Microscopic Anatomy of skeletal Muscle Fiber:-

- Muscle Fibers are most important component of skeletal muscle tissue.
- The diameter of Mature skeletal muscle Fibers ranges from 10 to 100 μm ($1 \mu m = 10^{-6} m$)
- Typical length is about 10 cm (4 inch) some are as long as 30 cm (12 inch)
- Each skeletal Muscle Fiber arises during Embryonic development.

- From fusion of 100 (or) more small Mesodermal cells called Myoblasts.
- So, Each skeletal Muscle Fiber has hundred / more Nuclei
- once fusion has occured, it loose its Ability of cell division.
- So, No. of skeletal Muscle Fibers is set before we are born, most of these cells last a life time.
- A few Myoblasts do persist in Mature skeletal Muscle as Satellite cells
  ↓
  They have capacity to fuse one another (or) with damaged Muscle fibers to regenerate Functional Muscle Fibers.

Sarcolemma, Transverse Tubules and sarcoplasm:-

- Sarcolemma is the PM of a Muscle cell.
- Multiple Nuclei of a skeletal Muscle Fiber are located just below to it.
- Thousands of tiny invaginations of the sarcolemma is called Transverse (T) Tubules. it is filled with interstitial Fluid.
- The Muscle Action potentials travels along the sarcolemma and through 'T' Tubules.

Sarcoplasm is the cytoplasm of Muscle Fiber.
↓
It contain substantial Amount of glycogen (large Molecule of many glucose)
↓
use for synthesis of ATP.

- sarcoplasm Also contain a red-colored protein Myoglobin
  it binds & release oxygen when it is needed by Mitochondria for ATP production.

Myofibrils and sarcoplasmic reticulum:-

- **Myofibrils** is small structures
  - ↓
  - Contractile organelles of skeletal Muscle.
  - → 2 μm in diameter & Extend the Entire length of Muscle Fiber.

Sarcoplasmic reticulum is fluid-filled Membranous sacs.
Encircles each Myofibril.

Dilated end sacs of sarcoplasmic Reticulum is called.
Terminal cisterns.

In a relaxed Muscle Fibers. → SR store Ca^{2+}
↓
Release Ca^{2+} to trigger Muscle contraction

Filaments and Sarcomere:-

- ↳ smaller structure in Myofibrils.
- Thin Filament – 8 nm in diameter and 1–2 μm long
- Thick " – 16 nm " " and 1–2 μm long.

- They are Arranged in compartments called Sarcomere
  ↓
  Basic Functional unit of Myofibril.
- Narrow plate shaped regions of dense protein Material called. Z-discs.
  - ↳ sarcomere Extends from one Z disc to Next Z-disc.
- Thick and Thin Filaments overlap one Another depending on Muscle contracted, relaxed (or) stretched.
- Darker Middle part of sarcomere is the **A Band**
- I band is lighter and less dense Area that contains. Thin Filaments but no thick filament.

- H zone is center of each A band contains thick but not thin filaments.
- Supporting proteins that hold thick filament together at center of H zone form M line.
  ↓
  Named bcz it is at Middle of Sarcomere.

MUSCLE PROTEINS:-

- Myofibrils are built from 3' kind of proteins

(1) Contractile proteins
↓
Actin & Myosin
↓
Generate force during contraction

(2) Regulatory Proteins
↓
Tropomyosin & Troponin
↓
Help to switch the contraction process on & off.

(3) Structural proteins
↓
Dozen of proteins
↓
Keep thin and thick filaments in proper Alignment.

(1) CONTRACTILE PROTEINS:-

Main components of { Thick filament – Myosin
Thin filament – Actin

Myosin – Functions as Motor portein in all 3' types of Muscle Tissue
↓
convert ATP's chemical energy to Mechanical Energy of motion | Produce force.

- In skeletal Muscle → abt 300 Molecules of Myosin form a Single thick filament
- Each myosin molecule is shaped like two golf clubs twisted together.

Actin – Main component of thin filament, Anchored to 'z' discs.

- on each Actin molecule there is a Myosin-binding site where a Myosin head can Attach.

(2) Regulatory proteins:=

smaller amt. of two regulatory proteins { Tropomyosin, Troponin } present in the thin filament

- In relaxed Muscle → Myosin is blocked from binding to Actin bcz strands of tropomyosin cover the myosin binding site on Actin.
- Tropomyosin strands are held in place by Troponin Molecule.

(3) structural proteins:-

↳ Dozen of ST. protein
↓
contribute to the Alignment, stability, elasticity and Extensibility of Myofibrils.

- some key structural proteins are Titin, α-actenin, myomesin, nebulin and dystrophin

Titin Third most plentiful protein in skeletal Muscle after Actin and Myosin.
↓
It connect z disc to 'M' line of sarcomere, so stabilize. the position of Thick Filament.

- As it can stretch & then spring back, so provide elasticity & Extensibility to Myofibrils.

α-Actinin → structural protein of z-discs
↓
Attaches to Actin Mol. & Titin Mol.

Myomesin → Form M-line of sarcomere
↓
Bind to titin mol. & connects adjacent thick filament to one Another.

Nebulin wraps around Entire length of each thin filament

↓

Helps to Anchor thin filament to Z-discs regulate length of thin filament during development.

Dystrophin links the thin filament to Integral Membrane protein in Sarcolemma