# Development of hand function

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## Purpose of this presentation

- To have a good understandig 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

(Netherlands, 1995)

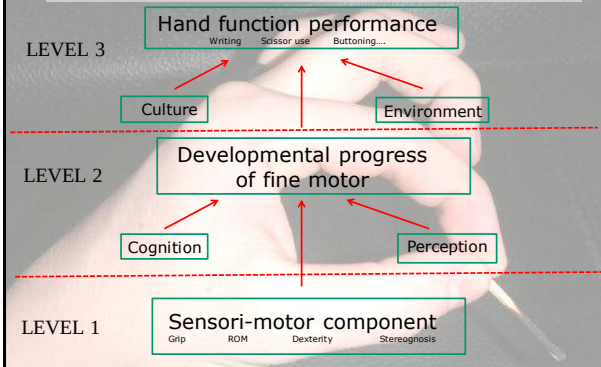
## Table of content

- 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

By Li-Tsang C.W. P. (2003). Britisch journal of developmental Disabilities, 49, 99-110,



**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)

Leisure and play

School-related work

Activities of daily living

## Sensori motor components:

## LEVEL 1

- **Development**
- **Observation**
- **Assessment**

"Hand function is critical to interaction with the environment"

## Hand function evaluation model

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LEVEL 3

Hand function performance
Writing Scissor use Buttoning....

Culture

Environment

LEVEL 2

Developmental progress of fine motor

Cognition

Perception

LEVEL 1

Sensori-motor component
Grip ROM Dexterity Stereognosis

## Sensori motor components:

## LEVEL 1

**Development**

## Development concepts

Through vision & touch

is motivated for

exploring objects within environment

via perception

feedback is provided about performance

in order to learn that action causes reaction

as a result

develops haptic perception

## 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

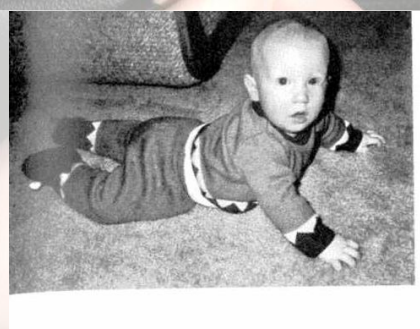
↓

Postural stability/control is needed for stability UE

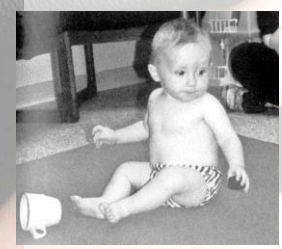
↓

Stability UE is important for fine motor skills

## Development of postural control



## Development of postural control



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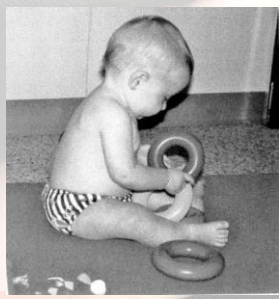
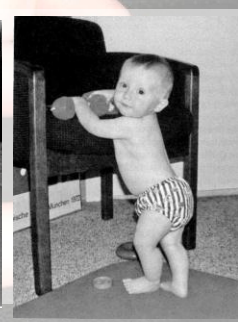




## Sensori motor components:

## 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 dissocation 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

**How do you observe problems with postural control?**

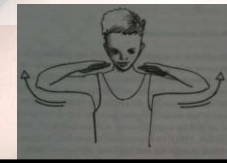
- Child with poor co-contraction trunk
  - have difficulties maintaining postural stability
  - have a hard time to sit still
  - are constantly 'moving' on their chair

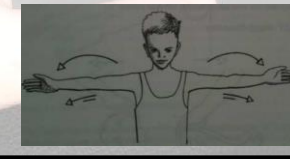
**How do you observe problems with postural control?**

- 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 positition
  - have a hard time to sit still
  - are constantly 'moving' on their chair

**Assessment of postural control?**

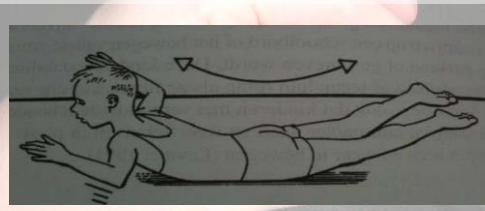
- Let the child make slow, ritmic movements UE –> quality is important!
- This assesses function in cerebellum
- Shoulderstability is necessary–>agonist/ antagonist





## Supine-extention position

- Indication of strong extension tone ->trunk
- Child of 6years – 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

## Armextension 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 dissocation crucial for moving arms independently

## Finger-nosetest

- Touching your nose with the tip of your finger
- Observation of intentiontremor
- 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 + precesion of finger/thumb touch
- Girls do this better than boys
- When not sufficiently done (no good precision + no fluent movement) -> problems in kinesthetic feedbackcircle
- Example systematic forgetting 1 finger -> Fingeragnosie -> problems with cortical differentiation

## Sensori motor components:

## LEVEL 1

## Treatment

## Treatment principles

- Work vertically instead off horizontaly
- Use extension provocative exercises around the shoulder girdle
- Use exercises that strenghten the shouldergirdle
- Ensure sufficcient cocontraction between belly and backmuscels
- Learn the child to move shoulder and wrist independently from each other

- 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

## SI and Postural control

# Milestones of fine motor developmental

# Level 2

"Hand skills emerge through the interaction of systems"

## Hand function evaluation model

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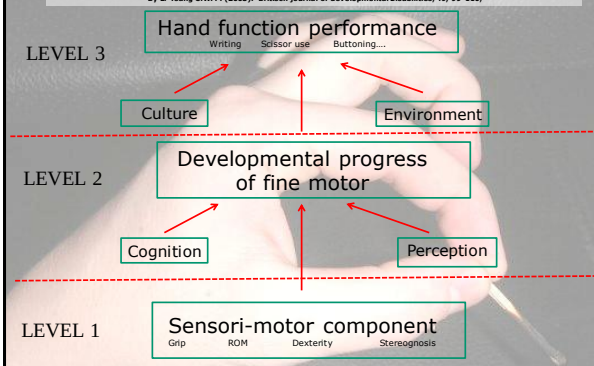



## Components of hand function

*effective use of hands to engage in ADL*

*is dependent on COMPLEX interaction of visual-perceptuale fine motor funtion*

- *Fine motor skills*
- *Visual skills*
- *Visual perceptual skills*

## Developmental concepts

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

## A) Basic principles of the development of handfunction

## Development of hand function

Reach

Hand reflexes: foundations of grasp patterns

Grasp

In-hand manipulations

Voluntary release

Bilateral hand use

## 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

## 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

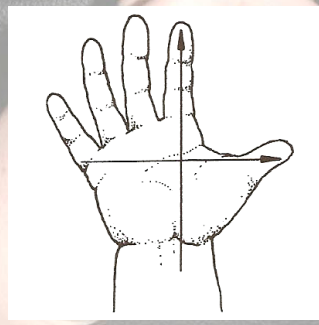
## Instinctive grasp reaction

## C) Development of grasp: prehension

## Development of grasp

- The ulnar grasp
- The digito-palmar grasp
- The radio-palmar grasp
- The radio-digital grasps

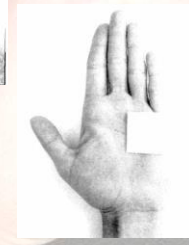
## Developmentalof grasp



## D) Detailed information on transitional grasps

## Reflex squeeze grasp

## Crude palmar grasp





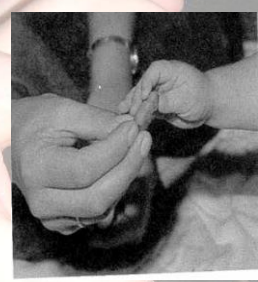
## Radial palmar grasp

## Raking grasp

## Radial digital grasp


## Developmental scissors grasp


## Inferior pincer grasp

## Three Jaw chuck

## Pincer grasp


## Neat pincer grasp

# Treatment principles

**Examples**

## Functional/purposeful grasps

- Cilinder grasp

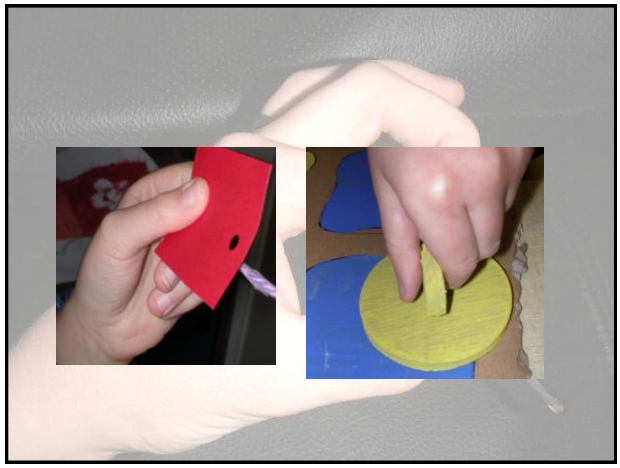
## Exercises on cilinder grasp

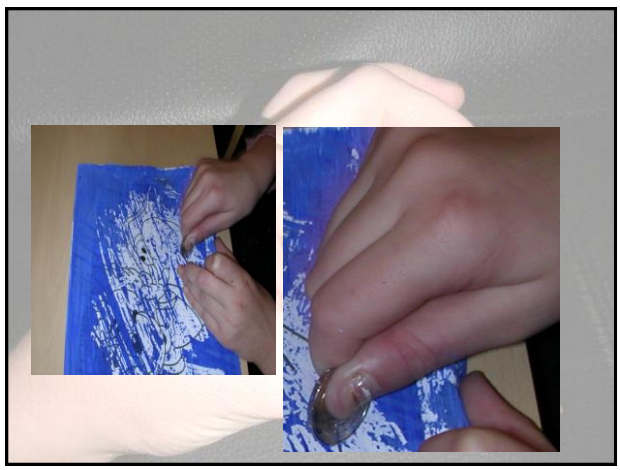


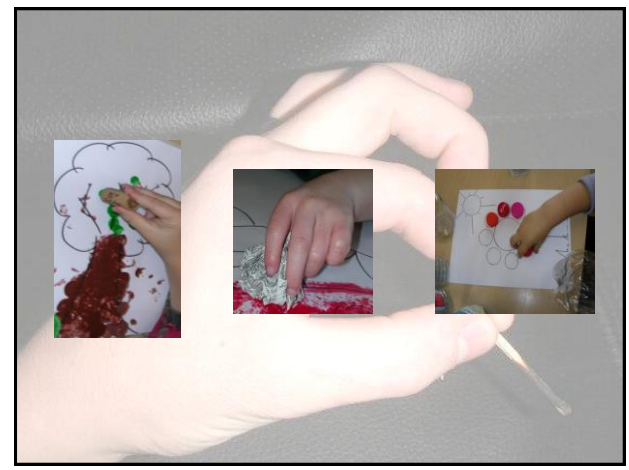


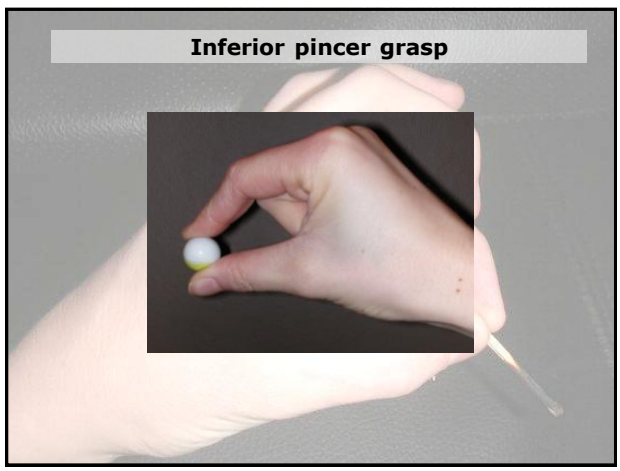


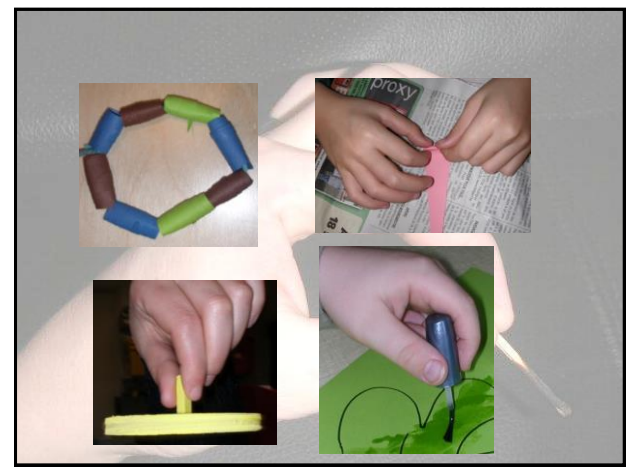
## 3 jaw chuck



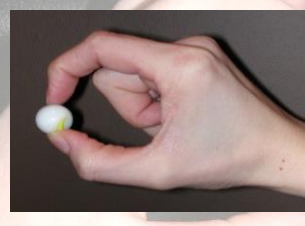


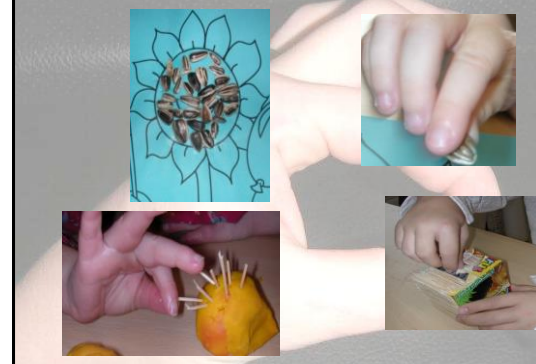



Inferior pincer grasp



## Superior Pincer grasp



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