INTRODUCTION

1. Evolutionary Basis of Upper Limb Function

A. Adaptation to Upright Posture

i. Functional Changes

- Adoption of upright posture and bipedal locomotion:
  - Frees upper limbs from weight-bearing
  - Allows mobility away from the chest wall

ii. Functional Advantages

- Enhanced range of motion
- Improved manipulation capability
- Development of grasping and precision functions

B. Role of Thumb in Prehension

i. Opposability

- Separation of thumb from other digits
- Enables opposition → key for grasping

ii. Functional Outcome

- Hand becomes an effective grasping organ
- Facilitates:
  - Power grip
  - Precision grip

2. Types of Hand Grips

A. Basic Classification

i. Precision Grip

- Acquired later in evolution
- Involves:
  - Fingers + thumb
- Used for:
  - Fine tasks (e.g., holding pen)

ii. Power Grip

- More primitive
- Involves:
  - Entire hand
- Used for:
  - Strong grasping (e.g., holding tools)

B. Neurological Basis

i. Cortical Representation

- Large somatotopic area for hand in motor cortex

ii. Muscular Contribution

- Lumbricals and interossei:
  - High specialization
  - Important for precision movements

3. Hand as a Sensory Organ

A. Tactile Function

i. Specialization

- Hand acts as a tactile organ

ii. Mechanoreceptors

- Meissner's corpuscles:
  - Detect fine touch

B. Functional Role

i. Object Recognition

- Size and shape identification

ii. Vision Independence

- Recognition possible without visual aid

4. Structural Organization of Upper Limb

A. Connection to Axial Skeleton

i. Bony Connections

- Via:
  - Clavicle
  - Scapula

ii. Joints Involved

- Sternoclavicular joint
- Acromioclavicular joint

B. Role of Clavicle

i. Mechanical Function

- Acts as a strut:
  - Keeps limb away from trunk

ii. Articulation

- Connects axial skeleton to upper limb

C. Scapular Mobility

i. Independence

- Medial border free from vertebral column

ii. Functional Importance

- Allows wide range of movements

5. Shoulder Joint and Mobility

A. Structural Features

i. Joint Type

- Glenohumeral joint:
  - Highly mobile

ii. Stability vs Mobility

- High mobility → relatively less stability

B. Functional Integration

i. Shoulder Girdle Contribution

- Enhances:
  - Range of motion

ii. Movement Coordination

- Includes:
  - Scapular movement
  - Clavicular movement

6. Transmission of Forces

A. Pathway

i. From Upper Limb

- Forces transmitted via:
  - Clavicle

ii. Ligamentous Support

- Coracoclavicular ligament
- Costoclavicular ligament

7. Comparison: Upper Limb vs Lower Limb

A. Upper Limb

i. Mobility

- Designed for:
  - Movement
  - Manipulation

ii. Glenoid Cavity

- Shallow:
  - Allows greater mobility

B. Lower Limb

i. Stability

- Designed for:
  - Weight-bearing

ii. Acetabulum

- Deep:
  - Provides stability

8. Developmental Aspects

A. Pelvic Girdle Formation

i. Components

- Ilium
- Ischium
- Pubis

ii. Fusion

- Meet at acetabulum

B. Scapula Formation

i. Components

- Dorsal component:
  - Glenoid cavity (upper 1/3)
- Ventral component:
  - Remaining scapula (lower 2/3)

9. Axis of Limbs

A. Upper Limb

i. Pre-axial Border

- Thumb
- Radius

ii. Post-axial Border

- Little finger
- Ulna

B. Lower Limb

i. Pre-axial Border

- Great toe
- Tibia

ii. Post-axial Border

- Little toe
- Fibula

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10. Rotational Changes During Development

A. Upper Limb Rotation

i. Direction

- Lateral rotation (~90°)

ii. Outcome

- Flexor surface faces anteriorly

B. Lower Limb Rotation

i. Direction

- Medial rotation

ii. Outcome

- Flexor surface faces posteriorly
- Sole faces downward

11. Functional Orientation in Adult

A. Upper Limb

i. Position

- Palm faces anteriorly
- Limb directed laterally

B. Lower Limb

i. Position

- Sole directed inferiorly
- Limb aligned for weight-bearing