- Muscles

30 DAYS TO Getting Stronger

The science behind MUSCLES

Words: Dr Juliet McGrattan

Before you start working your muscles hard it's a good idea to know the science behind what's happening to them...

There is so much more to muscles than bulging biceps and rippling six packs. Medical knowledge about the roles that muscles play in the body is growing all the time. Their ability to repair and strengthen is incredible and, as well as being an engineering miracle, when it comes to moving our bodies, it's now known that muscles help to keep us healthy and prevent major medical conditions. Let's take a microscope and examine muscles in more detail to help us understand their true power.

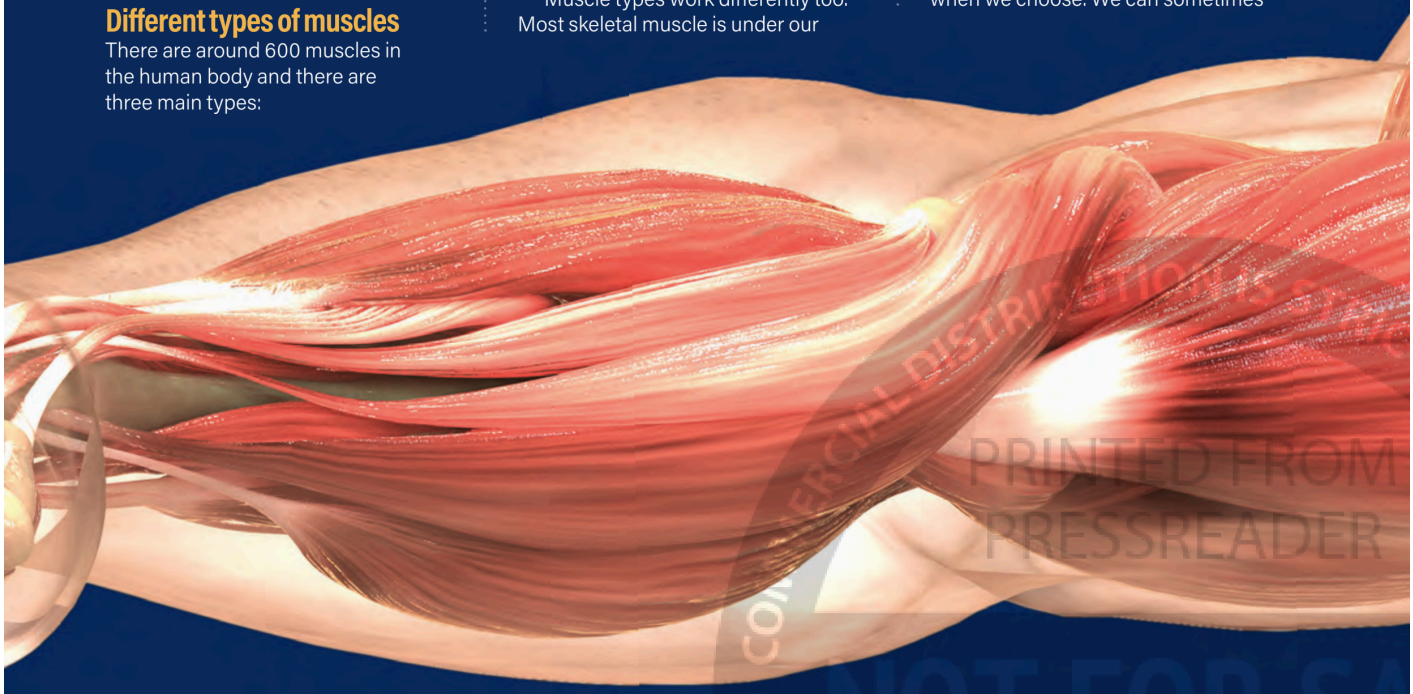
Different types of muscles

There are around 600 muscles in the human body and there are three main types:

- **Skeletal muscle:** attaches to bones and moves our body around
- **Smooth muscle:** in blood vessels and organs such as the gut and bladder
- **Cardiac muscle:** only found in the heart.

Each muscle type looks different. The cells of skeletal muscle and cardiac muscle are arranged in bundles that gives them a stripy (striated) appearance, whereas smooth muscle cells form sheets rather than bundles so they're more uniform and don't have stripes.

Muscle types work differently too. Most skeletal muscle is under our control; we can choose when to contract and relax it so we can move freely. Sometimes skeletal muscle moves as a reflex, which you'll know if you've ever had your lower leg involuntarily kick out when a doctor has checked your knee reflexes. Smooth muscle and cardiac muscle work in an involuntary way. The narrowing and widening of our blood vessels or gut wall when smooth muscle contracts and relaxes, and the pumping of our heart through the action of cardiac muscle, are not something we can stop and start when we choose. We can sometimes



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influence smooth or cardiac muscle action through our nervous system – for example, you can slow your heart rate in a tense situation through regulating your breathing.

What muscles do in the body

In addition to moving our body, muscles are involved in endless body processes, these include:

- **Hearing:** tiny striated muscles in the middle ear both transmit and dampen sound.
- **Vision:** muscles outside the eye move the eye ball and muscles inside the eye change the shape of the lens and dilate and constrict the pupil.
- **Breathing:** the diaphragm is a sheet of muscle that relaxes and contracts as you inhale and exhale. The intercostal muscles between the ribs open the rib cage when you breathe in.
- **Sexual function:** muscles in the pelvis enable erections, ejaculation and orgasm.
- **Posture and support:** muscles enable us to sit and stand without collapsing and pelvic floor muscles support the bladder, bowel and uterus that sit on top of them.
- **Digestion:** food is propelled through the gut by a wave of muscular activity called peristalsis.
- **Urination:** the bladder is a bag made of muscle called detrusor muscle. When the time is right this contracts and the pelvic floor muscles relax to let urine out.
- **Childbirth:** the smooth uterine muscle is capable of intense contractions to push a baby out.
- **Protection:** along with fatty tissue, muscles act as padding to protect internal organs.
- **Metabolism:** muscles store energy as glycogen, which can be released and broken down into glucose to fuel the body. Fat can also be stored in muscle. >



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- **Temperature control:** when muscles work they generate heat, which is why you shiver if you're cold – your body is trying to raise its temperature. Smooth muscle in blood vessels also contracts if you're cold to minimise the amount of blood losing heat near the surface of the skin.
- **General health:** muscles release hormones called myokines, which have an effect on metabolism and the immune system and communicate with the body's organs triggering the release of other hormones and chemicals.

What are muscles made of?

Skeletal muscle is made up of bundles of muscle fibres called fasicles. A large muscle such as the quadriceps or thigh muscle could have one hundred muscle fibres in each bundle. Each individual fibre contains muscle cells (myocytes) that are long and cylindrical in shape. The most powerful muscles have cells packed with mitochondria, which generate energy for the muscle. Within the muscle fibre are hundreds of myofibrils made of proteins called actin and myosin. Thin actin and thick myosin myofibrils run the length of the muscle fibre, these are important because they are what allows the muscle to contract. When a nerve impulse arrives at the muscle telling it to contract, it triggers the myosin to attach to the actin filaments and pull them along. This is called 'the sliding filament theory' and is thought to be the explanation for muscle contraction. The same theory applies to smooth muscle, but the muscle fibres are arranged in a more haphazard way rather than in bundles.

There are two main types of skeletal muscle fibre, Type 1, slow twitch and Type 2, fast twitch. The slow twitch fibres contract over a long period of time and give a muscle endurance. Fast twitch fibres are used

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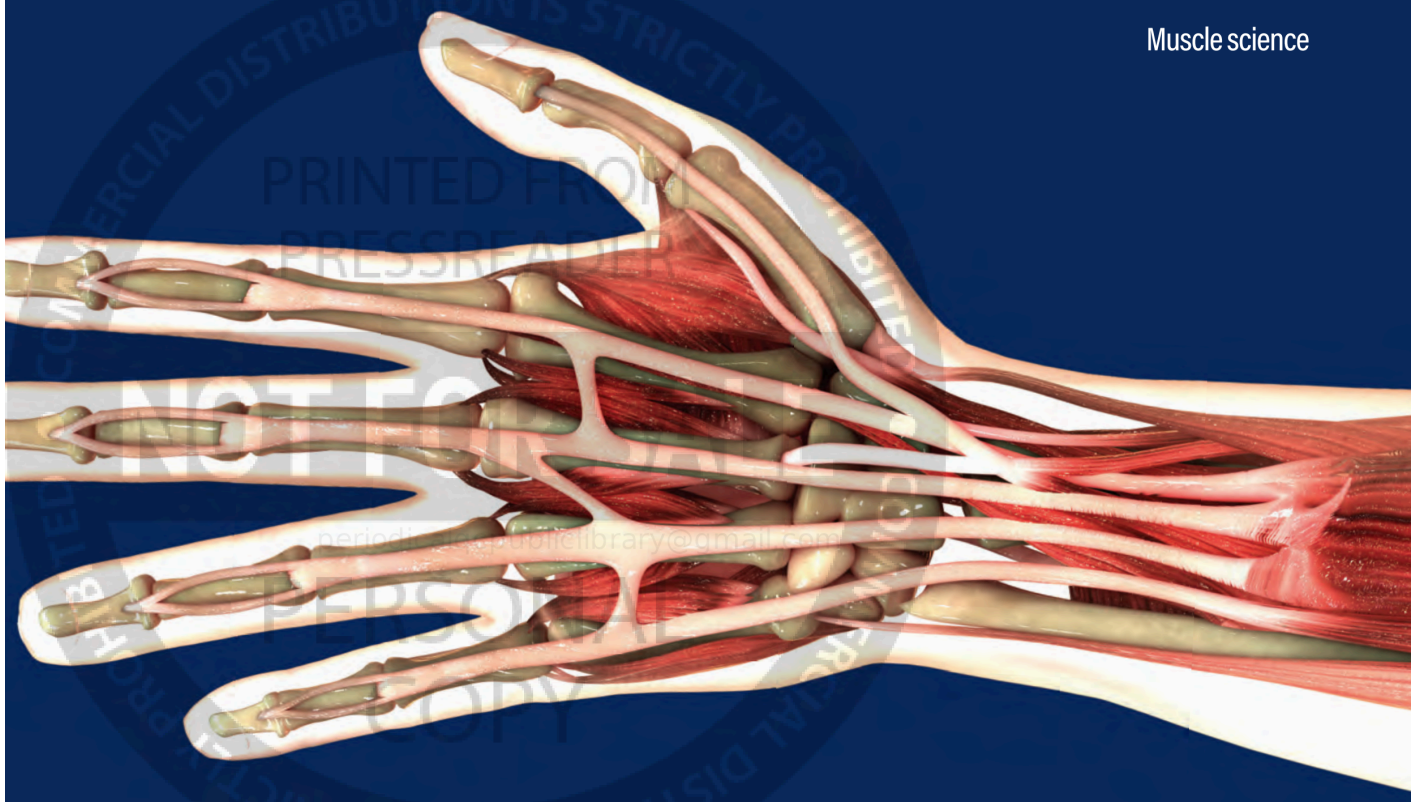

for explosiveness and power, so enable jumping and sprinting. We all have a different percentage of each, which makes us naturally more gifted at different sports, but we can train both types of fibre.

When muscles grow, it's the size and activation of the muscle fibres that increases, not the number of them, which remains the same. The fibres become wider and they contain more actin and myosin making the muscle contraction more powerful.

When muscles don't work

Muscles are strong and resilient, but sometimes things go wrong.

- **Cramp:** The pain of a muscle cramp can be intense. The muscle fibres get stuck in a contracted state and can't relax. Cramp has lots of causes, including dehydration and reduced blood supply, and is linked to medical conditions such as diabetes and thyroid disorders. Exercise induced cramp is thought to occur due to an imbalance in the contract and relax messaging coming via the nervous system.
- **Tearing a muscle:** When you use a muscle during intense exercise, you create 'micro tears' in the muscle fibres. These are normal and it's during the repair of these that the muscle gets stronger. A torn muscle happens when the fibres are damaged, either overstretched or torn completely. The muscle can still repair itself ,but longer rest is needed for this to happen.
- **Muscle weakness:** A muscle can become weak if not used for a period of time. Some people are born with under-developed muscles. Muscle weakness can also be a symptom of a medical condition, including myasthenia gravis, a stroke or multiple sclerosis. In addition to being weak, muscle action may become uncoordinated making precise movements difficult to control.

MUSCLE HEALTH

5 ways to *look after your muscles*

When you realise the complexity of muscle and the many roles it has in the body, it helps you to realise how much you need to respect your muscles and take care of them rather than take them for granted. Here are five basic things you can do to look after your muscles:

1. Eat plenty of protein-rich foods to supply the building blocks your body needs to repair and build muscle.
2. Warm up well to prevent muscle injuries and to activate the muscles before intense exercise.
3. Do specific strength workouts at least twice a week to preserve the muscles you have, maintain the nerve pathways to your muscles and to increase your muscle mass.
4. Allow enough rest for muscles to repair themselves between your workouts.
5. Don't ignore niggles and injuries, get assessed by a medical professional to ensure your muscle heals properly and get advice on when and how to return to exercise.

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