# The Development of Reach, Grasp, Release and Manipulation

## NEWBORN

- Soft tissue constraints at shoulder-
  - anterior deltoid, subscapularis, scapular-humeral tightness
  - Elbow – lateral epicondyle and anterior capsule
  - Wrist – ulnar side of wrist and finger flexors

- Random movements assist in lengthening of muscles (gravity assisted)

- Total synergies horizontal humeral abduction, elbow extension wrist and finger extension with abduction

- Hands come to body with humeral internal rotation, forearm pronation, elbow flexion, wrist and finger flexion and adduction

- Prone position allows for hand to mouth and mouth to hand activity (rooting)

- Prone position vital for comfort and modulation

- Strong tactile input to face chest and long finger and wrist flexors

- Grasp reflex strong – ulnar side strongest (lumbricales on this side, postural muscles of the hand)

- Ambient vision strong prefers high contrast (black and white), bright colors

## TWO MONTHS

- Asymmetrical extension not balanced by active flexion provides stability for visual regard and reach

- Swiping at objects on face side

- Prone-humeral abduction, gives wide base of support

- Grasp object placed in hand and maintains while arm moves through space

- Brings object to mouth, looks from object to hand

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**THREE -FOUR MONTHS**

- Bilateral symmetrical muscle activity allows for reach with humeral adduction, external rotation and elbow flexion with wrist and finger extension
- Reach visually directed, not accurate
- Prone weight bearing on forearms with pectoral, abdominal synergy, deltoid and rotator cuff activity
- Primitive weight shift with shortening on the face side gives some disassociation between right and left sides of body.
- Mouth continues to be used as third hand
- Plays with feet in sitting (accommodation)

**FIVE MONTHS**

- Reach with humeral forward flexion, elbow extension, neutral forearm rotation and wrist and finger extension
- Lateral weight shift in prone leads to reaching with one hand
- Palmar grasp
- Beginning of release transfer of object from hand to hand with mouth used as intermediary

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**SIX MONTHS**

- Reaches for feet in supine allows for accommodation of hands around body parts (shaping using intrinsic muscle activity)
- Triceps activity allows for weight bearing through the hands
- Rocking on hands and knees elongates wrist and long finger flexors
- Return to forearm weight bearing for unilateral reach, creating mechanical supination, wrist extension with radial deviation
- Bilateral visually guided, directed, accurate reach, with humeral flexion, elbow and wrist extension
- Grasp is radial palmar, use wrist flexion and extension to manipulate object
- Rakes at small objects with active finger flexion and extension
- Release through transfer with mouth used as an intermediary
- Experiments with food, to get more movement through the hand

**SEVEN-NINE MONTHS**

- Unilateral reach with object brought into midline with both hands
- Objects can be held in each hand
- Supination in space with humeral adduction or support on surface
- Radial digital grasp emerging
- Lateral (key) grasp with smaller objects. Index finger extended or flexed and thumb hyperextended. (narrow web space)

- Shoulder girdle depressed (lower trap) reach with forward flexion, external rotation, elbow extension
- Through diagonal weight shift, moving from sit to 4-point and back, thumb moves away from palm with extension at MP joint (increase size of web space)
- Arches in hand develop through weight shift over hand and crawling over a variety of surfaces
- Radial-ulnar disassociation allows for child to stabilize object on the ulnar side and grasp another on the radial side.
- Strong grasp with PIP'S and DIP joints radial digital grasp
- Beginning movement toward pincer but prefers lateral grasp
- Self feeding experiences allow for child to develop isolated finger control necessary for in-hand manipulation
- Release with supination/pronation or wrist flexion

**TEN MONTHS**

- Reach is feedforward generated for familiar objects
- Reach with supination in space with elbow flexion
- May use tactile system to grasp without visually direction
- Approach objects with radial side of the hand
- Index finger strong and points, plucks and probes with good strength
- Inferior pincer grasp (web space collapses), ulnar side flexed and stabile

- Play schemes developed in sagittal plane (banging on surface), frontal plane (clearing the table)

**TWELVE MONTHS**

- Good bilateral integration, uses both hands to grasp, may hold container with one hand and place objects in
- Beginning symbolic play using objects for a purpose-brush teeth, comb hair, use spoon (tool use)
- Uses supination/pronation, radial and ulnar deviation to change the perspective of objects
- Gestural imitation with both hands – pat-a-cake, peek-a-boo, so-big, itsy-bitsy spider
- Strong web space and stability at the CMC and MP joint. PIP and IP joint strong with precise control developing
- Tool use – digital pronated grasp with wrist flexion and ulnar deviation

**EIGHTEEN- TWENTY-FOUR MONTHS**

- Arm swing present during gait, UE'S move freely in space to carry objects
- Digital manipulation used for daily life skills, assist with dressing and drawing
- Uses whole hand to grasp crayon with supination---digital pronate grasp (pronation) ----radial digital grasp with thumb and first two digits

- Pincer grasp for small objects and translation to palm develops---palm to finger translation (24-36 months)
- Self-feeding experience with utensils assists in manipulative skills. Whole hand digital pronate grasp of spoon with pronation and humeral abduction
- Radial grasp will lead to supination and humeral external rotation

## TYPES OF GRASP

### A. PALMAR GRASPS

- **RADIAL –PALMAR**- involve the palm and digits on the radial side.
- **POWER GRASP or FULL PALMAR GRASP**- the entire palm is active in grasping powerfully heavy or a large object
    1. Carrying a suitcase
    2. Holding a baseball bat
    3. Hammering

**CYLINDRICAL GRASP-** the digits move away from the palm. Used for large objects and less power. The majority of the input comes from the digits. Removing a can from the cabinet

1. Shaking a can
2. Holding a cup

**SPHERICAL GRASP**- involves 3-4 radial digits. The fingers are in contacct with the lateral aspect of the object. Important for disassociation between radial and ulnar side of the hand.

1. Carrying an egg
2. Throwing a ball
3. Opening a jar

### B. DIGITAL GRASPS

Object held with opposed thumb and fingertips of radial digits. Space visible between palm and digits.

- **RADIAL-DIGITAL GRASP/THREE-JAW CHUCK**- object held with thumb and fingertips of two fingers. Requires disassociation between radial and ulnar side of the hand
    1. Putting on glasses
    2. Finger feeding
    3. Removing a screw

- **SCISSORS GRASP**- small object held between thumb and proximal side of curled index finger

- **INFERIOR PINCER GRASP** – small object held between ventral surface of the thumb and index finger.

- **LATERAL PINCER GRASP**- small object held between lateral side of index and ventral surface of adducted thumb.
    1. Using a key
    2. Zippering

3. Snaps
4. Using a remote

- **PINCER GRASP**- small object held between distal pad of thumb and index finger.
    1. Buttoning
    2. Turning a page
    3. Placing a coin into machine

- **SUPERIOR PINCER GRASP**- small object held between fingertip of thumb and index finger.
    1. Threading a needle
    2. Putting on earrings

**C. IN-HAND MANIPULATION**- In- hand manipulation is a form of precision handling in which an object is adjusted within the hand after it is grasped (Exner, 1989)

Exner identified three types of in-hand manipulation skills:

- **TRANSLATION**- moving small objects from fingertips to storage in the palm of the hand or the retrieving objects from the palm to the fingertips for action.
- **SHIFT**- moving the fingers linearly on an object.
- **ROTATION**

    **SIMPLE ROTATION**- rolling a small object between the pads of the thumb and fingers

    **COMPLEX ROTATION**- using thumb and fingers to turn an object end over end.

Exner differentiated between translation, shift, and rotation with and without stabilization. Without stabilization happens when a single object is manipulated. With stabilization happens when multiple objects are manipulated in the palm.

**DEVELOPMENTAL NORMS FOR IN-HAND MANIPULATION**

- **TRANSLATION**
  - Fingers to palm
    Without stabilization: 1-11/2 years
    With stabilization: 2-21/2 years
  - Palm to fingers
    Without stabilization: 3-31/2 years
    With stabilization: 6-7 years
- **SHIFT**
  Without stabilization: 3-31/2 years
  With stabilization: 3-31/2 years
- **ROTATION**
  Without stabilization: 2-21/2 years
  With stabilization: 3-31/2 years

Exner, Charlotte- reference