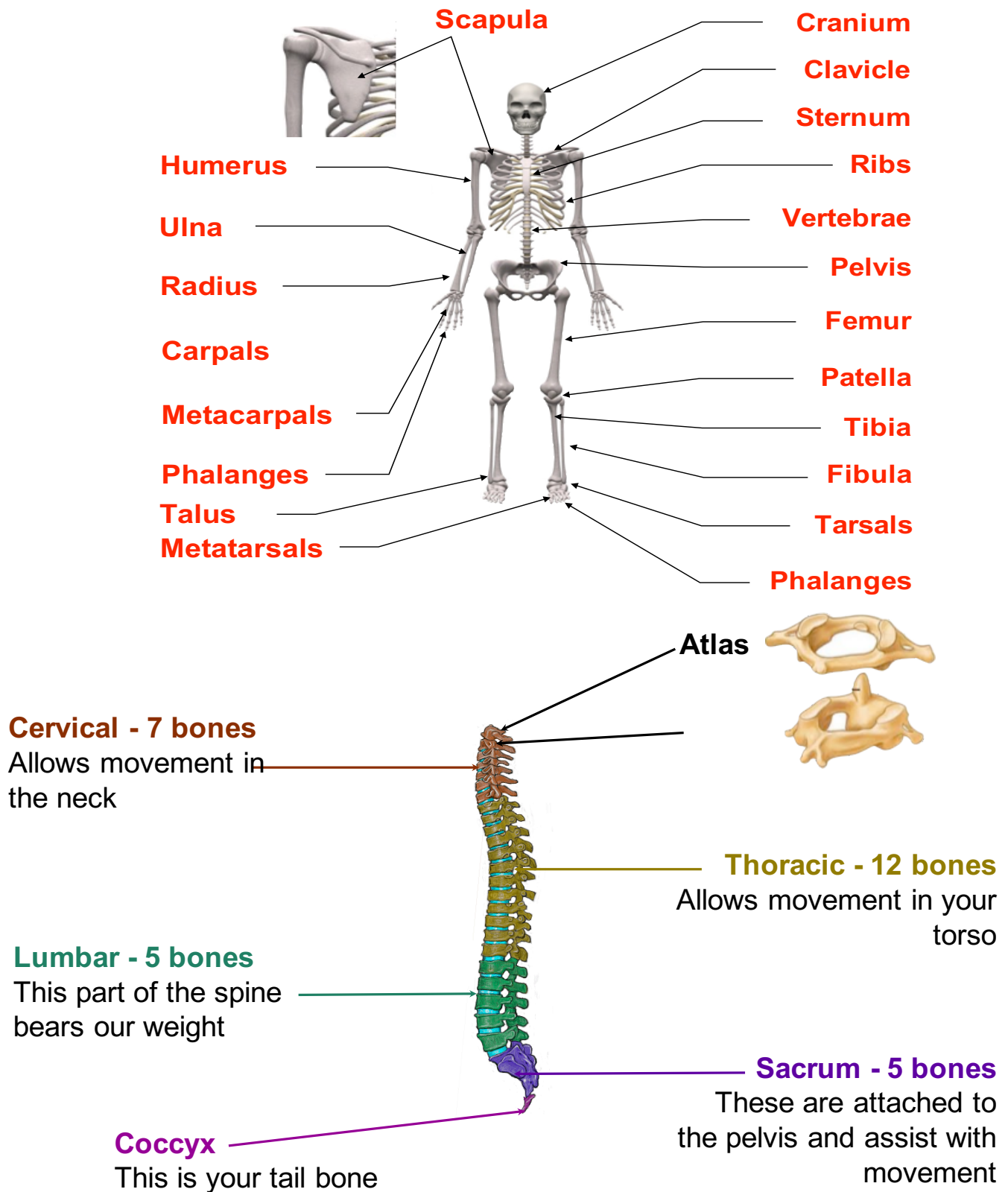
Muscular System

Isometric Contractions



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1. Skeletal system



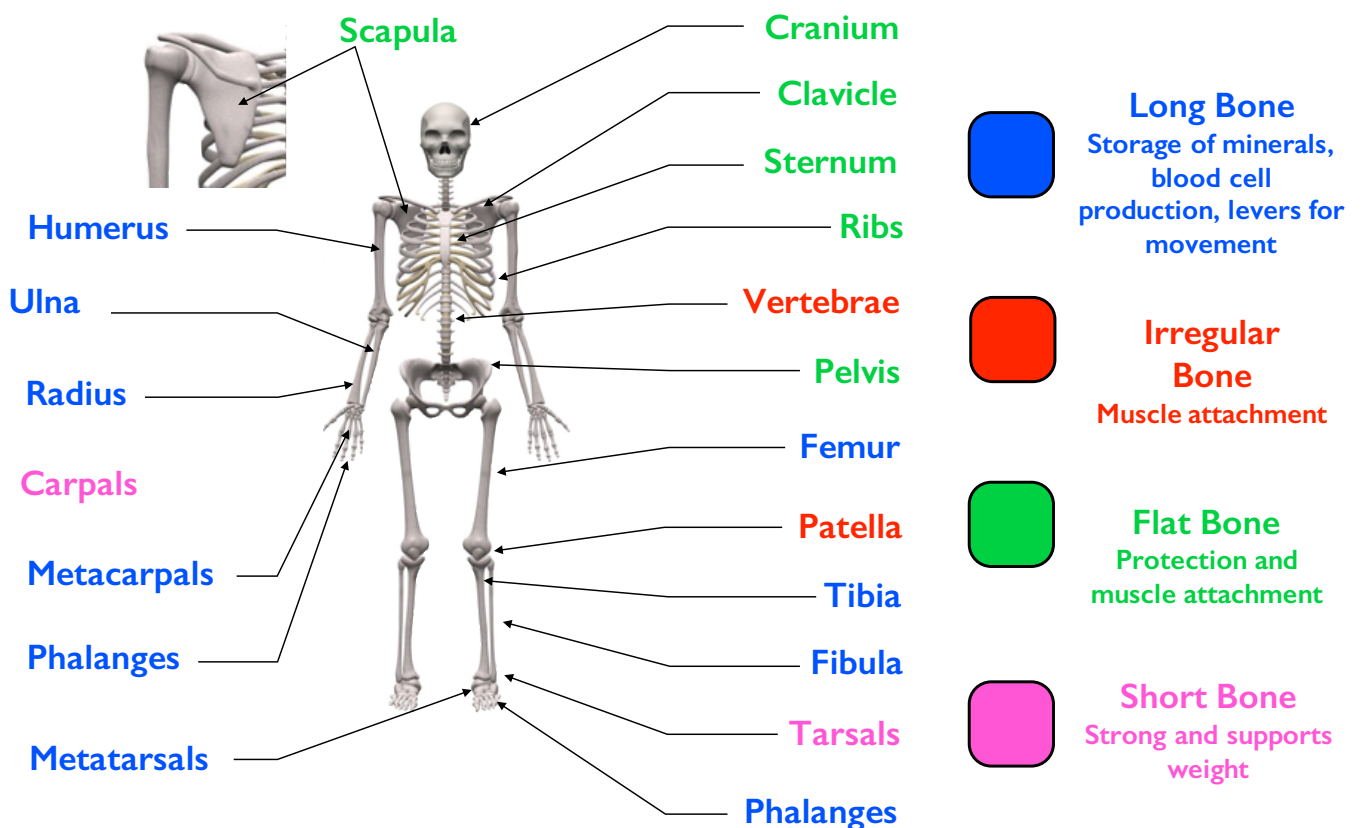
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2. Joints

The human body has **joints** where bones meet and **articulate** to create **movement**.

- ▶ **Shoulder** - scapula, clavicle, humerus.
- ▶ **Elbow** - humerus, radius, ulna.
- ▶ **Hip** - pelvis, femur
- ▶ **Knee** - femur, patella, fibula, talus
- ▶ **Ankle** - tibia, fibula, talus

3. Types of joints





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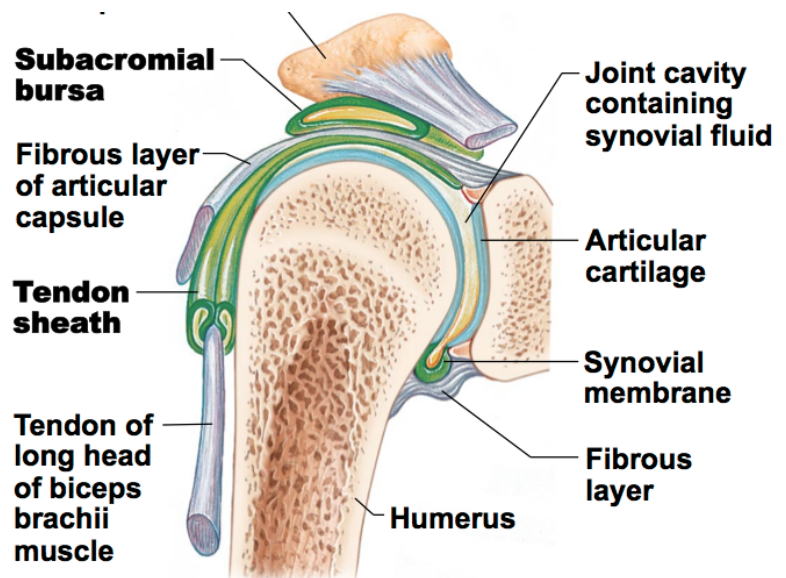
4. Functions of the skeletal system

1. **Support** - Bones are strong and are able to bear our weight. For example carpals support and weight bear in a handstand.
2. **Protection** - Bones protect our vital organs. For example the flat bones of the cranium protect the brain when heading the ball.
3. **Structural shape and points for attachment** - Muscles attach to bones so when they contract our bone becomes a lever which generates force and allows us to reach. For example when the bicep contracts it moves our radius and ulna when throwing a ball.
4. **Storage of minerals** - Our bones store calcium and phosphorus and release it when needed. This keeps the correct balance of minerals in our body for optimum sports performance.
5. **Production of blood cells** - The marrow in our bones (i.e. femur) produces vital blood cells. Red blood cells for oxygen carriage, white blood cells for fighting disease and platelets for clotting blood when we cut ourselves whilst performing.



5. Synovial Joints

- ▶ These joints **move freely**.
- ▶ There are **many parts** to the synovial joint that work together to allow smooth movement:
 - ▶ **Joint capsule** holds the joint together.
 - ▶ **Joint cavity** is the space between the two bones.
 - ▶ **Synovial fluid** fills the joint cavity and acts as a lubricant preventing friction/pain and wear and tear.





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- ▶ **Hyaline cartilage** at the ends of the bones also stops the bones from touching and the smooth material **reduces friction** preventing wear and tear of the bone. The cartilage also acts as a **shock absorber**.
- ▶ **Bursae** is a sac of liquid that floats inside the joint to **reduce friction** between the tendon and bone.
- ▶ **Ligaments** join bone to bone and **stabilise the joint**.

6. Types of joints

Ball and Socket

- ▶ Allows the largest amount of movements and are found at the **shoulder** and the **hip**.

Range of Movement
Flexion
Extension
Abduction
Adduction
Rotation
Circumduction

Hinge

- ▶ Allows two types of movement and are found at the **elbow, ankle** and the **knee**.

Range of Movement
Flexion
Extension

Pivot

- ▶ Allows only one type of movement and can be found at the **neck** as well as the **radio-ulnar joint**.

Range of Movement
Rotation

Saddle

- ▶ Also allows a **full range of movement** and can be found at the **thumb**.

Range of Movement
Rotation

Gliding

- ▶ Allows a **full range of movement** and are found between the joints in your **hand**.

Range of Movement
Rotation

Condyloid

- ▶ Allows a **full range of movement** and are found in the **ankle**.

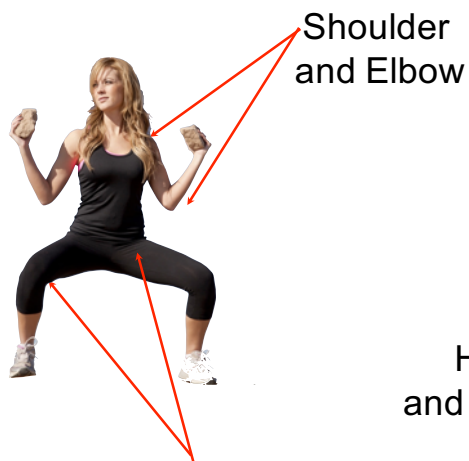
Range of Movement
Flexion
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7. Range of movement

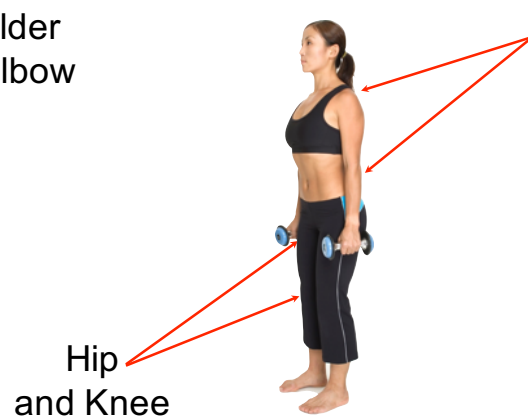
Flexion

Decrease the angle at the joint



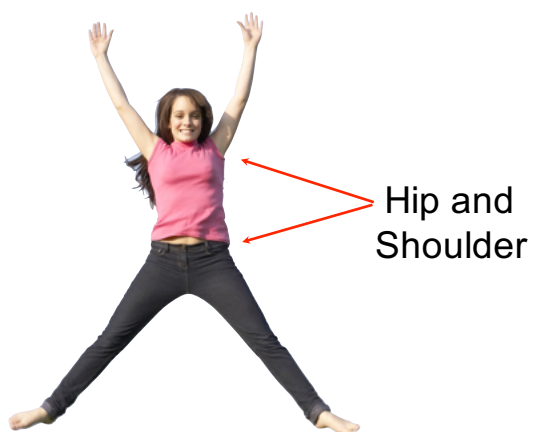
Extension

Increase the angle at the joint



Abduction

Move the limb away from the central axis



Adduction

Move the limb towards the central axis





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Rotation

Twisting movement around an axis/rotational movement



Neck

Circumduction

A combination of flexion, abduction, adduction and extension.



Shoulder

Plantar flexion

Movement at the ankle joint that points the toes



Dorsiflexion /

Movement at the ankle joint that flexes the foot upwards



9. Ligaments and tendons

Ligaments

- ▶ Connect **bone** to **bone**.
- ▶ Slightly **elastic** and **tough**.
- ▶ Restricts movement in the wrong direction preventing **dislocation**.

Tendons

- ▶ Connects **muscle** to **bone**.
- ▶ Transmits the mechanical force of the muscle to the bones, creating **movement**

10. Types of Muscle

a. Involuntary Muscle - Smooth Muscle that works **without consciousness**.

- ▶ **Arteries** - The walls of the arteries contract and push the blood along.
- ▶ **Stomach** - When the walls contract, food is squeezed through the gut

b. Cardiac Muscle

- ▶ Smooth muscle that contracts **without consciousness** and **works non-stop** without tiring.
- ▶ Found in the **walls of the heart**
- ▶ When it contracts this is your **heart beat**.
- ▶ The walls squeeze the blood along the circulatory system.

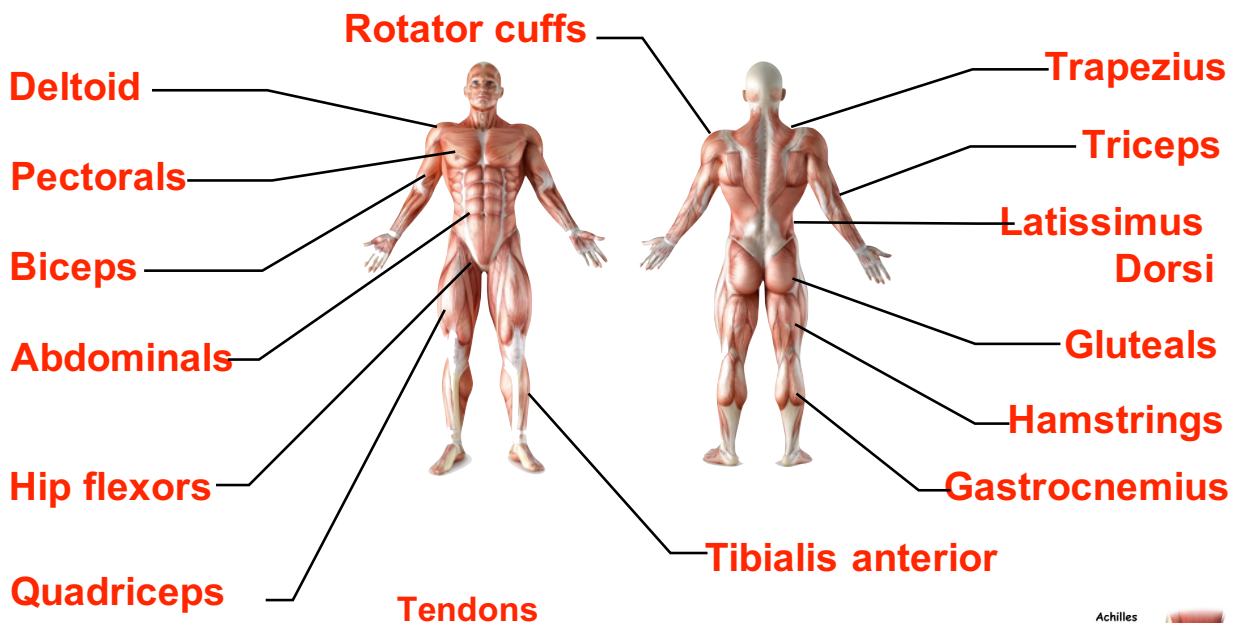
c. Voluntary Muscle

- ▶ Works under **conscious** control.
- ▶ **Skeletal muscle** attaches to bones by tendons called the origin and insertion.
- ▶ They **create movement** but they can only pull bones so they need to work in pairs.
- ▶ Voluntary muscles **tire** - so they can only work for a limited amount of time



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11. Muscular system



12. Muscle action

Muscle	Main Action
Deltoid	Flexion, extension, adduction and abduction at the shoulder
Trapezius	Rotation at the shoulder
Pectorals	Rotation and adduction at the shoulder
Biceps	Flexion at the elbow
Triceps	Extension at the elbow
Latissimus Dorsi	Adduction, extension and rotation at the shoulder
Abdominals	Flexion at the trunk
Gluteals	Rotation and extension at the hip
Quadriceps	Extension at the knee
Hamstrings	Flexion at the knee
Gastrocnemius	Extension (plantar flexion) at the ankle joint



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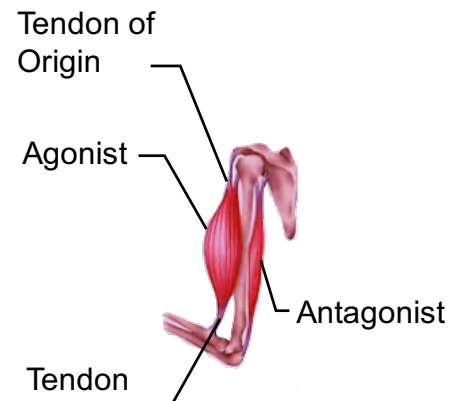
13. Antagonistic Pairs

Two good examples of **antagonistic pairs** are:

- ▶ **Hamstrings and Quadriceps**
- ▶ **Biceps and Triceps**

Muscles can **only pull** so they have to work in pairs to create movement

- ▶ When the muscle contracts it **pulls on the moveable bone** attached by the **tendon of insertion**.
- ▶ It pulls **towards the tendon of origin** on the **fixed bone**.
- ▶ The **contracting muscle** is called the **prime mover** or **agonist**.
- ▶ The other muscle in the pair **relaxes** and this is called the **antagonist**.
- ▶ During movement other muscles called **synergists** contract to **support the contraction**.



14. Types of muscle contractions

4. **Isotonic Contraction** - Muscle contraction that results in **limb movement**.

- ▶ This is the most frequent muscle contraction during **sports play**.
- ▶ When the **muscle contracts** it causes a **concentric movement**.
- ▶ When the **muscle relaxes** it causes an **eccentric movement**.
- ▶ **Training** your muscles **isotonically** improves dynamic (moving) strength, power and endurance.





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5. Isometric Contraction - Muscle contraction with **no** limb movement.

- ▶ Despite contracting the muscle length stays the **same**.
- ▶ One muscle may contract isometrically to **stabilise a movement** so others can contract isotonicly.
- ▶ Less sports require this muscle contraction but examples are **gymnastic handstand** or **rugby scrum**.
- ▶ Training isometrically provides **little improvements**.



15. Fast twitch and slow twitch muscle fibres

There are three different types of muscle fibre

Slow Twitch (Type I)	Fast Twitch (Type IIa)	Fast Twitch (Type IIx)
Contracts slowly	Contracts quickly	Contract quickly with huge force
Burns oxygen slowly	Burns oxygen quickly	Lactic acid build up is quick
Uses aerobic energy	Uses anaerobic energy	Uses anaerobic energy
Fatigues slowly	Fatigues quickly	Fatigue very quickly
Suited to endurance sports	Suited to middle distance sports	Suited to explosive sports