Development of hand function

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Purpose of this presentation
• To have a good understanding of the complexity + importance of fine motor skill development while working as a pediatric OT
• To be intrinsically motivated to learn more about this subject
• To develop a creative and critical thinking attitude while working with children

Relevance of “hand” function
• 30-60% of children’s time is spent on fine motor activities
• 85% of children’s time spent on “writing” tasks
• 20 % have serious fine motor problems

Table of content
• Very complex!
• Level 1: Sensori-motor component
• Level 2: Developmental progress of fine motor skills
• Level 3: Hand function performance
• Treatment principles: examples

A Very complex concept

Hand function evaluation model

LEVEL 3
Hand function performance
Writing  Buttoning

LEVEL 2
Developmental progress of fine motor
Cognition  Perception

LEVEL 1
Sensori-motor component
Grip  ROM  Dexterity  Stereognosis
1. Manual gesture
2. Body contact hand skills
   Adaptive skilled hand use
   3. Grasping
   4. Holding
   5. In-hand manipulation
   6. Releasing
   7. Isolated finger movement

Arm-hand use
8. Reaching
9. Turning
10. Carrying
11. Moving
12. Catching
13. Throwing
14. Stabilising

Bimanual use
15. Transferring
16. Using both hands simultaneously
17. Using both hands cooperatively

Quality of hand skills
18. Accuracy
19. Pace
20. Movement quality

Assessment of children's hand skills (ACHS)

"Hand function is critical to interaction with the environment"

Hand function evaluation model

LEVEL 3
Hand function performance

LEVEL 2
Developmental progress of fine motor

LEVEL 1
Sensori-motor component

Sensori motor components:

LEVEL 1
- Development
- Observation
- Assessment

": Social, emotional and intellectual development, etc. (AHHS)

Sensori motor components:

LEVEL 1
Development

Hand function evaluation model

LEVEL 3
Hand function performance

LEVEL 2
Developmental progress of fine motor

LEVEL 1
Sensori-motor component

"Hand function is critical to interaction with the environment"

Development concepts

An example
Sensori motor concepts of hand function

- Hand skills emerge through interaction of
  - Perception: vision and touch
  - Posture
  - Somatosensory issues

Why is postural control needed for hand skills development?

- Neuromotor functions are needed for postural control
  - Postural stability/control is needed for stability UE
  - Stability UE is important for fine motor skills

Development of postural control

Sensori motor components:

LEVEL 1
Observation/pathology
Typical problems with postural control

- Disorders in muscle tone
- Continued presence of primitive reflexes/reactions
- Cognitive problems
- SI problems
- Abnormal coordination of muscle function (*co-contractions)

Signs of ↓ postural control?

- Arms held close to their body
- Shoulders are elevated
- Neck muscles are ‘short’, throat muscles are ‘long’, ears next to shoulders
- High tone in wrist, fingers & shoulders
- Less dissociation at wrist & fingers (poor in hand manipulation skills)

How do you observe problems with postural control?

- Child with low muscle tone
  - back in kyphosis (round spine)
  - pelvis inclined (at sacrum)
  - hold their head
  - trunk is leaning to the bench/table -> find stability

- Child with poor co-contraction trunk
  - have difficulties maintaining postural stability
  - have a hard time to sit still
  - are constantly ‘moving’ on their chair

- Child with trunk rotation issues
  - insufficient dissociation head versus trunk
  - move their trunk as 1 piece
  - Child with balance issues
  - need 1 or 2 arms on the table to maintain an upright position
  - have a hard time to sit still
  - are constantly ‘moving’ on their chair

- Let the child make slow, ritmic movements UE --> quality is important!
- This assesses function in cerebellum
- Shoulderstability is necessary-->agonist/antagonist
Supine-extension position

- Indication of strong extension tone -> trunk
- Child of 6 years – at least 30 sec

Prone-flexion position

- Due to vestibular-proprioceptive input a child is able to put head and trunk ‘upright’
- Important to observe an “active chin tuck”

Arm-extension with head movements

- Observation of “trunk” rotation when passively turning head
- Observation of dissociation between head and arm-movements
- Observation of “choreo” type movements in fingers (might be leisure at basal ganglia)
- A fair amount of dissociation crucial for moving arms independently

Finger-nose test

- Touching your nose with the tip of your finger
- Observation of intention tremor
- When eyes are open -> insufficient cerebral coordination
- When eyes are closed -> good development of kinesthetics i.e. body awareness

Diadochokinesis
### Diadochokinese
- Observation of tempo, regularity, differences between right and left
- Provides information on motor development ‘progress’
- Provides information regarding ‘lateralisation’ problems
- More information Njiokiktjien 1993

### Finger-opposition
- Observation tempo each hand + precession of finger/thumb touch
- Girls do this better than boys
- When not sufficiently done (no good precision + no fluent movement) -> problems in kinesthetic feedback circle
- Example systematic forgetting 1 finger -> Fingeragnosie -> problems with cortical differentiation

### Sensori motor components:

#### LEVEL 1

**Treatment**

- Reach, grasp & release in different planes are facilitated while straddling a bolster
- Therapist provides support to the UE
- Positioning for toy in midline facilitates bilateral UE involvement & decreases the need for trunk rotation

### Treatment principles

- Work vertically instead of horizontally
- Use extension provocative exercises around the shoulder girdle
- Use exercises that strengthen the shouldergirdle
- Ensure sufficient cocontraction between belly and back muscles
- Learn the child to move shoulder and wrist independently from each other

### SI and Postural control
Milestones of fine motor developmental

**Level 2**

"Hand skills emerge through the interaction of systems"

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**Components of hand function**

**Effective use of hands to engage in ADL**

- Fine motor skills
- Visual skills
- Visual perceptual skills

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**Development of hand function**

- Reach
- Hand reflexes: foundations of grasp patterns
- Grasp
- In-hand manipulations
- Voluntary release
- Bilateral hand use

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**Developmental concepts**

- Influencing factors
  - culture
  - social factors
  - cognitive function
  - visual perception
  - sensory integration
  - somatosensory awareness
  - motor and physical factors

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**Hand function evaluation model**


- **Level 3**
  - Hand function performance
    - Writing
    - Buttoning
    - Artwork

- **Level 2**
  - Developmental progress of fine motor
    - Cognition
    - Perception
    - Environment

- **Level 1**
  - Sensori-motor component
    - Eye
    - Nose
    - Ear
    - Mouth
### Development of hand function

- **Prehension** = manual control
  - **REACHING:**
    = moving hand from initial location to target location (involves 70-80% of time)
  - **GRASPING**
    = shaping of hand around object
    = primitive & transitional grasps
    = purposeful grasp

### B) Reflexive behavior that influence grasp

- Current research: thumb sucking foetus
- Relationship early reflexes/grasp
- If certain reflexes fail to develop/diminish
  -> purposeful prehension affected
- Knowledge of expected reflex maturation
  -> ESSENTIAL

### Reflexive behavior that influence grasp

- ATNR
- Traction response
- Avoiding response
- Grasp Reflex
- Instinctive grasp response

### Asymmetric Tonic Neck Reflex

### Traction Response

- Proprioceptive phase = contactual phase
Traction Response

Avoiding Response

Grasp Reflex

Instinctive grasp reaction

C) Development of grasp: prehension

Development of grasp
- The ulnar grasp
- The digito-palmar grasp
- The radio-palmar grasp
- The radio-digital grasps
Developement of grasp

D) Detailed information on transitional grasps

Reflex squeeze grasp

Crude palmar grasp

Radial palmar grasp

Raking grasp
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<th>Developmental scissors grasp</th>
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Treatment principles

Examples

Functional/purposeful grasps

• Cilinder grasp

Exercises on cilinder grasp

3 jaw chuck
Inferior pincer grasp
Superior Pincer grasp

REFERENCES

- Burns Y (1992): NSMDA: Physiotherapy Assessment for Infants & Young Children Brisbane: CopyRight