

* There is no single fiber which are for normal body activity and normal function of the human body.

→ usually these fiber present in bundle and we called it as nerve like for e.g. one of spinal cord contain many axon each of these axon will be branched into many different branches and each of these branch will end in one single muscle fiber.

So the arrangement:-

nerve fiber → contain axons ^{divided} and ^{supplied} many muscle fiber

→ all these branches and all these muscle fiber which is supply by one single axon is called Motor unit. (= fiber)

* each muscles in our body have alot of Motor unit

* How can we use very strong force or minimum force or in between?

∴ these depend on impulse that we send from cortex.

Once time we need to give a stimulus more than that we need force more than that → what will we do? giving a stimulus one after the other and rapidly ~~stimulus~~ stimulus and it will increase a force → not by increasing the number of M.U

but by increasing the ~~the~~ shortening of muscle.

* How we can increase shortening?

→ stimulation will increase Ca^{+2} . Ca^{+2} will build cross bridges →

So if we do repetitive stimulation → will increase Ca^{+2} to increase cross-bridges and increase the shortening.

The changes in muscle

* The first changes in muscle are the action potential (electrical)

* The second changes are chemical changes and they ~~also~~ make thermal changes. Final will be mechanical changes.

Electrical → A.P.

Mechanical → Simple muscle twitch (S.M.T)

Chemical → ATP hydrolysis.

Thermal → by product of the chemical change

* The important difference in the skeletal muscle is duration \rightarrow 10 msec

\rightarrow While in n.F is less than \rightarrow 4 msec

* The simple muscle twitch has duration less than 100 msec (much slower)

duration \rightarrow not less than 100 msec S.M.T has \rightarrow phases

(1) Latent period (زمن التماسك)

$Ca^{+2} + (ActH) \rightarrow$

(2) Contraction phase \rightarrow the time needed for making the cross-bridge - kinking - release - making another cross bridge.

(3) Relaxation phase \rightarrow the time needed for occurring relax of muscle

What is the Factor that increase the shortening and force and power of the muscle?

* Length m.F

* Nutrition (حركة التغذية)

* changes in temperature

(في الجوانب الثلاثة الحركة سرعة الحركة)

* Strength and repetitive stimulation

Force and motion with strength of contraction

(3)

① length of m.f.

Why the increase in the length will produce the increase in the Force?

The sacromere is 0.6 micron

0.6	Shortening	1 sacromere	is 151
6 micron	←	10 sacromere	
60 micron	←	100 sacromere	

So as we increasing the length we are increasing the sacromere so we are increasing the shortening and increasing the Force. So that increasing amplitude of contraction.

But each time the sacromere will take a time so that when we contract a big muscle we need a longer duration

There will be increasing in duration but there is ~~not~~ increase.

② nutrition → binding of ATP → Force of contraction

∴ increasing of the nutrition will produce

the increasing of ATP and this will produce increase the shortening and increase in the tension

but when we increase the energy \rightarrow increase the ATP the duration will be shorter

عندما نزيد الطاقة \rightarrow نزيد ATP المدة ستكون أقصر

* ATP سبب نقصان

③ Temperature \rightarrow

When there is increase in Temperature the work and activity will be faster, easier and it will produce more force why?

The temperature will increase metabolism

chemical reaction

As we increase the temperature up to $\rightarrow 43^{\circ}$ it will produce increase activity more than 43° it will produce denaturation of protein or damage so we can't have (myosin and actin) \rightarrow damage of the muscle

thermostate of damage

نقطة التلف

إذا قلنا الحرارة سوف يزداد

There will be decrease the amplitude \rightarrow increase in the duration \rightarrow there will be no stimulation no response.

Tetanus → giving high rate that produce continuous contraction without relaxation.

Stimulus $\frac{\text{إلحاح}}{\text{إلحاح}} \text{ is relaxation } \frac{\text{إلحاح}}{\text{إلحاح}}$

if we give a rate less than that which produce Tetanus we give a time for relaxation it is called clonus (shaking) $\frac{\text{إلحاح}}{\text{إلحاح}}$

* There are 2 types of contraction:

① isometric → constant (not increasing the force of contraction, increase the shortening of contraction)

② isometric

Exercise

Each one of the exercise produce certain changes in the muscle.

if we do aerobic long sustained exercises

$\frac{\text{إلحاح}}{\text{إلحاح}}$

$\frac{\text{إلحاح}}{\text{إلحاح}}$

b bicycle

marathon

it need more blood so there will be increase the supply + mitochondria
blood

→ this type of exercise it will produce increase in muscle efficiency ($\frac{\text{إلحاح}}{\text{إلحاح}}$)

it will not produce

Fatigue

② High intensity, short burst exercise: it this type there will increase glycolytic activity :-

* Effect of muscle denervation ^{training} :-

Paralysis ^{muscle} → no movement → no metabolism → ↓ ATP

Chemical changes

The type of energy which works in muscle is ATP (adenosine triphosphate)

High energy phosphate
comes from Food → metabolism

(aerobic) oxidative Anaerobic

38 ATP
ATP
glucose

If anyone do anaerobic metabolism
lactic acid \rightarrow acidosis \rightarrow vaso spasm in B.V
 \rightarrow Spasm in muscle \rightarrow immediate metabolism in anaerobic

Sources of ATP

* at the first few second of exercise
the ATP come from creatine

10 sec in

* protein is not used in formation of energy
but for built-up of body so when we eat
we must eat (Carbohydrate + protein + Fat)

But, protein can produce energy

nit

1. **Sub-minimal stimulus < threshold.** → it will not produce action potential → not produce function
No contraction.
2. **Minimal stimulus = threshold.** → it excited one or few nerve fiber → will excite one or few motor unit.
Minimum contraction.
3. **Sub-maximum > threshold.** → activation of many motor unite
Increased force of contraction.
4. **Maximal stimulus.** → will excite all nerve fiber and all motor unite, will get maximum force in our muscle
Maximum contraction.
5. **Supra-maximum:** → not produce extra work
No farther increase in contraction