25/10/21 Ch-20

LOCOMOTION AND MOVEMENTS

* Types of Movement [Human body].

1. Amoeboid
→ Pseudopodia → by protoplasmic streaming.
→ Macrophages, leucocytes (WBCs).
Microfilaments → involved in amoeboid move.

2. Ciliary
→ Internal tubular organs lined by ciliated epithelium. e.g.,
trachea → removing foreign particles
oviduct → ova movement.

3. Muscular
→ Contractile property of Muscles
→ Human + Most Multicellular org. for locomotⁿ etc..
→ Perfect Coordinatⁿ b/w Muscular, Skeletal & Neural system.

* Flagellar Movem :→ Swimm. of spermatozoa, maintain water current in sponges canal system, locomotⁿ of Euglena.

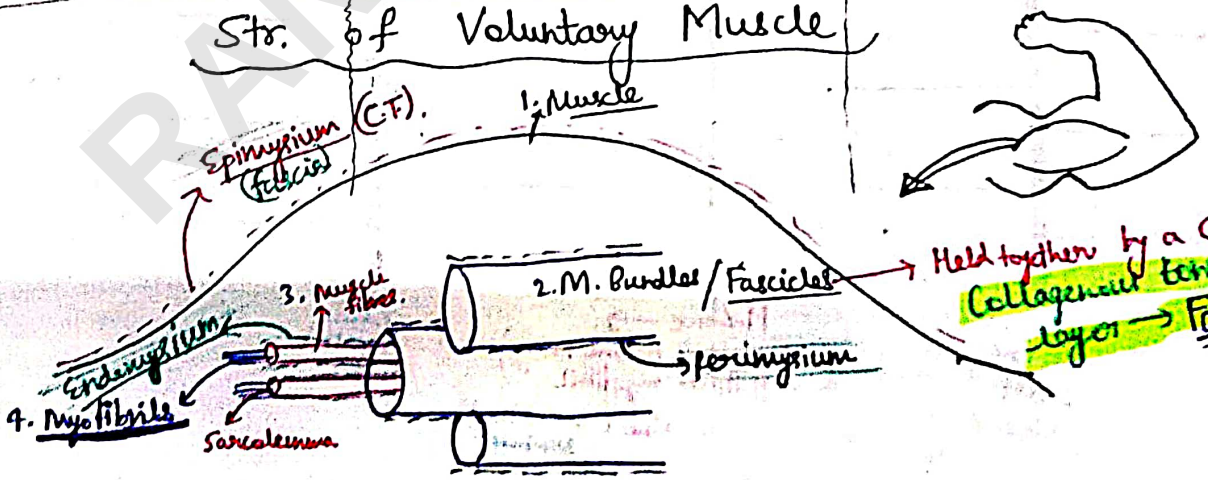
** Muscles
→ Mesodermal origin
→ 40-50% body wt.
→ ① Excitability ② Contractibility ③ Extensibility ④ Elasticity.
Basic → Locomotⁿ

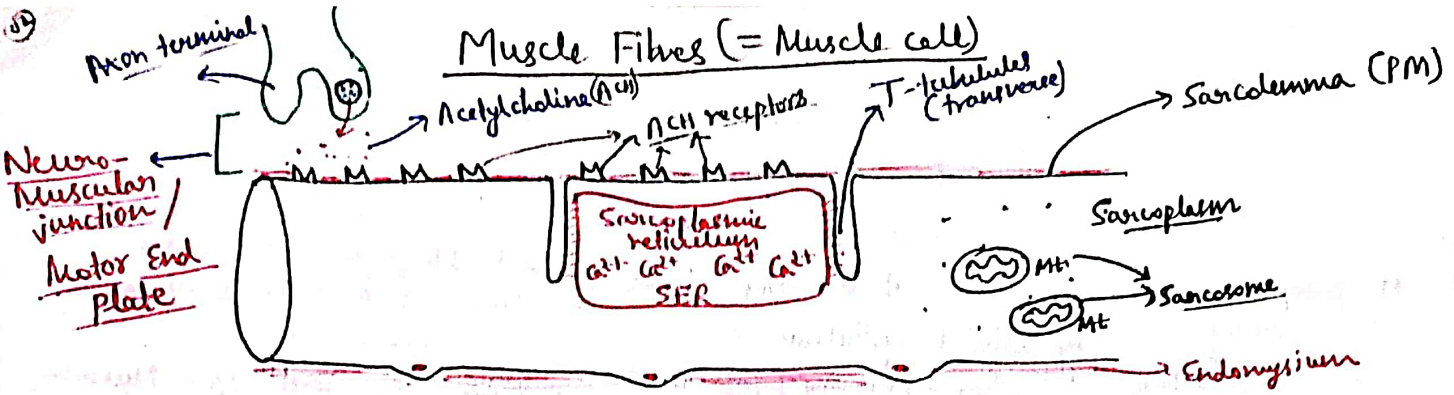
Skeletal / Voluntary
→ Striped appearance → Striated
→ Close associatⁿ with skeletal elem.
→ Voluntary.
→ 1° involved in locomotⁿ & body posture changes.

Visceral / Involuntary
→ No striped → Smooth
→ Inner walls of hollow visceral organs. eg., alimentary canal, Reproductive tract.
→ Involuntary.
→ Cranate movem., food movem. etc.

Cardiac
→ Heart Muscles
→ Striated
→ Assembled in branching pattern.
→ Involuntary.
→ Has intercalated discs.

Str. of Voluntary Muscle





→ cylindrical → Occur in bundles → Syntitium [Multinucleated]
→ peripheral nucleus → Unbranched.

In sarcoplasma ← Myofibrils / Myofilaments

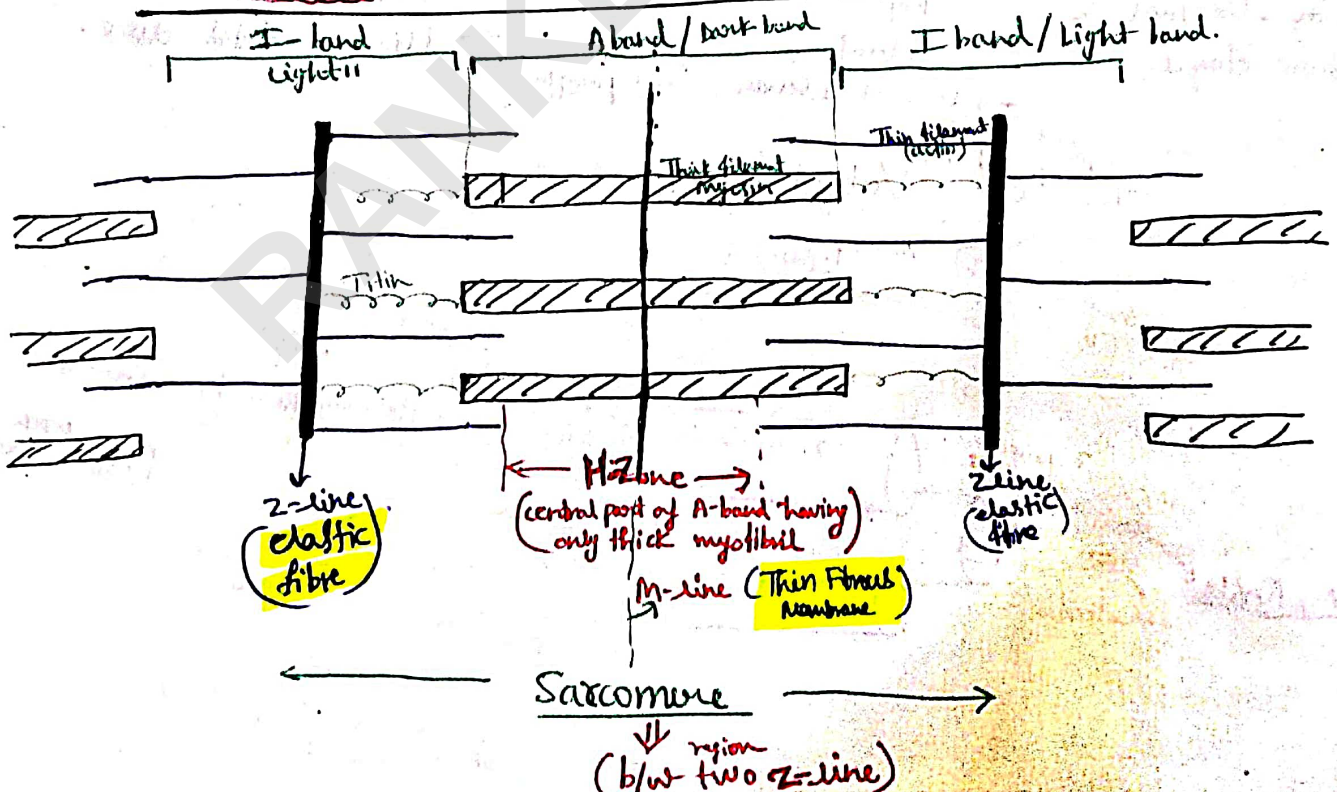
→ Have Striped appearance [alternate light and dark bands]

Due to distribut^{n} of :→ ① Actin ② Myosin: Proteins.

* Light / Isotropic (I) band / Thin filament → Actin.
* Dark / Anisotropic (A) band / Thick filament → Myosin.

] → Arr. ‖ as rod like str. & ‖ to longitudinal axis of myofibrils.

functional unit of contract^{n} → Sarcomere → $\left[\frac{1}{2}(I)+(A)+\frac{1}{2}(I)\right]$



V.V. Imp.

During Muscle Contraction :→

1) Z-line → comes closer 2) Sarcomere contracts
3) I-band shortens 4) A band → same.

Str. of Contractile Proteins

- Actins
  - Tropomyosin
  - Troponin
  - → Thin myofilaments
- Myosin → Thick myofilament

Thin Myofilament

Mg^{2+}

G-actins (globular) → F-Actin (polymer) (Filamentous) → for Myosin active binding site

2 F-actin helically wounded to each other.

Two filaments of Tropomyosin running close to F-actins.

Troponin ← TPM

- Troponin: masks active binding site of Myosin on actin filaments in resting state
- TPI: Inhibits Binding of Actin & Myosin
- TPC: Ca^{2+} Binding site

fig. Thin filaments

Thick Filament (Myosin) → polymer of Meromyosin

Meromyosin
- HMM (Cross arm)
  - Globular Head → projects outwards at regular distance & angle from Myosin surface
  - Short arm
- LMM → Tail

Globular Head → Active ATPase enzyme

Cross arm [Head + Short arm]

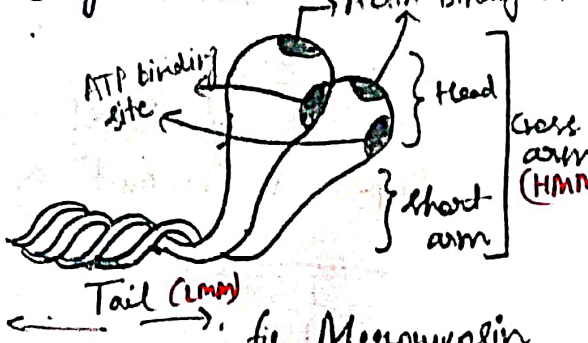
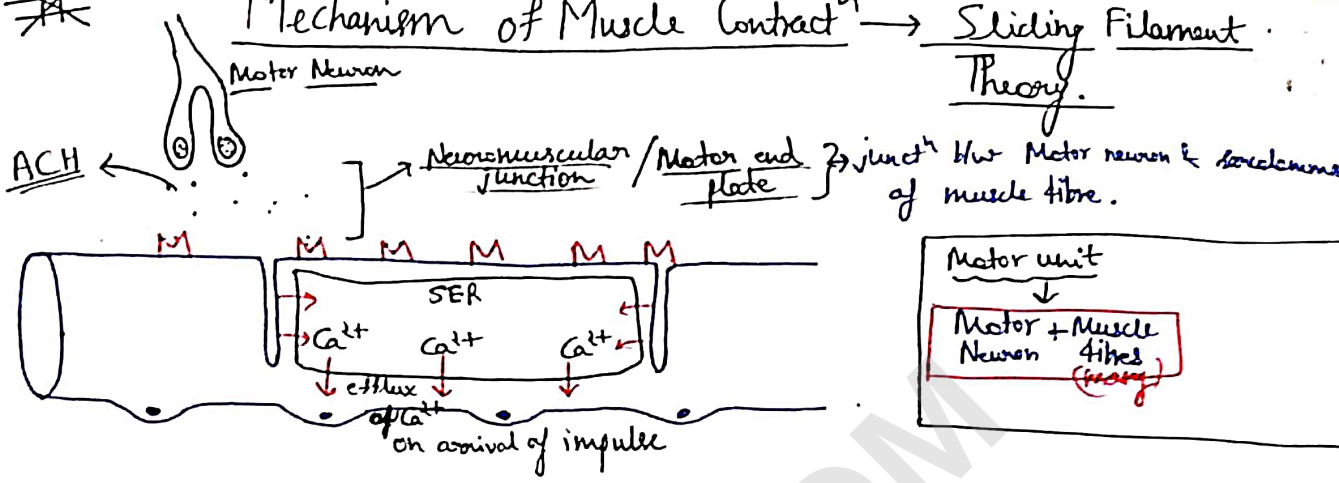


fig. Meromyosin (Mnemonics)

Mechanism of Muscle Contract^{n} → Sliding Filament Theory.



Steps of Muscle Contract^{n} :→

1) Generat^{n} of Act^{n} potential in Sarcolemma due to ACH. (Neurotransmitter)
2) Conduct^{n} of Impulse to SER → Ca^{2+} release in Sarcoplasm
3) Ca^{2+} → Bind to Subunit of Troponin ← Removal of Masking of active site for Myosin on Actin.
4) ATP Hydrolysis: $ATP + H_2O \xrightarrow[Mg^{2+}]{\text{Myosin ATPase}} ADP + P_i +$ Energy
   Used to form Cross Bridge b/w actin & Myosin filament [Myosin Head Binds to exposed Myosin binding site on actin].
5) ~~P_i releases~~ actin filaments pulled towards centre of A-band.
   ⇒ Z-line pulled inwards → Shortening of Sarcomere
   ⇒ I-band shortens → A-band → retains length. } Contract^{n} of muscle
6) ADP + P_i released → Myosin goes back to relaxed state.

Muscle Relaxat^{n}

7) New ATP binds → Cross bridge broken.

Process continues till Ca^{2+} pumped back to Sarcoplasmic Reticulum. cisternae. causing masking of actin again → Return of Z-line back to original posit^{n}. (Relaxat^{n}).

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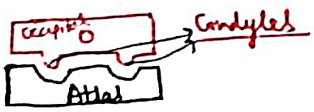
* Rxn time of Fibres → differ in diff. muscles
* Repeated activat^{n} of Muscle → accumulat^{n} of lactic acid due to anaerobic glucose breakdown.
  ↓
  Cause fatigue & pain



Types of Skeletal Muscle Fibres (MF)

Red M.F.

- → High Myoglobin content
- → Plenty of Mitochondria
- → Aerobic muscles
- → Low amt. of Sarcoplasmic Reticulum (slow & sustained contraction)
- → Rich blood supply → Don't fatigue easily

White M.F.

- → Low Myoglobin content
- → less mitochondria
- → Anaerobic muscles.
- → High amt. of Sarcoplasmic reticulum. (Rapid contrac
- → Poor blood supply.
- → Fatigue easily

Myoglobin → → Reddish pigment → Stores Oxygen.
→ In Muscles.

SKELETAL SYSTEM : → Bone + Cartilage (Framework)

Bone → Hard, Non pliable matrix ⇒ Ca^{2+} salts.

Cartilage → Solid, pliable matrix ⇒ Condroitin salts.

Funct^{n} → 1) Vital Organ Protect^{n} 2) Locomot^{n} & Movement
3) Mineral source (Ca^{++} etc.) 4) Long bones [Erythropoiesis]

Total bones [206] (Adult)

- Axial (80)
  - Skull (22)
    - Cranial (8) → Hard protective outer covering of [Cranium]
    - Facial (14)
  - Ear ossicles (6) — M (2) I (2) S (2) (Stirrup)
  - Hyoid (1) U-shaped (hanging)
  - Thoracic Cage (51)
    - Vertebrae (26)
    - Ribs (24) 12 pairs
    - Sternum (1)
- Appendicular (126)
  - Girdles
    - pectoral (2×2=4)
    - pelvic (1×2=2)
  - Limb bones
    - Fore Limb (30×2)
    - Hind Limb (30×2)

Skull → Articulates with superior region of vertebral column by two Occipital Condyles
[Dicondylic Skull]

Cranium (8)

- → Unpaired :→ Frontal, Occipital bone, Sphenoid (butterfly), Ethmoid
  - Occipital bone → Has foramen for spinal cord → Foramen Magnum
  - Sphenoid → Sella turcica
- → paired → parietal (2), temporal (2) → Has ear opening.

Occipital → Dicondyle → Atlas

Facial → Paired → Zygomatic bone → Cheek bones
→ Maxilla (upper jaw)
→ Nasal
→ Inferior Nasal concha
→ Palatine bone (palate)
→ Lacrimal

Unpaired
→ Mandible
→ Vomer

Hyoid → U-shaped → No joint → Provide surface for attachment of tongue muscles.
↳ at base of buccal cavity.

Thoracic cage

1. Vertebral Column :→ 26 → adult 33 → (embryo).
→ Dorsal
→ Forms Main Framework of Trunk. → Protect Spinal cord, support Head
→ Each Vertebrae → Neural Canal [Central Hollow Port"] → spinal cord passes through it.

V.C [$C_7 T_{12} L_5 S_{(5)} C_{(4)}$] adult

- Cervical (7) — Ex: in almost all mammals
- Thoracic (12) — point of attachment of ribs to musculature of back.
- Lumbar (5)
- Sacral (1-fused) (5 fused)
- Coccygeal (1-fused) (4) vertebrae

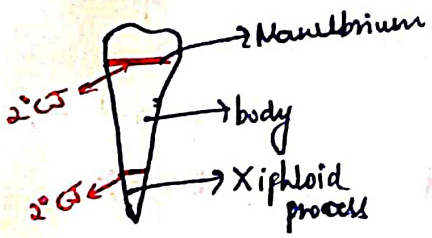
Neural canal → For spinal cord passing

V.C. → S shaped → essential for Bipedal Locomot"

2. Ribs :→ 12 pairs → thin flat bones attached :→
1) Dorsally → V.C. 2) Ventrally → Sternum. } True ribs → by Hyaline Cartilage
→ Has 2 articulat" surface on dorsal end ⇒ c/a Bicephalic

i) True ribs (7 pairs) → Vertebro-sternal ribs
ii) False ribs (8^{th}, 9^{th}, 10^{th} pair) → Vertebro-chondral ribs → articulate ventrally to 7^{th} ribs pair by Hyaline Cartilage
iii) Floating Ribs :→ (11^{th} & 12^{th} pairs) → Not connected Ventrally.

3. Sternum (1) → Ventral · dagger shape

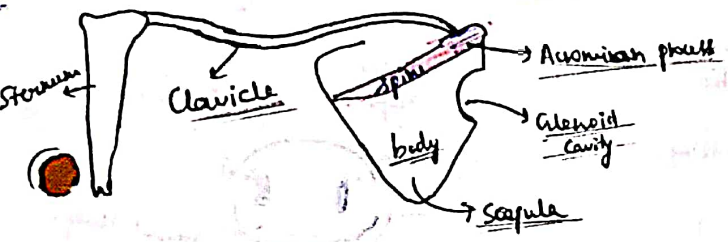


Appendicular Skeleton →

1. Pectoral Girdle (4) :

1. Scapula (2) :→ Large △, Dorsal, Flat bone → b/w 2nd & 7th Rib.
   (part of thorax)
   → Shoulder blade (another name)

   * Acromian process [projecting spine (slightly elevated ridge)]
     → Flat expanded
     → Articulated with Clavicle
   * Glenoid Cavity
     → Depression below Acromian process.
     → Articulates with Humerus.



2. Clavicle →→ Collar bone → Has 2 Curvatures.
   → long Dorsal→ Acrom. process Ventral→ Sternum.

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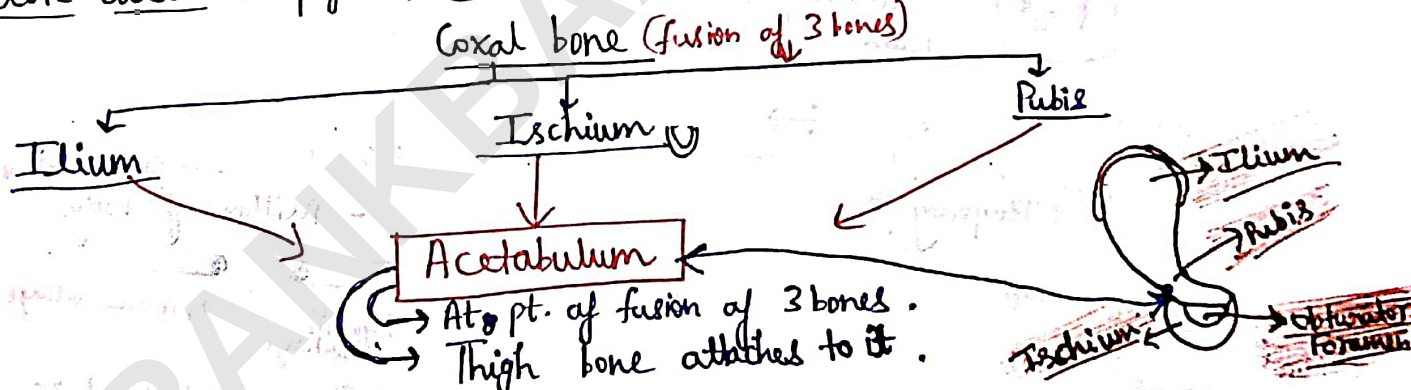
2. Pelvic Girdle (Hip girdle) (2) :→ 2 Coxal bones



* Pubic Symphysis :→ Fibrous Cartilage → attaches two coxal bones ventrally.

* Obturator Foramen → by Isch. & Pubis..

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3. Fore Limbs (30×2=60)

→ Humerus(1)(upper arm) → Radius (outer)(1) & Ulna(1)(inner) →(Lower arm)

→ Carpals (8) → Metacarpals (5) → Phalanges (14) : (2+3+3+3+3)
Digit formula → 23333

Hindlimb (30×2 = 60)

→ Femur(1) [Longest, Strongest, Thickest] → Tibia(1) & Fibula(1)

→ Tarsals (7) → Metatarsals (5) → Phalanges (14) : 23323

→ Patella (Knee cap) → 1 (Largest Sesamoid Bone) → Develop in Rectus Femoris's (Muscle) Tendon

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pt. of contact blw bones or ← bones and cartilages.

Joints → Act as Fulcrum.
→ Force generated by muscle carry out movement through joints

3 Structural Forms.

Fibrous Joints
Almost Immovable
→ Ligament

Cartilagenous Joints
→ Slightly movable
→ Cartilage

Synovial joint
→ Significantly movable & responsible for locomot°.
→ Hyaline cartilage
ligament
Synovial lining
Fibrous Capsule
Synovial Fluid

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1. Fibrous Joints :→

Examples
a) Sutural joints (blw skull bones) → Sutural ligament → Skull bone
b) Gomphosis → Teeth → Periodontal ligament → Gum

2. Cartilagenous Joint :→

1° CJ → Temporary jt.
Bone — bone
Hyaline cartilage
Ossificat° → Bone
eg.,

2° CJ → permanent jt.
→ Midline of body.
→ Fibrous cartilage
Hyaline cartilage

eg., 1) Intervertebral disc.
2) Pubic symphysis (Fibrous cartilage)
3) Manubrium
2° CJ
Body
2° CJ
Xiphoid process

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3. Synovial Jt. :→

1) Gliding jt. :→ eg., Intercarpal jts.
Intertarsal jts.

2) Hinge jt :→ eg., Elbow jt → Interphalangeal jt.
Knee jt.

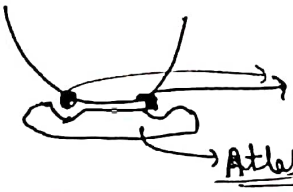
③ ∴ pivot jt → ↓↑ [illegible] → eg → Atlanto-axial jt ($C_1 \leftrightarrow C_2$) ("NO" type movement)
∴ → Radioulnar jt

④ Ball & Socket Jt. :→
- Shoulder jt (b/w Humerus & pectoral girdle)
- Hip jt. (b/w pelvic girdle & Femur)

⑤ Saddle jt :→

→ b/w Carpal & Metacarpal of Thumb
→ b/w Clavicle & Sternum

⑥ Condyloor / Ellipsoid Jt. :→ eg.→ Atlanto-occipital jt. (say "Yes")
→ wrist joint.
→ b/w ~~Carpals~~ & Metacarpals – phalanges



Disorders of Muscular & Skeletal System

1. Myasthenia Gravis :→ Auto Immune disorder → affect Neuro muscular junct^n [ACH is eaten up] → [Act^n potential X] → Causes Fatigue, weakening, paralysis of Skeletal muscles.
(Acetylcholinesterase enzyme)

2. Muscular Dystrophy :→ Genetic Disorder [Myotic Dystrophy].
→ Progressive Degenerat^n of Skeletal Muscle.

3. Tetany :→ Rapid spasm [wild contract^n] in muscle due to low Ca^{2+} level in blood. [Hypocalcemia].

4. Gout :→ Inflammat^n of jts. due to accumulat^n of uric acid crystals

5. Arthritis → Inflammat^n of jts. → Gouty Arthritis →
→ Rheumatoid Arthritis → Deposit^n of Pannus
↳ Autoimmune disorder.

6. Osteoporosis → ↓ levels of Estrogens is Common cause → ↓ collagen fibre synthesis
→ Age related → ↓ bones mass & ↑ chances of Fractures.