



Structure & Function of Skeletal Muscle

QUESTIONS & ANSWERS

TO REINFORCE LEARNING AND PROVIDE
FEEDBACK ON UNDER-STANDING

(23 Pages)

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A Types of muscle fibre

Task 1

Read through the following materials, answering questions in the spaces provided.

The movements that occur during sporting performance are due to the action of skeletal muscles contracting to cause the bones that make up our joints to move. Skeletal muscles consist of bundles of **fibres** that may be several centimetres long, and up to 2 cms across. They appear to have light and dark stripes when viewed under a microscope, and therefore this type of muscle is sometimes called striped or **striated** muscle.

Only rarely do individual muscle fibres run the whole length of a muscle; more usually they are connected to other fibres by connective tissue, which is continuous with the tissue that forms tendons.

Different types of muscle fibre exist. There are two major types of muscle fibre within a single skeletal muscle: **Slow-twitch** (ST) and **Fast-twitch** (FT). They are named according to how quickly they can reach peak tension (contract).

- a What is the essential difference between fast and slow-twitch muscle fibres?

speed of contraction

Slow-twitch fibres are adapted for slow rhythmical contractions, although they can still contract quickly enough for all essential sporting activities; they tend to be smaller in cross section and produce less overall force than fast-twitch fibres.

The slow-twitch fibres are more energy efficient, and are therefore well adapted for prolonged exercise, where the supply of energy might become a factor that limits performance. By comparison, fast-twitch fibres are easily fatigued.

- b Complete the following table to show the differences between fast and slow-twitch muscle fibres.

	fast-twitch	slow-twitch
type of contractions	fast, non-rhythmical	slow, rhythmical
cross-section	<i>larger</i>	<i>smaller</i>
amount of force produced	<i>more</i>	<i>less</i>
energy efficiency	<i>less</i>	<i>more</i>
adapted for	<i>short duration exercise</i>	<i>long duration exercise</i>
resistance to fatigue	<i>non-resistance</i>	<i>resistance</i>

Task 1 *continued*

- c** What would be the predominant fibre being used in a marathon race? Explain your answer.

slow-twitch - slow, rhythmical contractions; more energy efficient; long duration exercise; not easily fatigued

Most muscles contain different proportions of slow-twitch and fast-twitch fibres:

Approximate Percentages of Slow-twitch (Type I) Fibres in Muscles from Sedentary Human Males, 20-35 Years of Age

Muscle	% Slow Twitch
Soleus	87
Tibialis Anterior	73
Deltoid	52
Gastrocnemius	44
Biceps Brachii	43
Triceps Brachii	32

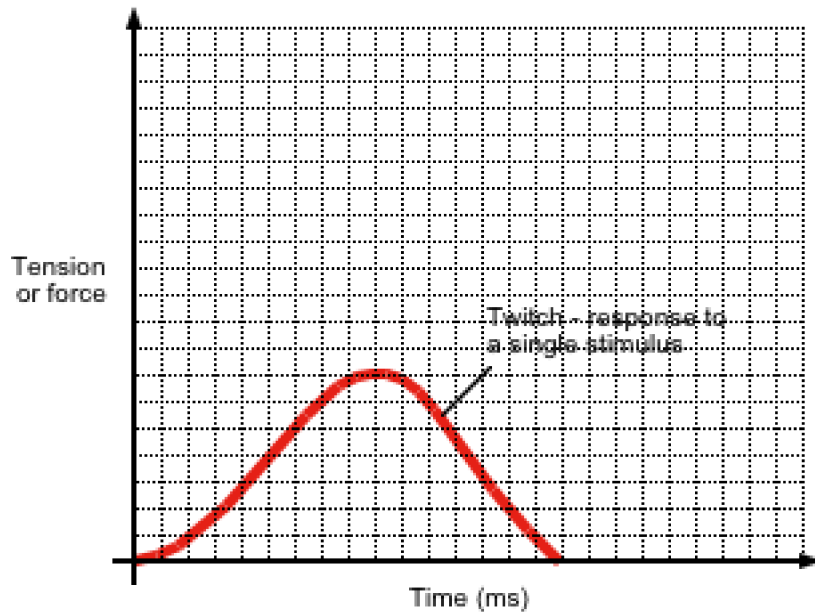
- d** Look at the above table, can you suggest a trend in the figures?

More slow-twitch muscle fibres in leg muscles; less in arm muscles

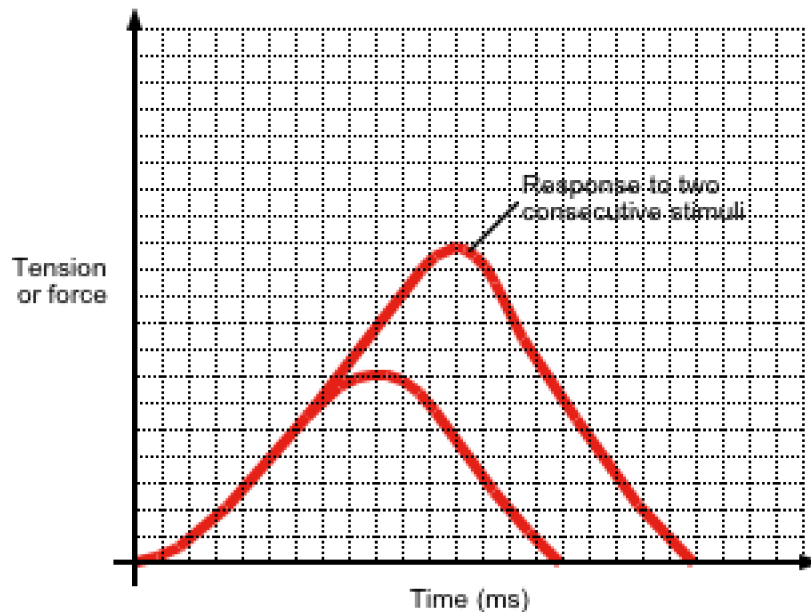
Task 1 *continued*

A single impulse from a motor neurone produces a brief period of contraction of a motor unit, followed by relaxation. This is called a **twitch**.

A recording of such a twitch is shown in the following diagram.



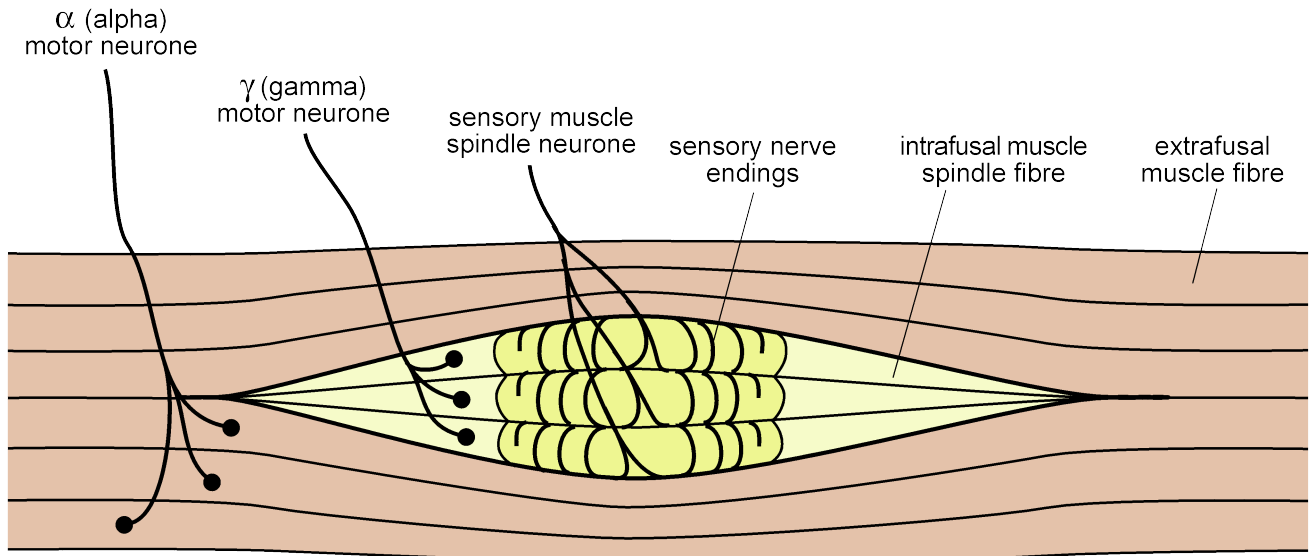
If a second nerve impulse is applied to a motor unit before it completely relaxes from the previous twitch, the tension (force) produced by the second stimulus is greater than that produced by a single twitch alone. This idea is called summation.



Task 2 continued

Each muscle spindle consists of three modified muscle fibres (**intrafusal fibres**), wrapped up in a connective tissue skin (**the capsule**).

The intrafusal fibres lie within the normal muscle fibres (**extrafusal fibres**), and are supplied with both motor and sensory neurones. See the following diagram:



- c What is the essential role of the muscle spindle apparatus?

They detect changes in the length of muscle fibres, and the rate of change of the length of the fibres

Muscle spindles are involved in the following processes: the detection of how contracted a muscle fibre is (**state of contraction**); the anticipation of how much of a contraction the muscle is going to need; the fine or delicate control of muscle contraction.

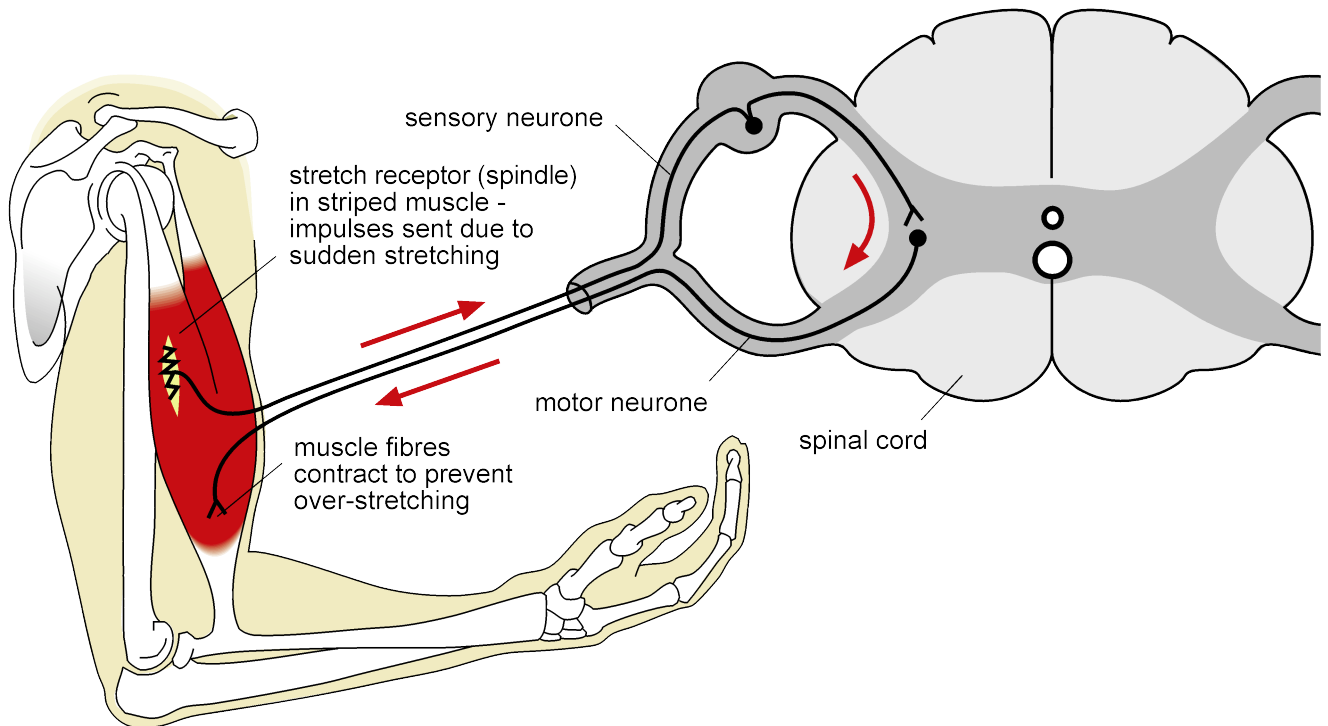
- d What are the three functions of the muscle spindle apparatus

Detection of state of contraction; anticipation of muscle loading; fine control of muscle contraction

Task 4 continued

Contraction of the quadriceps stops the stretch on the muscle, thus removing the stimulus for the reflex, and the muscle quickly relaxes. The stretch reflex prevents over-stretching of a muscle and is thus a protective mechanism.

The same reciprocal inhibition acts in all voluntary muscles. See below:



- e Describe the stretch reflex.

Protective mechanism where sudden stretching of a
muscle is detected by muscle spindle apparatus, which
leads to a reflex contraction of the muscle being
stretched