



Muscle tissue similarities and distinctive features

Banding in skeletal muscle

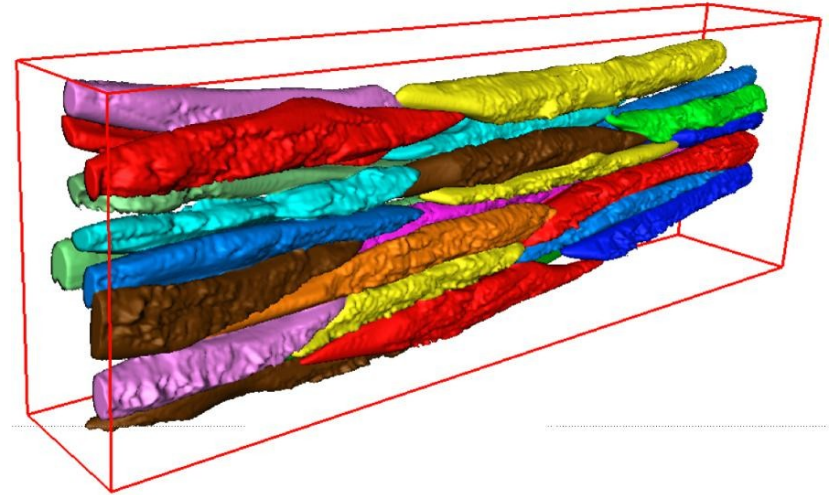
Contraction in skeletal muscle

MUSCLE TISSUE

İçindekiler

- General information about muscle (sarkos) tissue
- Skeletal muscle tissue
- Cardiac muscle tissue
- Smooth muscle

- Muscles cells are called Muscle fibers (fibra muscularis) instead of myocytes because of their shapes.

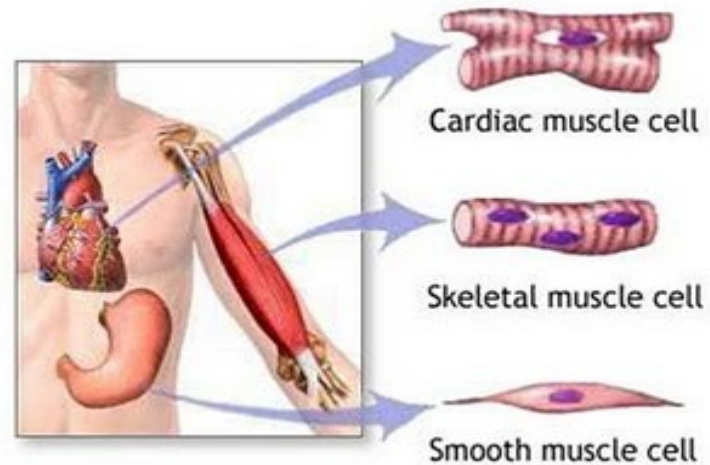




Muscle tissue is surrounded by connective tissue. Plenty of blood vessels and nerve fibers are found in this connective tissue.

Muscle Tissue Classification

- There are 3 types of muscle tissues in mammals according to the morphological, physiological and functional characteristics of the cells which make up the muscle tissue.
- These are; **Skeletal muscle, smooth muscle and cardiac muscle**



MUSCLE TISSUE

A- Skeletal Muscle: Strong, voluntary, transverse-striated muscles which contract discontinuously.

They are controlled by somatic nerves and can only get stimulated by nerve impulses.

Contracting is provided by mutual sliding movement of thick myosin filaments and thin actin filaments. The force for sliding is created by weak interactions between the crossbridge which bonds actin with myosin.

B- CARDIAC MUSCLE: Strong, involuntary, quick, transverse-striated specialised muscles which contract continuously. Although controlled by autonomic nerves, works automatically without the nerve impulses.

C- SMOOTH MUSCLE: Weak, involuntary, contracts slowly. They are non-striated. Controlled by autonomic nerve impulses. They are divided into two subgroups in terms of activity:

- 1- **Single-unit smooth muscle:** contracts when it's not receiving any neural stimulation, digestive system
- 2- **Multi-unit smooth muscle:** contraction must be initiated by an autonomic nervous system neuron. Large blood vessels' muscle layers, iris muscles, m. Dilator pupilla, m sphincter pupilla.

MUSCLE TISSUE

TYPES

- Skeletal muscle
- Cardiac muscle
- Smooth muscle

Muscle types

Skeletal muscle



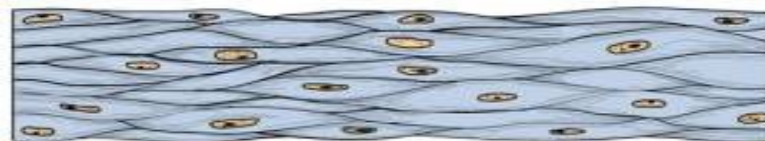
Nuclei

Cardiac muscle



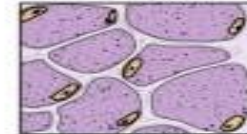
Intercalated disks

Smooth muscle

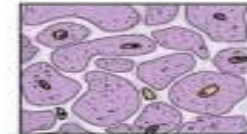


Activity

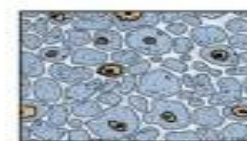
Cross sections



Strong, quick discontinuous voluntary contraction



Strong, quick continuous involuntary contraction



Weak, slow involuntary contraction

SKELETAL MUSCLE TISSUE



- Hypertrophy



- Atrophy

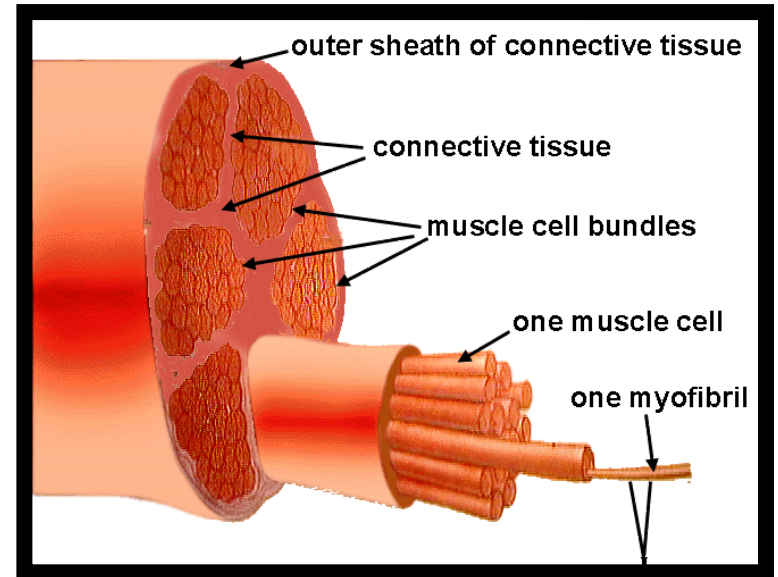


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<http://www.google.com.tr/imgres?q=muscle+fracture+atrophy&hl=tr&gbv=2&tbn=isch&tbnid=Y8MKGnU7snqvmM>

SKELETAL MUSCLE TISSUE

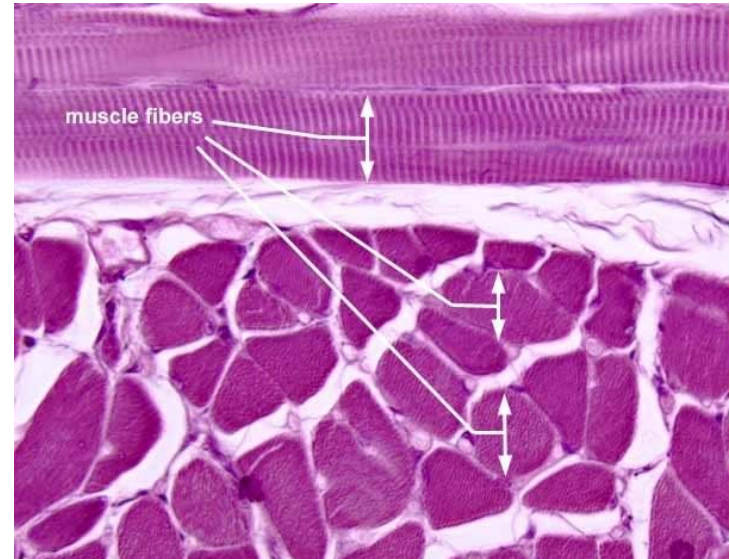
- Differentiated muscle cells in terms of their functions, contains contractable proteins in their cytoplasm
- Myofilaments come together to form myofibrils



Skeletal Muscle Histology 1

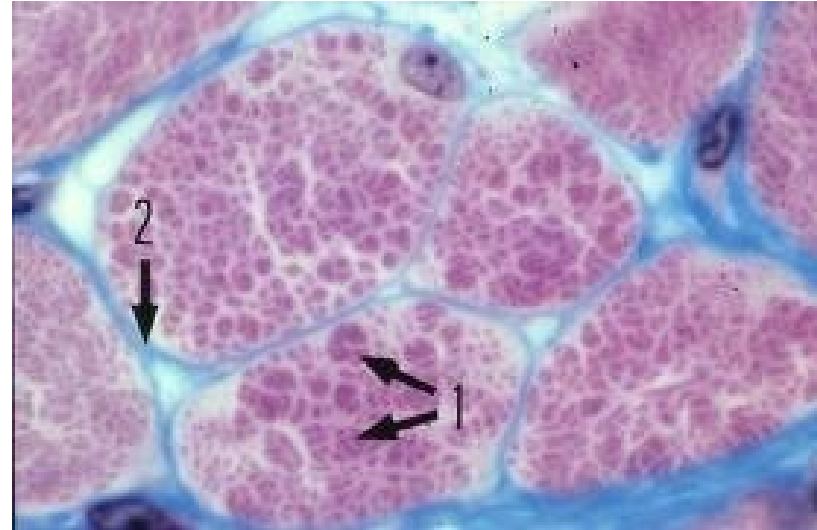
İçindekiler

- Longitudinal (top) and transversal (bottom) sections of skeletal muscle



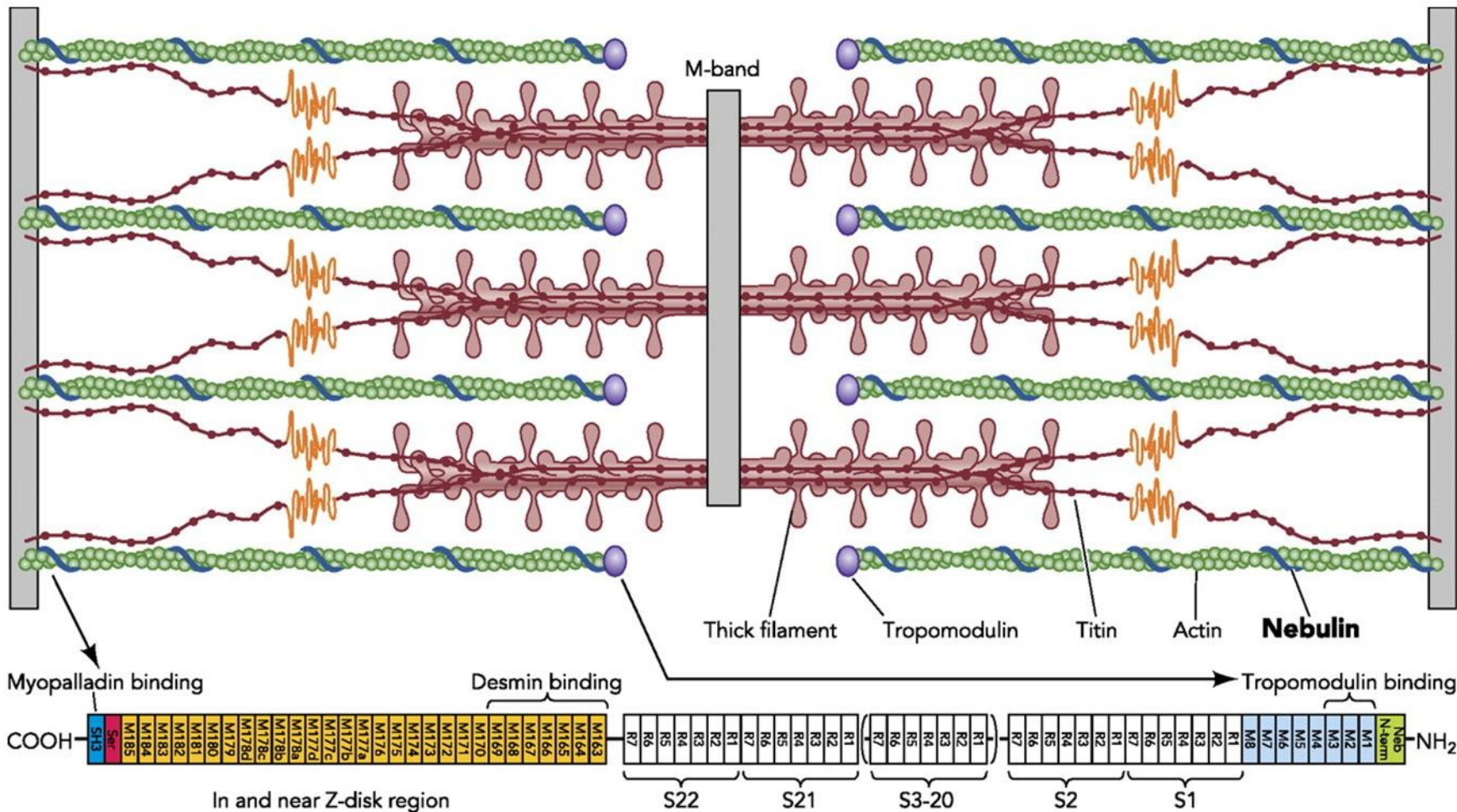
Skeletal Muscle Histology 2

- Conheim fields in transversal section



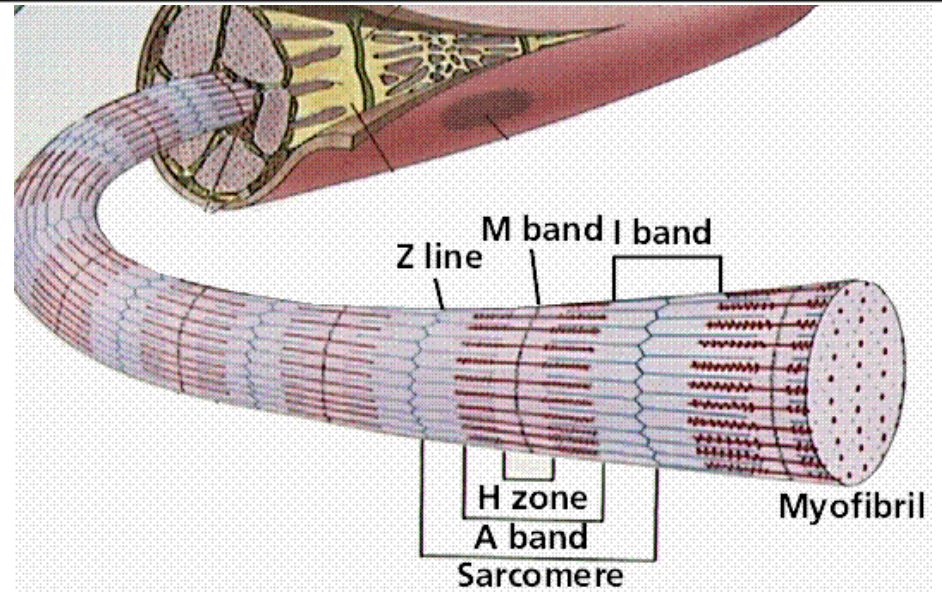
CONTRACTILE AND NON- CONTRACTILE FILAMENTS IN MUSCLE CELLS

Contractile filaments: ACTIN, MYOSIN
Noncontractile filaments: TROPONIN, TROPOMYOSIN
• ACTIN: Holds actin together and form Z line.
TITIN: The filaments which attach a myofibril when muscle contract and provides a return to its previous form.
• DESMIN: Connects myofibrils to each other to enable same type of bands to stay in the same line.



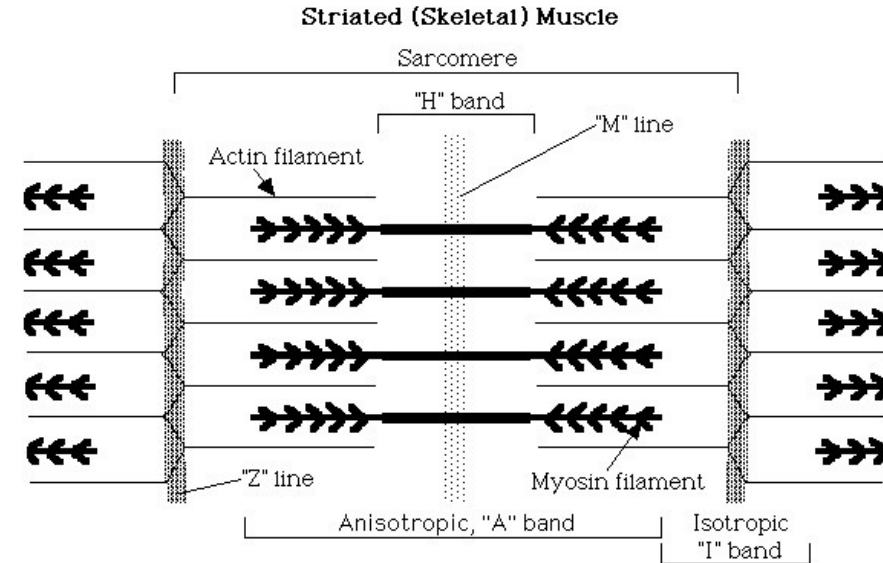
Skeletal muscle histology 3

- Bands of skeletal muscle



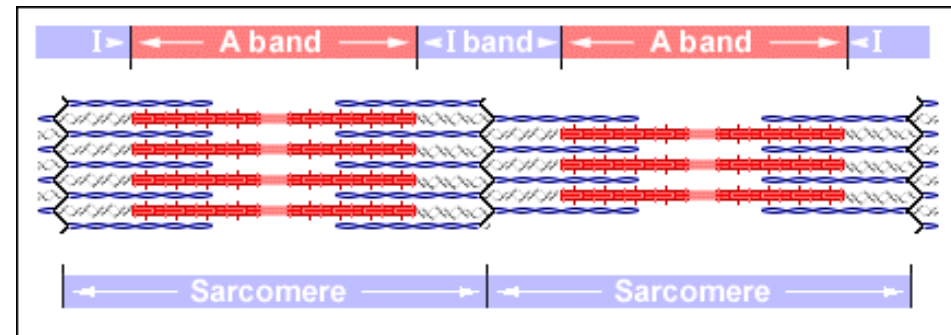
Skeletal Muscle Histology 4

- Sarcomere= unit area between two Z bands = a contraction unit



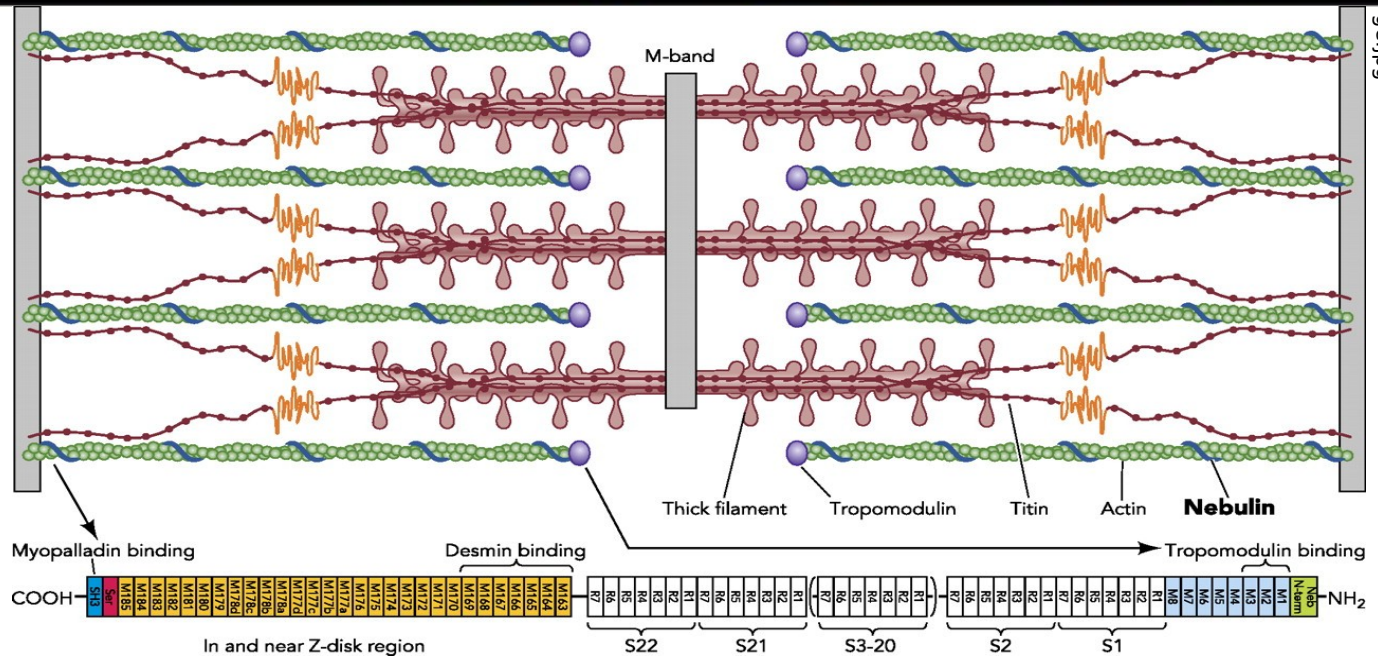
Muscle Contraction

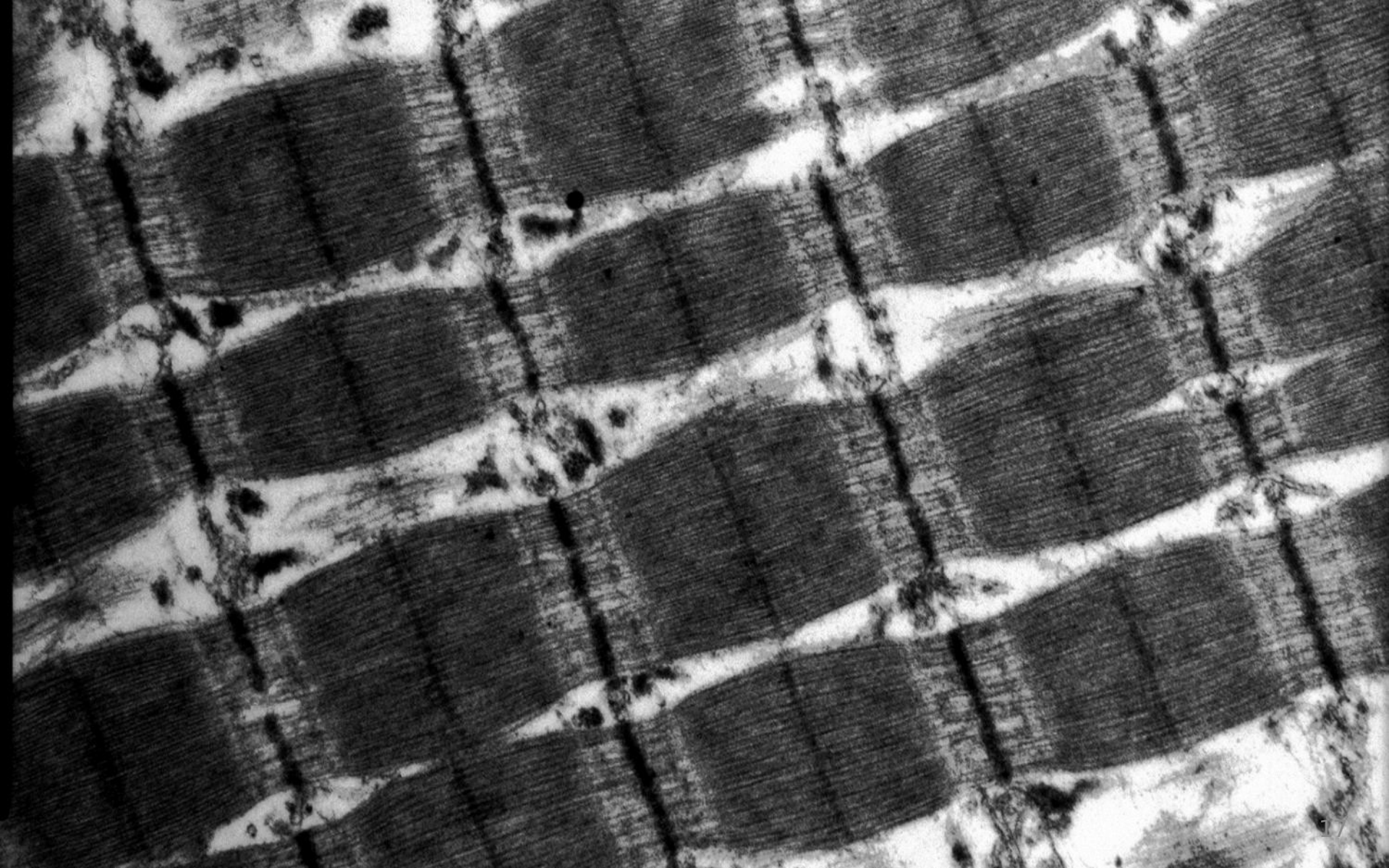
- As a result of muscle contracting mechanism, actin filaments slide between myosin filaments.



Skeletal Muscle Fine Structure Features

- Contractile and non-contractile skeletal muscle filaments





Stimulation of Skeletal Muscle (Innervation)

- Muscle innervation by motor endplate

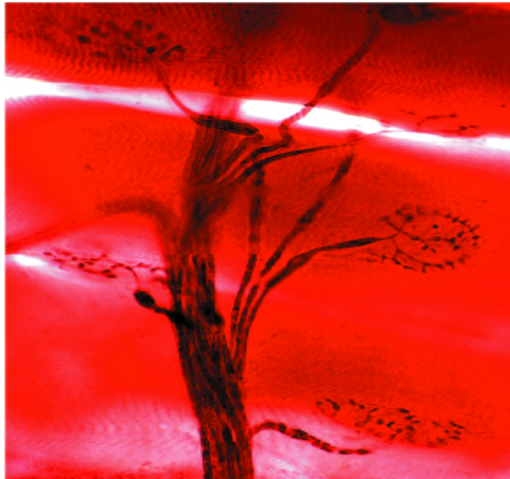
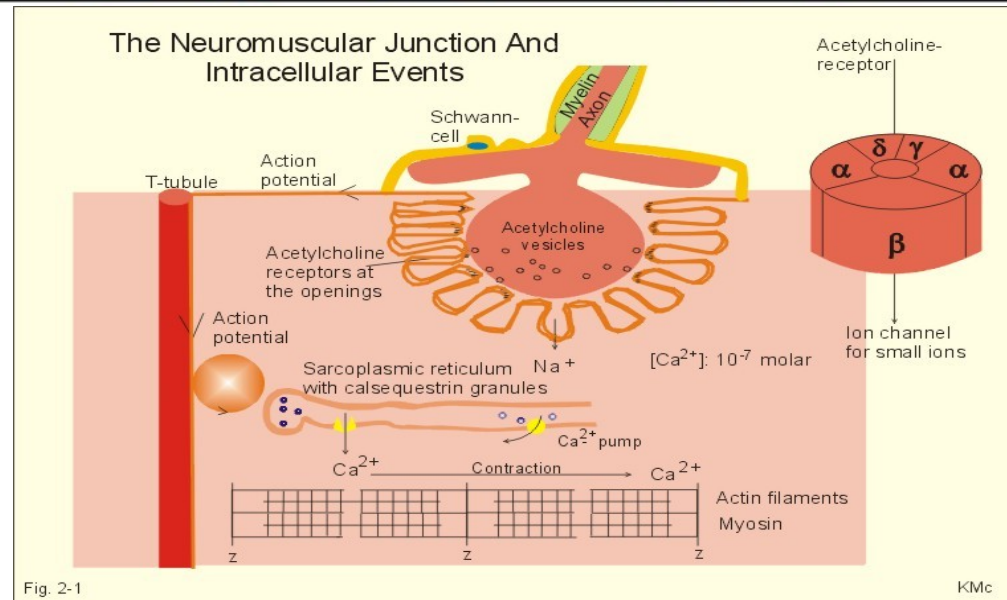
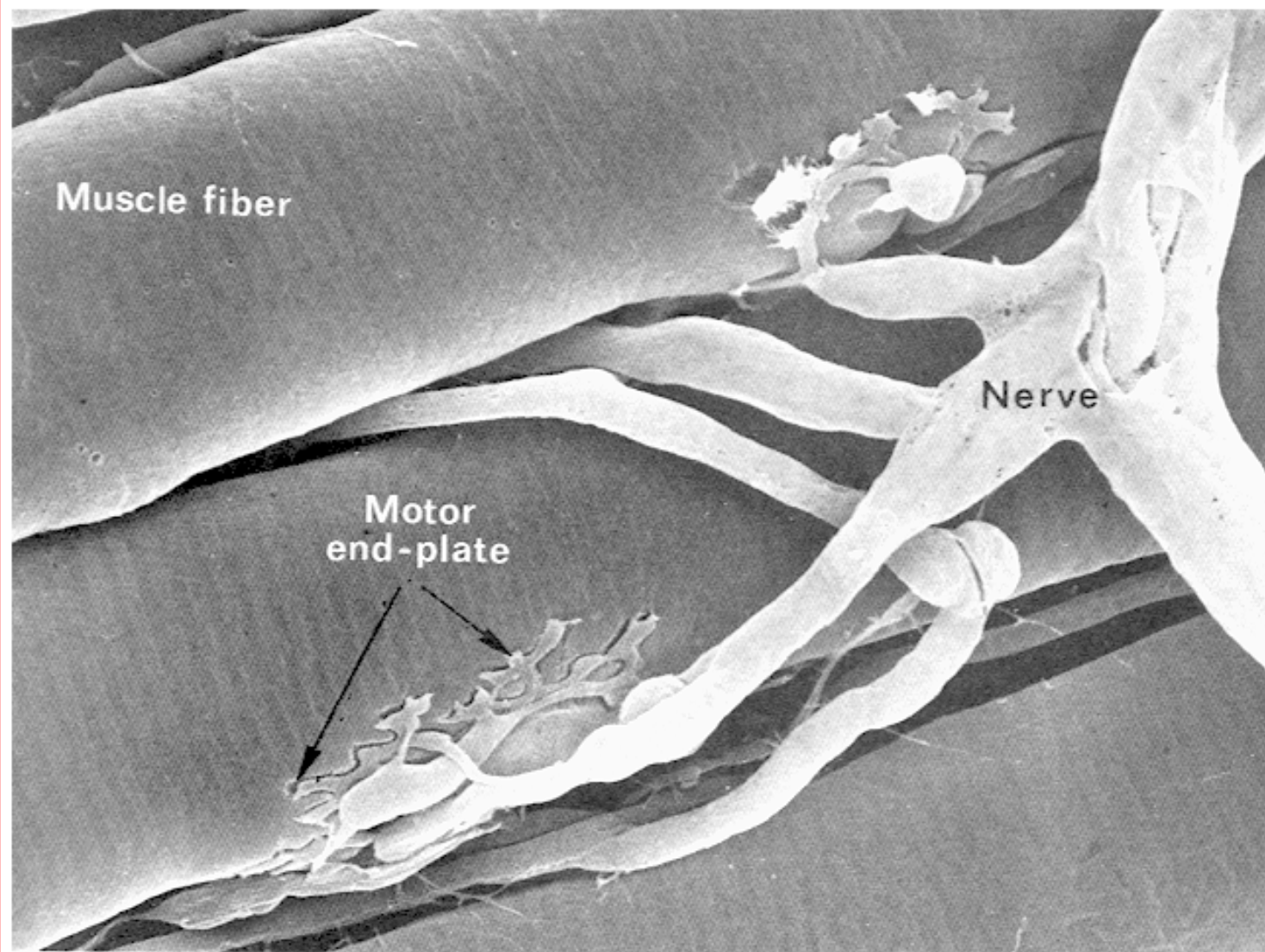
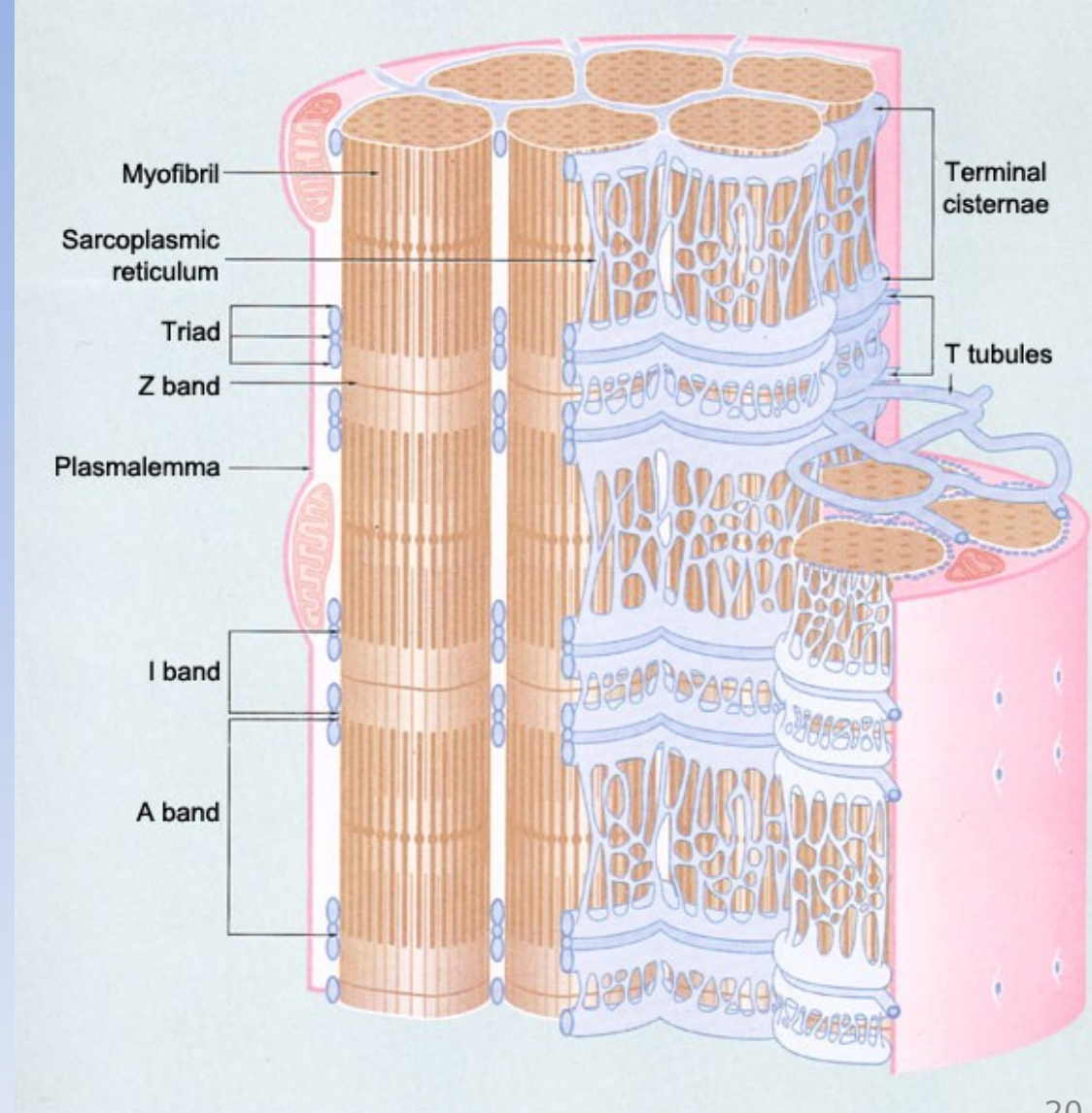


Figure 10.8. Photomicrograph of neuromuscular junction. X620.





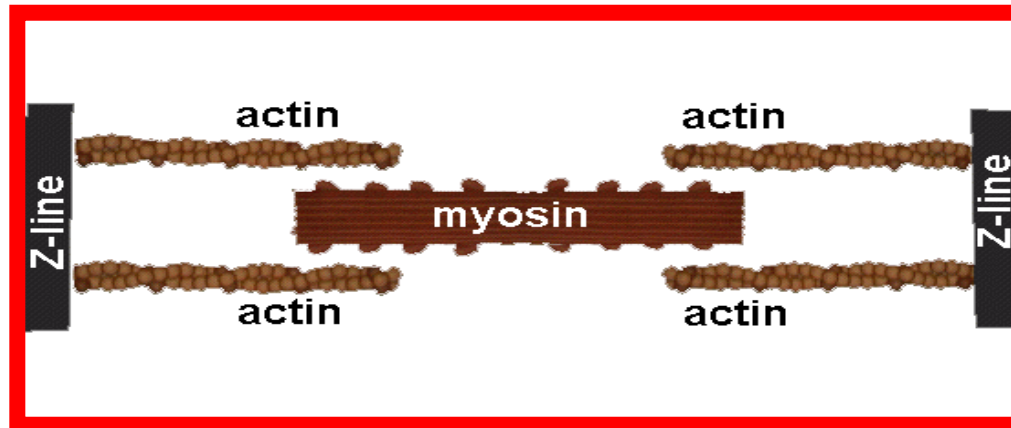
- A part of sarcoplasmic reticulum is in the form of tubules running along the myofibrils.
- Especially making anastomosis all around myofibrils on H band alignment.
- Other part of the sarcoplasmic reticulum runs along transvertical tubules forming large cisterns.
- These are called **terminal cisterns**.



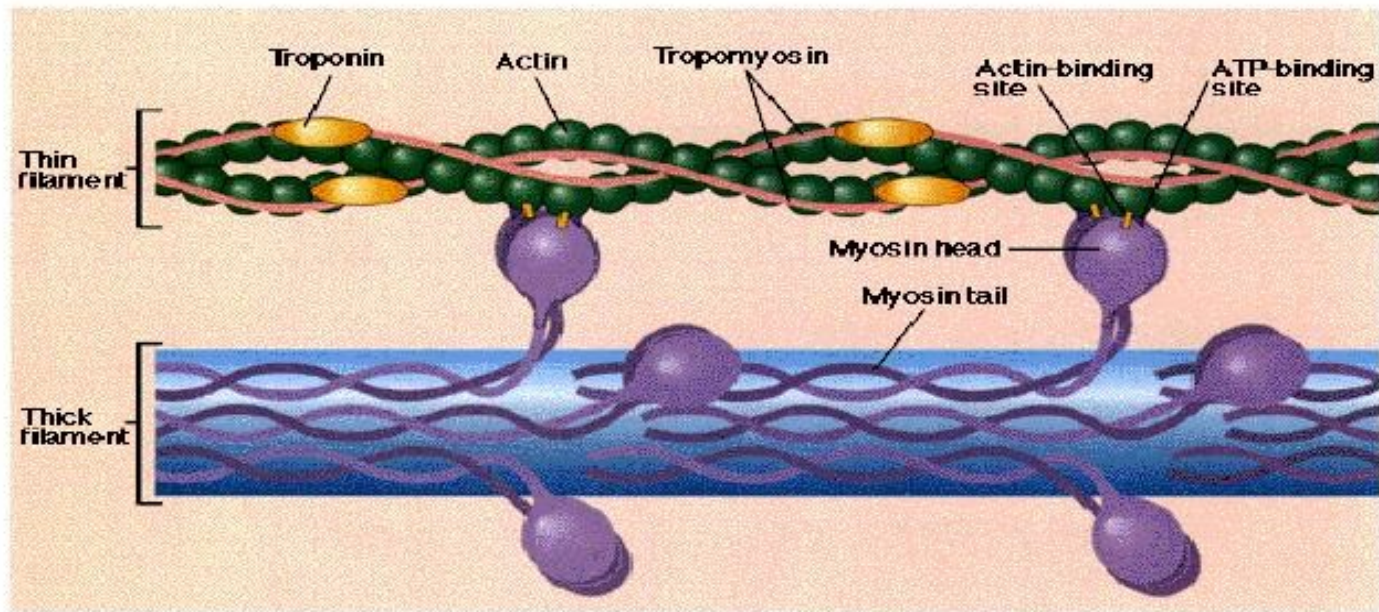
Molecules needed for contraction.

For an effective contraction, myosin heads must attach to actin molecule, form a slide movement and release must be repeated many times. Myosin heads attach, pull and release a further actin molecule each time.

Muscle contraction needs Ca^{++} other than 4 proteins (Myosin, actin, troponin, tropomyosin) and ATP.



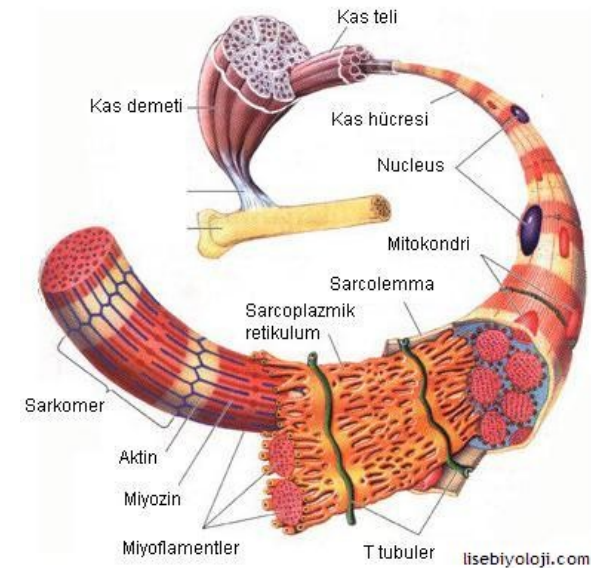
Myosin & the Thick Filament



Termination of skeletal contraction

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- Once the cell membrane depolarisation has ended, sarcoplasmic reticulum acts as a Ca storage and sends Ca into the cisterns via active transport.
- Triads which transversal tubules of sarcoplasmic reticulum and T tubules form together, provides active synchronised contracting along the muscles. As the triads number increase, muscle contraction increases..
- In some muscle groups especially the ones that act slowly, there are terminal cisterns on only one side of the transversal tubules which are called diad.



Muscle Spindles

Muscle spindles are sensory receptors only in skeletal muscles that primarily detect changes in the tension of contraction. For this reason it is rich of sensory nerve fibres.

Sensory receptors found in muscle spindles.

- 1- Sensory receptor organ that senses changes in muscle tension (Golgi tendon organ),
Until a point, the more muscle spindles stretch, the stronger the muscle will contract. But, if the contraction reaches an intense point, Golgi tendon organ will sense the tension and inhibit the contraction of the same muscle.
- 2- sensory receptor organ that senses muscle length (muscle spindle) a few millimetres long thin muscle fibres are taken into a spindle shaped structure called nuclear sac filled with liquid. Fibres inside the muscle spindle are called intrafusal, ones on the outside are called extrafusal muscle fibres. There are two types of receptors inside the spindle. Primary receptor release impulses in the first moment of contraction, secondary keeps sending impulses as long as contraction is proceeding. According to this, primary receptor receives and transmits the changes in both length and tension while secondary receptor only receives information about the muscle length.

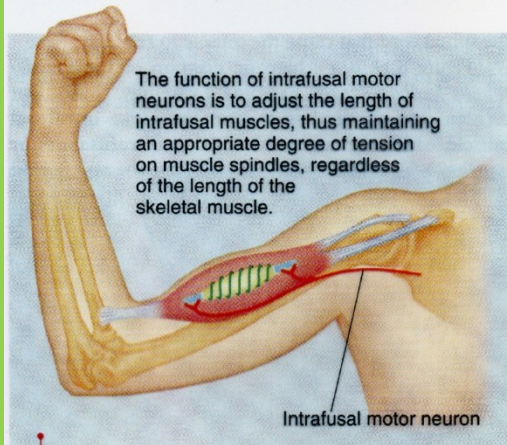
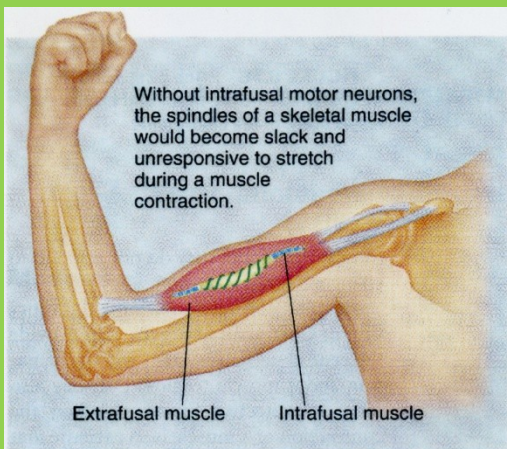
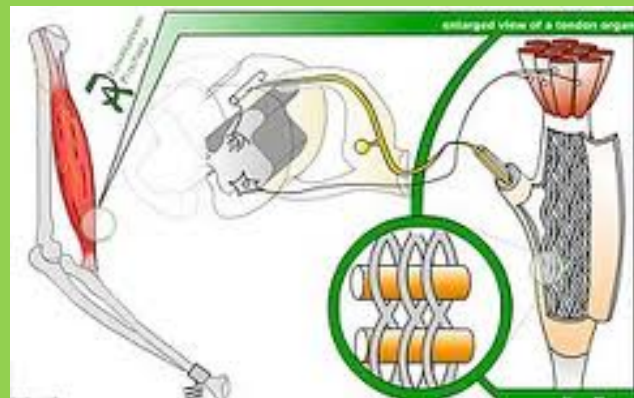
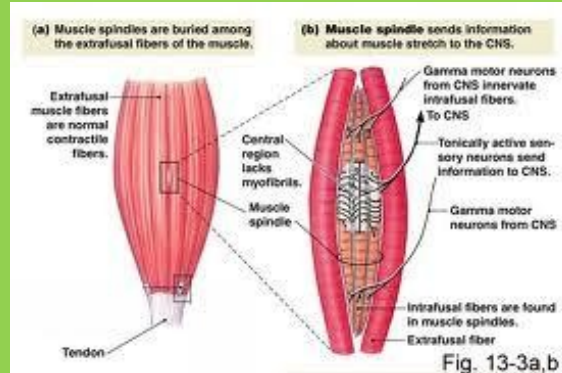
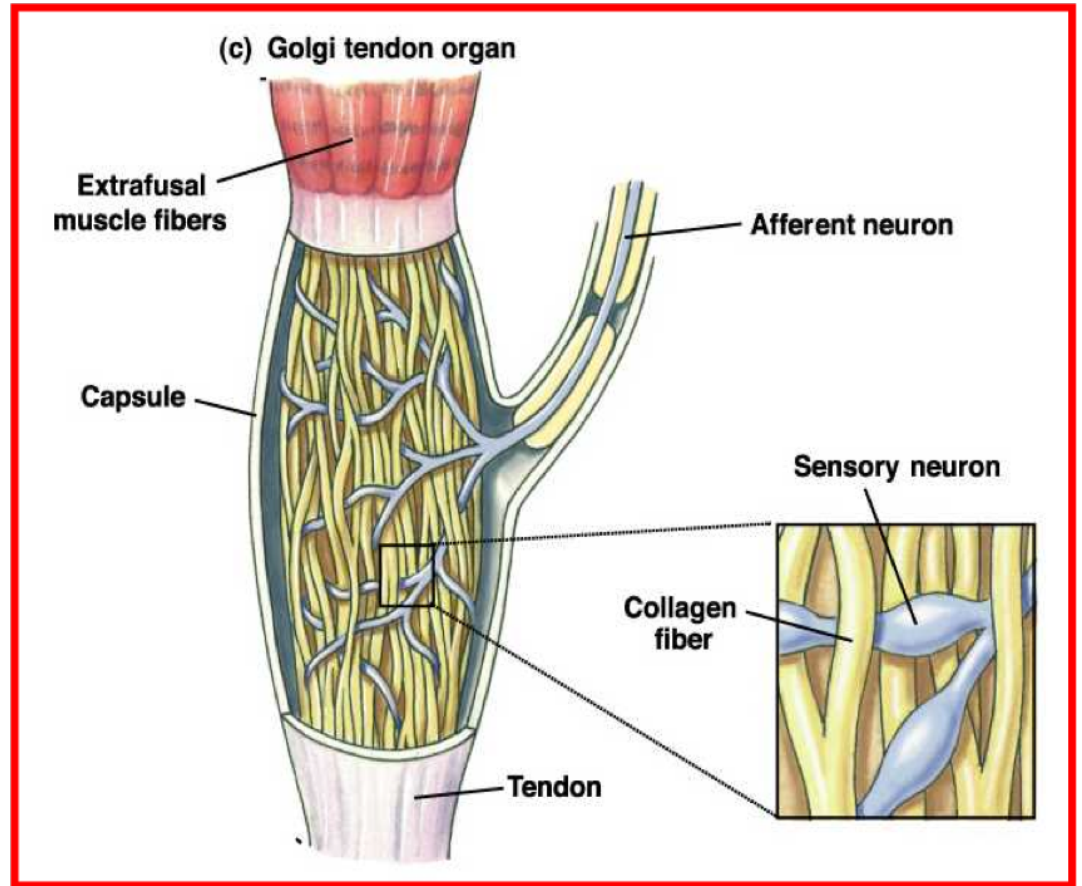
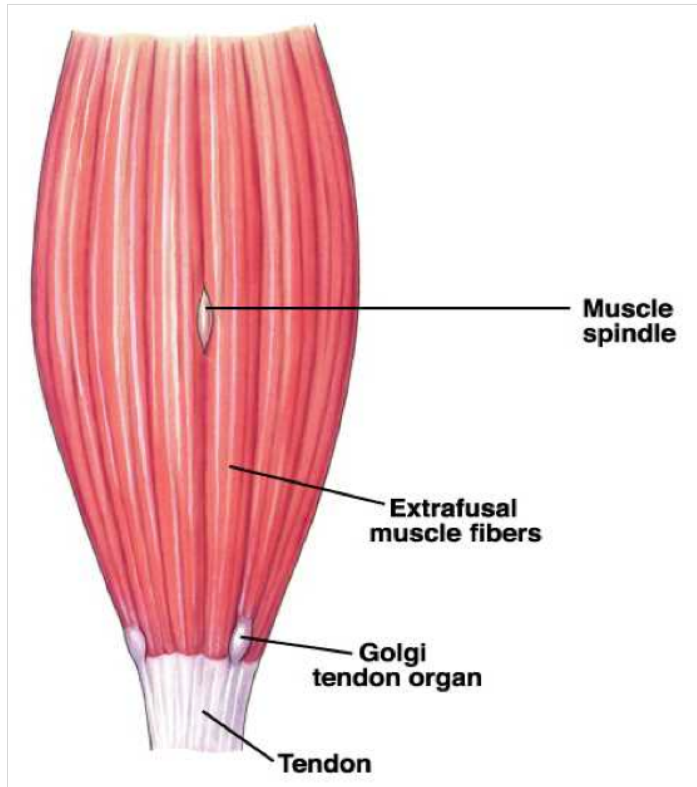


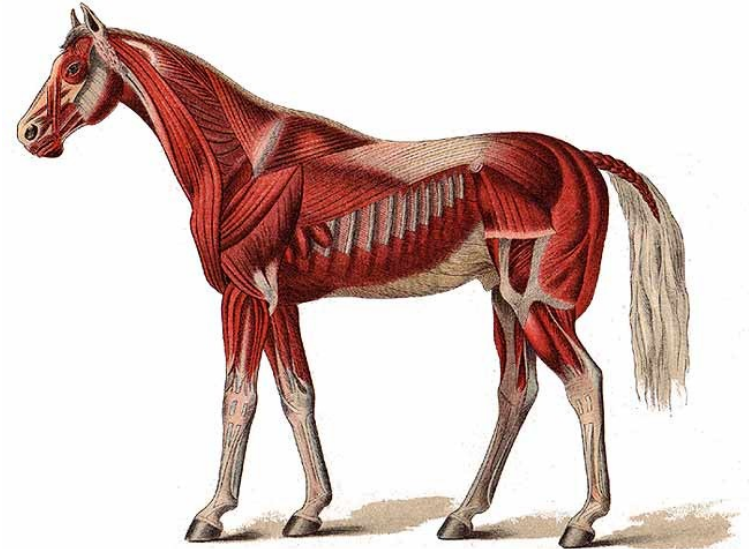
FIGURE 8.12 The function of intrafusal motor neurons.





Classification of skeletal muscle

- Red muscle fibres: slow muscles
- White muscle fibres: fast muscles
- Intermediar muscle fibres: moderately fast muscles



SUPERFICIAL LAYER OF MUSCLES.

(c)www.horse-diseases.com

Skeletal muscle is divided into three groups according to the morphological characteristics

A- White muscles **Intermediate muscles**

B-Red muscles

A- White muscle

B-Red muscle

- **Few myoglobin**
 - **Few blood vessels around muscle fibers**
 - **Muscle fibres are large-scaled**
 - **Myofibrils are settled individually and evenly**
 - **Poor in mitochondria, they breakdown glycogen in aerobic ways and convert it into pyruvate, breakdown pyruvate in anaerobic ways and convert it into lactate to use as energy source**
 - **Are very strong but get tired easily, contracts short-term.**
 - **Chicken breasts are white muscles.**
 - **Z bands are fine and regular**
 - **Motor plates are found at a few point in these muscles. They anastomose to form terminal points**
- **Plenty myoglobin**
 - **Plenty blood vessels**
 - **Fine-scaled**
 - **Myofibrils come together to form Conheim fields**
 - **Rich in mitochondria, they breakdown lipids in aerobic ways to use as energy source.**
 - **Can contract for a long time**
 - **Plenty of these muscles are found in migratory birds.**
 - **Mammals' extremity muscles are also red muscles**
 - **Z bands are thicker and irregular.**
 - **Motor plates are found a lot on these muscle fibres.**

Twitch and tonic Fibres

Twitch Fibres

Contracts with a single stimulation.

Divides into two subgroups called Fast and Slow Twitch muscles depending on the contraction speed.

Red muscles are in slow twitch group.

Contract slowly but for long time

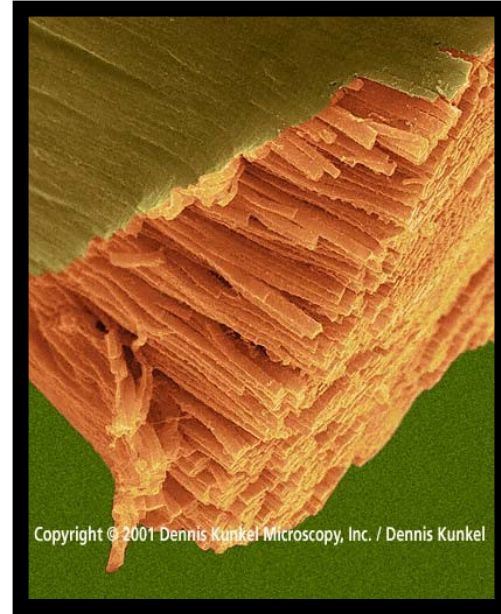
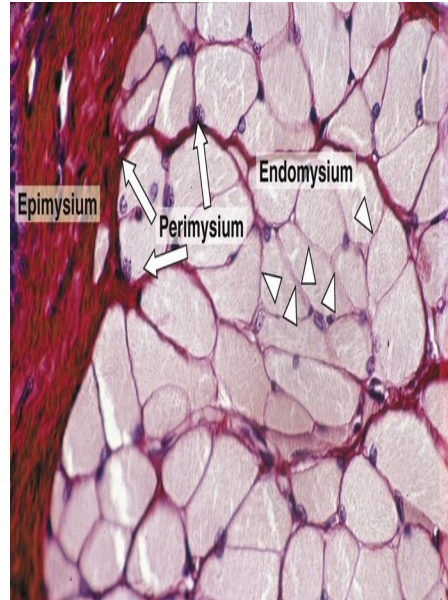
White muscles are in Fast twitch group.

Tonic Fibres

- **contraction with consecutive stimulation**
- **Encountered in amfibians and reptillians**

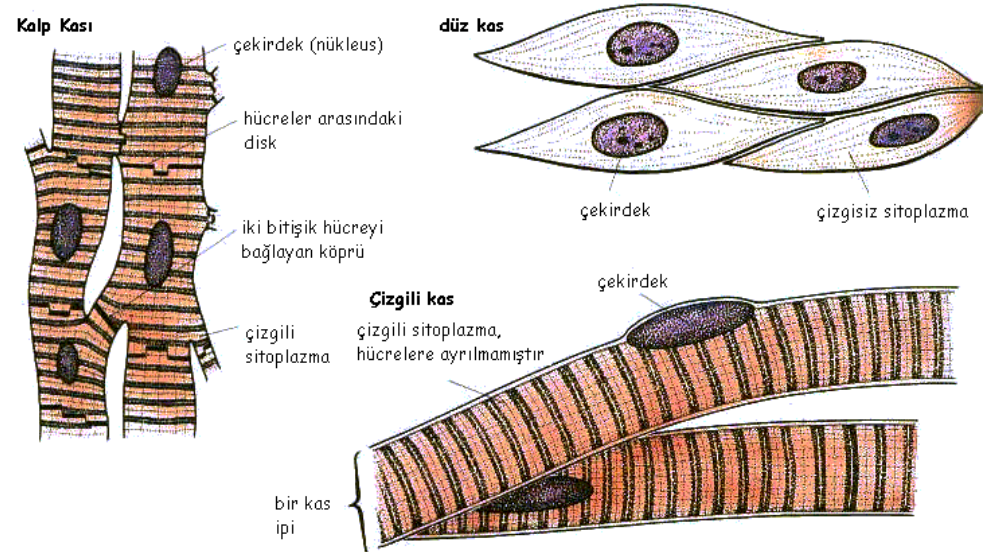
SKELETAL MUSCLE TISSUE

- **Muscle fibres form primary groups, the connective tissue surrounding muscle fibres in each bunch is called endomysium, connective tissue wrapping around muscle bunches is called perimysium. Connective tissue surrounding all muscle bunches is**



CARDIAC MUSCLE TISSUE

- Cardiac muscle has similarities with skeletal and smooth muscle and also has its unique features.



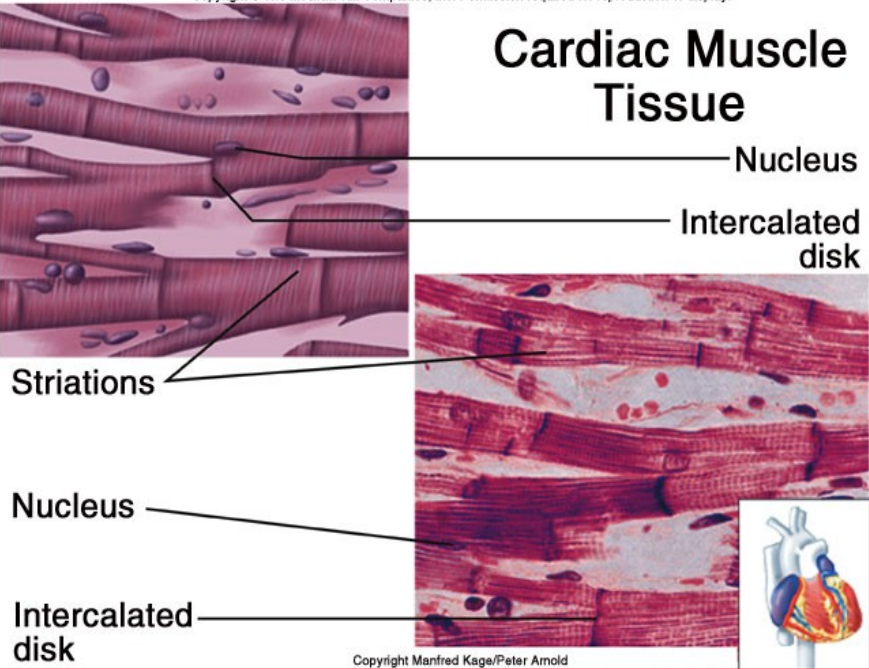
Üç tip kasın mikroskobik görünüşleri

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Cardiac Muscle

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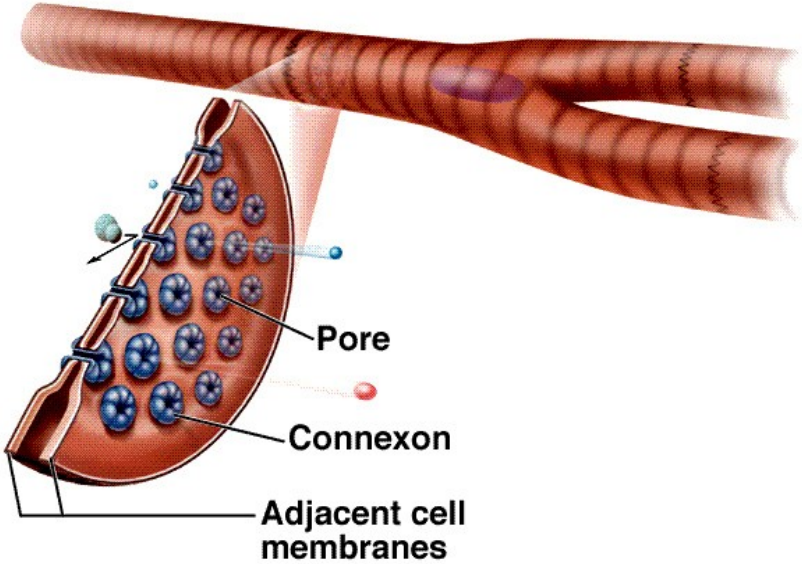
Cardiac Muscle Tissue



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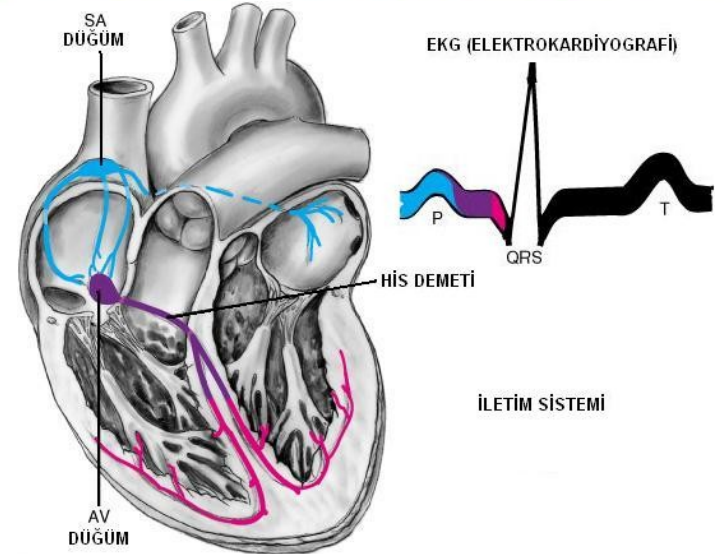
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Gap Junction



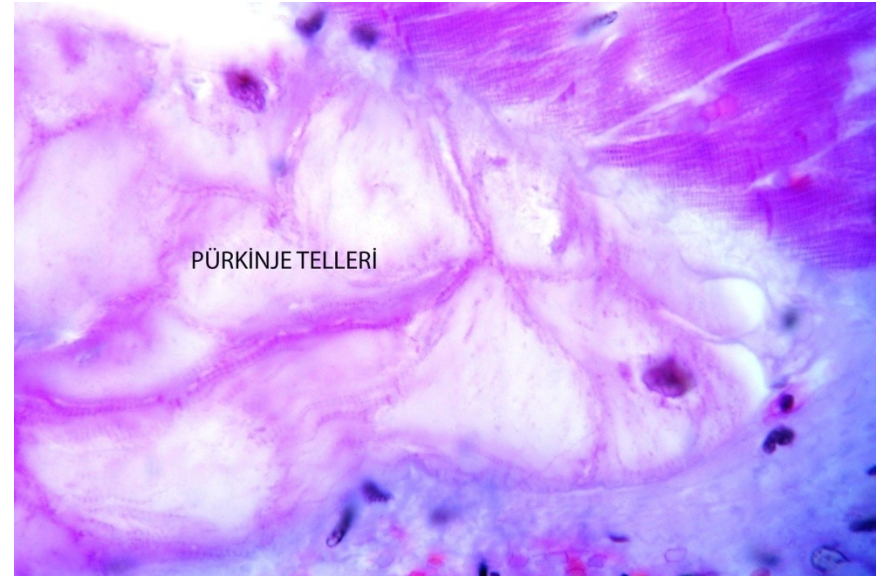
Stimulation of cardiac muscle (Innervation) 1

- Heart has its own unique stimulation system.
- SA: Sinoatrial node
- AV: Atrio ventricular node
- His bundles
- Purkinje fibres



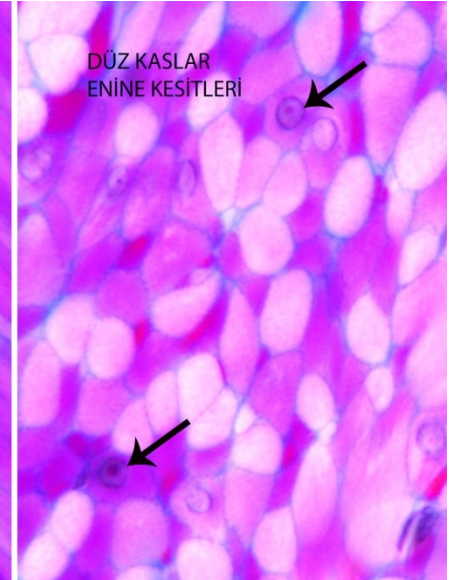
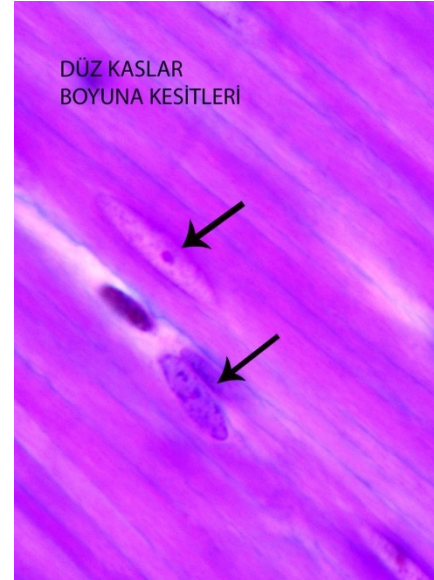
Stimulation of cardiac muscle (innervation) 2

- Fibres that end at the end of cardiac muscle of stimulation system
Histological image of purkinje fibres.



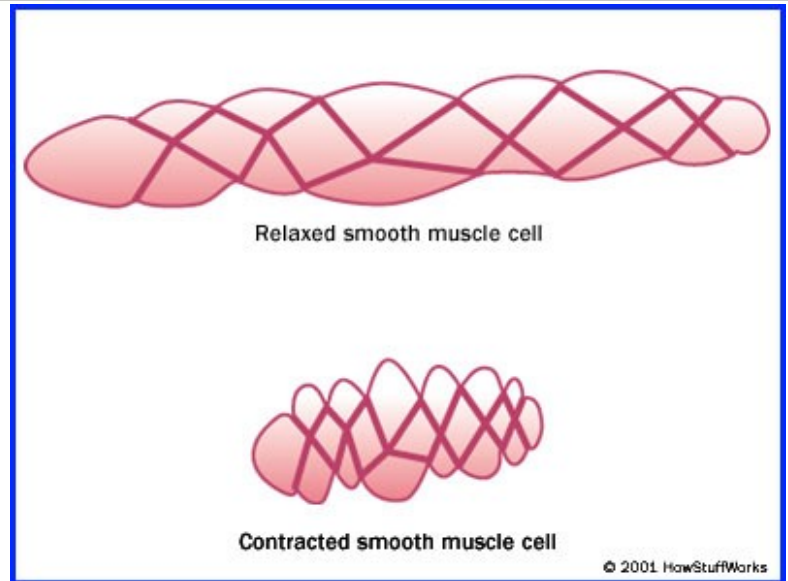
SMOOTH MUSCLE TISSUE

- Histological image of smooth muscle



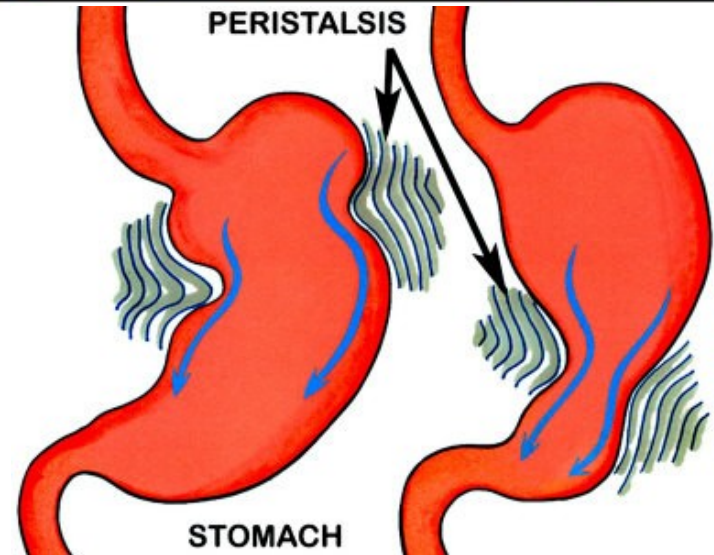
Smooth muscle contraction

- Nuclei shorten by spiraling after the muscle cell has contracted.



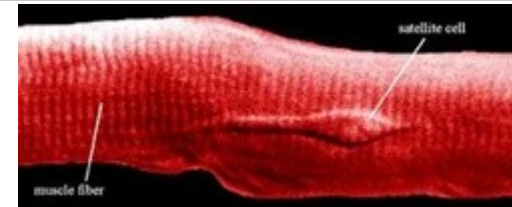
Smooth Muscle Contractions

- Some stimulations cause contraction of smooth muscle of the organs and thereby causes the forward movement of content.

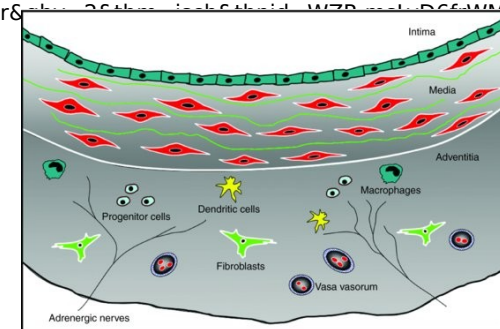


Regeneration in Muscle Tissue

- Regeneration shows differences in all muscle groups mentioned in mammals.
- Actin can not split from myosin in dead muscle cells due to lack of atp and this results in rigor mortis.



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q=muscle+regeneration&hl=tr&...](http://www.google.com.tr/imgres?q=muscle+regeneration&hl=tr&...)



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Thank you for listening..

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