

Physiology lab

Writer: 020

Corrector: Lamees Omar.



PHYSIOLOGY

LOREM IPSUM DOLOR

Introduction: first when we study the characteristics of skeletal muscle contraction, we prepare the muscle and try to contract as isometric contraction.

Graph → myograph or myogram to show the relationship between time (msec) on x-axis & force of contraction in skeletal muscle on the y-axis.

We can control and change:

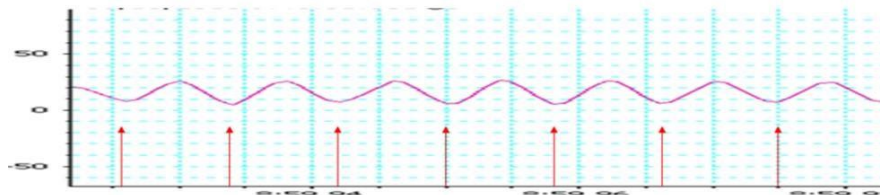
- **The voltage of the stimulus.**
- **The frequency of stimulation.**

Simple muscle twitch

Muscle twitch, is a brief muscle contraction (very small contraction) followed by relaxation that occurs in response to a single stimulus.

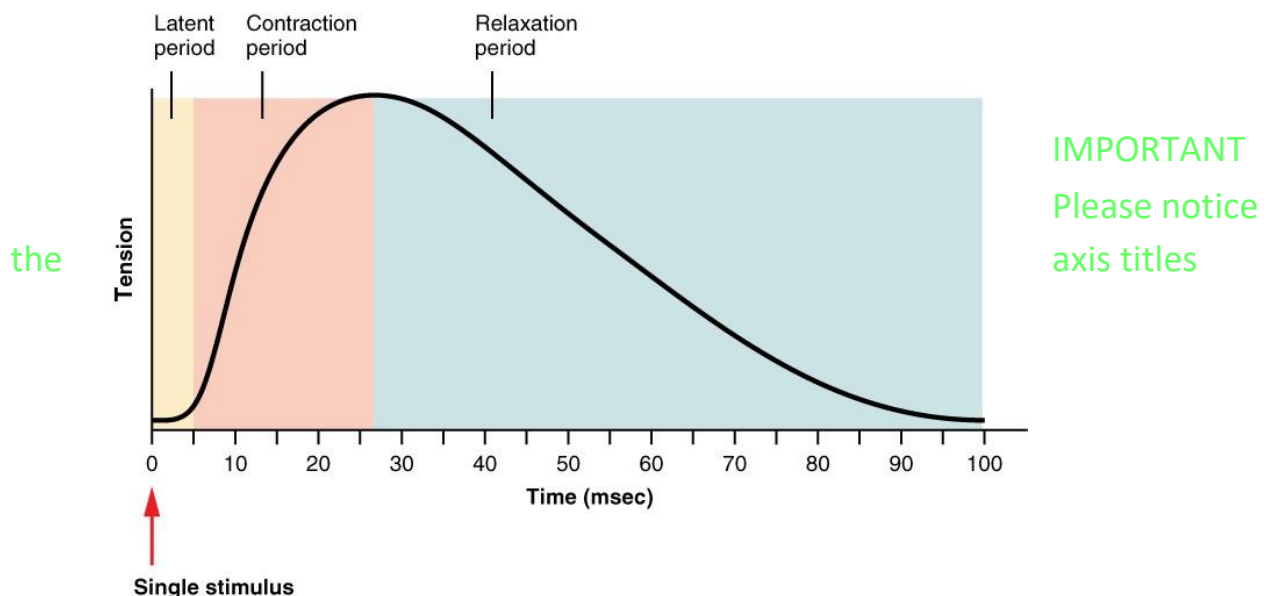
Simple muscle twitch in everyday life doesn't mean anything, it's not enough to do anything.

A threshold stimulation is the smallest amount of stimulation that will result in a contraction. Notice low frequencies for the AP to have enough time for muscle to contract then relax.



Give a stimulus above the threshold at low frequency

In simple muscle twitch we have three phases; latent period , contraction period , relaxation period.



The red arrow reflects giving stimulus to the nerve

In the **latent period**; The time between the application of the stimulus and the beginning of contraction.

no change in muscle tension. In this period , action potential is gonna spread along sarcolemma , and the calcium is released from its stores to sarcoplasm.

In **contraction period**, The time between beginning of contraction until it reaches the maximum tension

the tension is gonna increase inside the muscle. Calcium binds troponin, cross bridge formation and cycle goes on.

Relaxation period, When the tension starts to decrease till it returns to baseline.

Calcium ions are actively transported back into the sarcoplasmic reticulum, myosin-binding sites are covered by tropomyosin, myosin heads detach from actin, and tension in the muscle fiber decreases.

Relaxation takes longer time than contraction.

simple muscle twitch نشوط

1-we have to go back to same tension we started with.

2-the stimulus got to be above threshold

The duration is in milli second .The curve shape and width changes with , the contraction period may take longer or less time

SUMMATION

Summation is used to increase the intensity of overall muscle contraction.

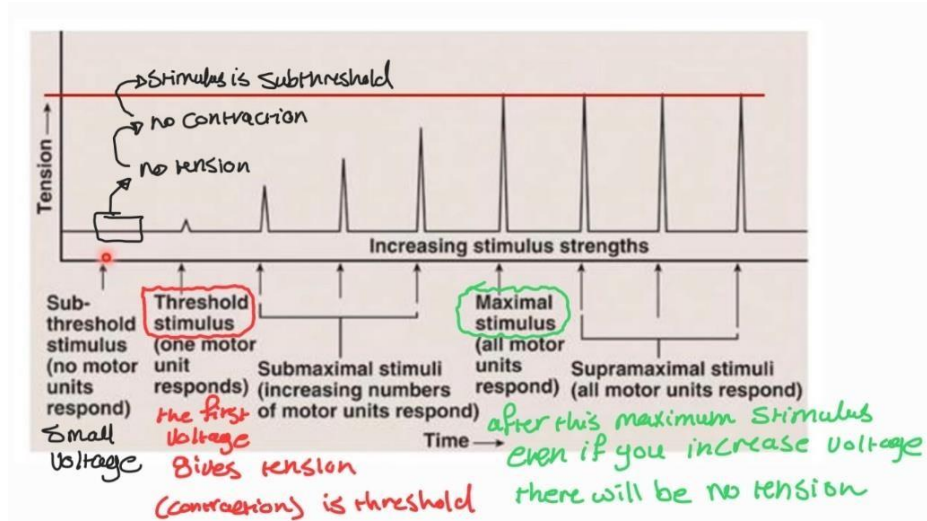
Muscle twitch is not enough to perform the function needed of muscle

Summation occurs in two ways: زيادة قوة الانقباض

1. **Multiple fiber summation: by increasing the number of motor units contracting simultaneously. It is achieved by increasing the stimulus strength** زيادة الفلوتاج
2. **Frequency summation: by increasing the frequency of contraction leading to an overlap between successive muscle twitches. It is achieved by increasing the frequency of stimulation** زيادة شعة الانقباض !!!Can lead to tetanization!!!!

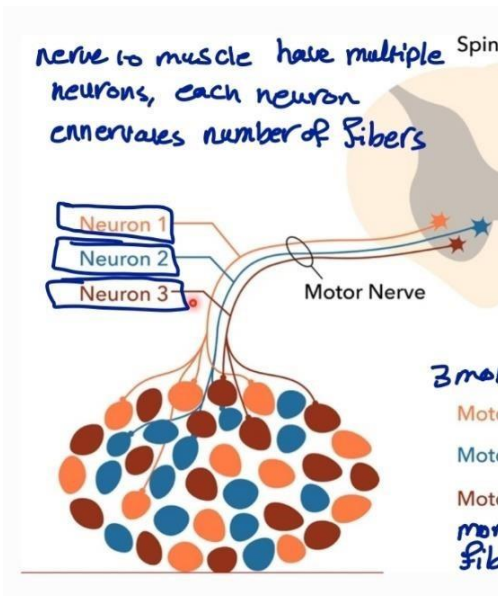
Multiple Fiber summation:

- Increasing the stimulus strength (voltage) will lead to increase number of motor units involved intension Multiple fiber summation.
- Occurs by increasing the number of motor units contracting simultaneously



Maximum, stimulus means all motor units in the muscle are contracted

No response to any higher voltage



If we give small stimulus, 100 mv (threshold) stimulates smallest motor units (orange one) and this gives me certain tension.

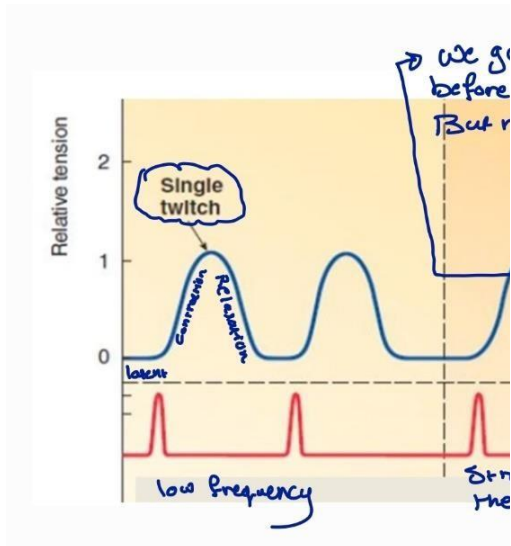
If we give higher stimulus two motor units (orange and blue) will be stimulated .

Maximum stimulus , three motor units will be stimulated so cant increase tension.

Frequency Summation:

IF the voltage (maximum or less) , increase frequency of stimulation.

- The increase in tension observed in frequency summation happens because a muscle fibre is unable to fully relax between twitches, the new contraction is partially added to the previous one resulting in higher tension (stronger contraction)
- The concentration of Calcium in the cytosol becomes higher with each successive contraction (because it is not completely removed , as the new stimulus come fast , so more Ca , more cross bridges , more tension)



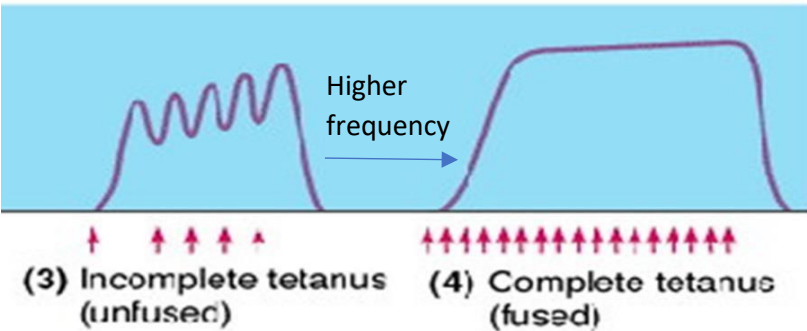
New contraction is stronger than the first bec it was partially added to the first one

Frequency Summation can lead to TETANIZATION

Tetanzation:

Is what we use in normal life to perform function ,Last for long time.

Tetanzation



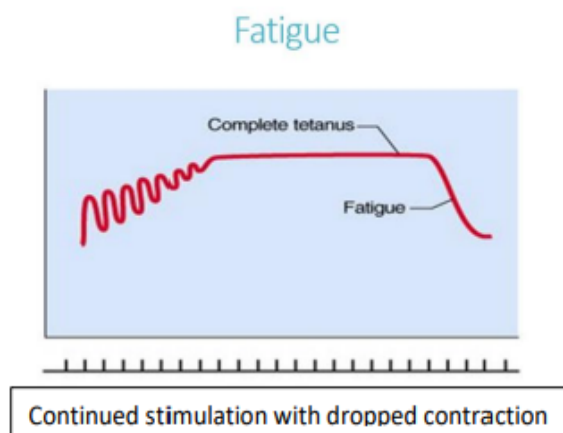
- **Unfused (incomplete) tetanzation** is a sustained but wavering contraction.
- Occurs When a skeletal muscle fiber is stimulated at a high rate, so it can only partially relax between stimuli.
- We used incomplete in our life
- Frequency is very high but there is enough time for calcium to go back ,, but we don't go back to baseline.(there is relaxation a little)
- Sustained but wavering contraction

If we fix the voltage and greatly increase the frequency of stimulation

- **Fused (complete) tetanzation**, a sustained contraction in which individual twitches can't be detected.
- Occurs when a skeletal muscle fiber is stimulated at a very high rate, so it does not relax at all between stimuli.
- The maximum tension a muscle can generate is reached.
- Any additional increase in frequency beyond that point has no further effect on increasing the muscle's tension.
- It occurs because enough calcium ions are maintained in the muscle sarcoplasm so that full contractile state is sustained.(cross bridges are fixed)

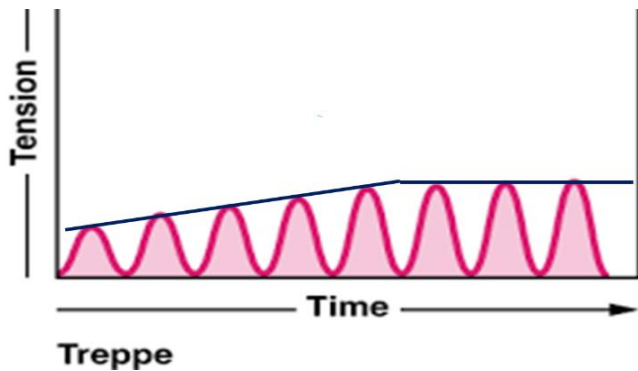
- Rarely used in real life leads to **Fatigue**
- In everyday life incomplete is better than complete.

Fatigue



- Fatigue is a decline in the ability of the muscle to respond to stimulation, occurs after prolonged and strong contraction.(after complete tetanization)
- On the graph it is depicted as a drop in tension **despite continued stimulation (tension decreasing while we are still stimulating)**
Why does fatigue happen?
 1. Inability of the contractile and metabolic processes of the muscle fibers to continue supplying the same work output. (Depletion of glycogen, accumulation of end products)
 2. Diminished transmission at the neuromuscular junction. (Depletion of acetylcholine)
 3. Interruption of blood flow which leads to loss of nutrient supply, especially loss of oxygen.
 4. Inadequate release of calcium from SR.
 5. Accumulation of lactic acid. (ADP)

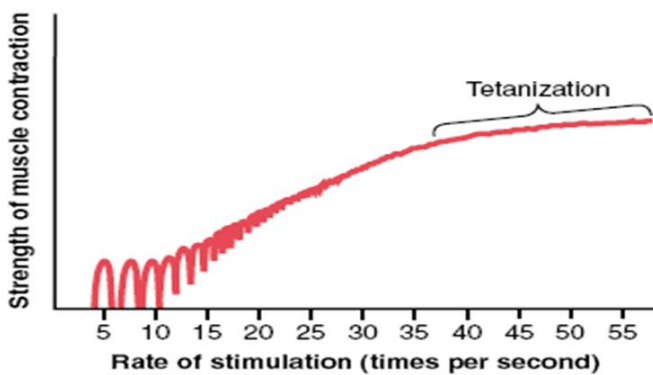
Treppe Effect



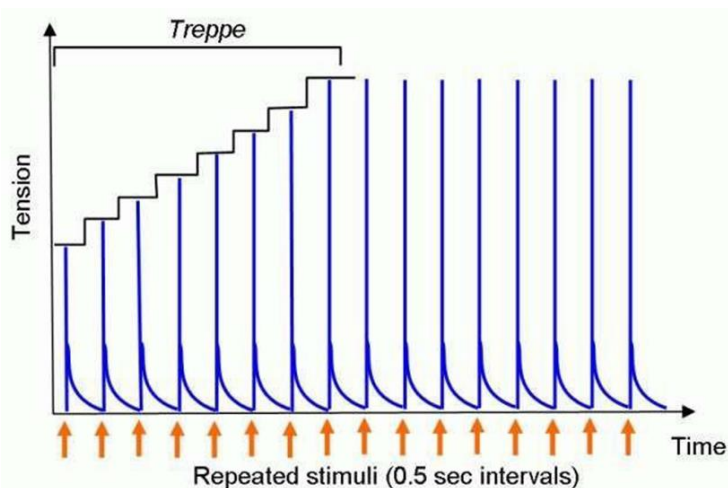
If we leave the muscle for a while , then start give it stimulus sbove threshold at low frequency (simple muscle twitch لازم تكون)

BUT we gain higher tension in each new frequent)

We don't change stimulus , we don't change frequency BUT tension is changed (response improving)!!!



- Treppe effect happens when a muscle begins to contract after a long period of rest, its strength of contraction will gradually increase with every successive stimulus till a maximum response is reached.
- It is believed to be caused by:
 1. The rise in muscle temperature.
 2. Increased concentration of calcium ions in the cytosol
 3. The enhanced blood flow



If a muscle contract after a long period of rest

Some people believe that its all about , muscle does not give the response

TREPP IS NOT SUMMATION bec we go back to relaxation (base)