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THE TREATMENT OF THE PEDIATRIC HAND PATIENT: PART I

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The Pediatric Hand Therapy patient: Who are They

- Smaller size/various sizes:
  - Body composition
- Limited attention span
- Limited understanding
- Fearful

The Pediatric Patient:

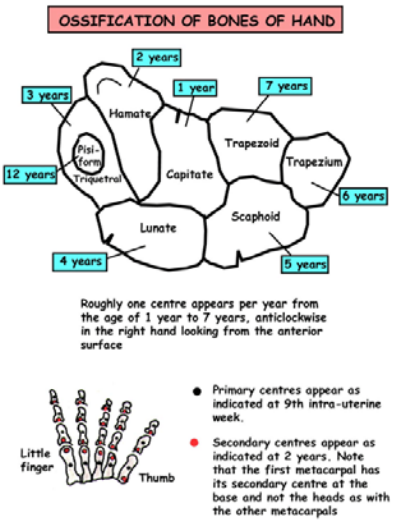
- Don't sit still: work with movement
- Don't get as much resultant stiffness
- Heal quickly
- Must deal with parents/caretakers

The Pediatric Patient:

- Developing systems: muscle, neurological, skeletal, cognitive, language.
- Know your development to better understand your patient.

Imaging: Bone Ossification

- The Wrist:



The Evaluation:

- **Observation:**
  - Posturing
  - Movement of extremity with use:
    - Visual Estimate
  - Avoidance
  - Color
  - Creases

Pain

- Observational pain scales: FLACC
- Wong Baker Faces Pain Scale
- Visual/verbal Analogue (age 7 and up or parent)

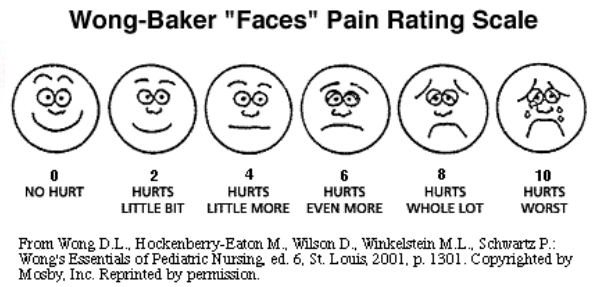
- Child Care Health Dev. 2003 Jul;29(4):281-90.
- **Predictors of a child's ability to use a visual analogue scale.**
- Shields BJ[1], Palermo TM, Powers JD, Grewe SD, Smith GA.

FLACC Scale:

- The FLACC Scale is a validated behavioral pain assessment tool for nonverbal infants and children ages two months to seven years. The scale rates the infant in five categories: face, legs, activity, cry and consolability. Scores range from 0-10. To interpret the scores, a score of 0 equates to no pain, 1-3 is mild discomfort, 4-6 is moderate discomfort and 7-10 is severe discomfort/pain or both.
- (Merkel, Voepel-Lewis, & Malviya, 2002).

Wong Baker Faces Pain Scale

- Ages: 3 and up (10)



From Wong D.L., Hockenberry-Eaton M., Wilson D., Winkelstein M.L., Schwartz P.: Wong's Essentials of Pediatric Nursing, ed. 6, St. Louis, 2001, p. 1301. Copyrighted by Mosby, Inc. Reprinted by permission.

Range of Motion/Movement

- Goniometry: age of accuracy
- Observation/description
- Active vs. passive
  - Reliable
  - Valid

Movement Scales/Use scales:

- Diagnosis specific
  - Mallet
  - Active Movement Scale
  - House Scale
  - Kapandji

Mallet Scale:

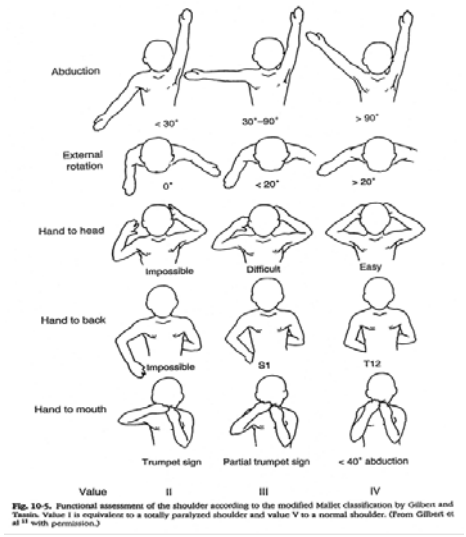


Fig. 10-5. Functional assessment of the shoulder according to the modified Mallet classification by Gilbert and Tanzis. Value I is equivalent to a totally paralyzed shoulder and value V to a normal shoulder. (From Gilbert et al [1] with permission.)

Active Movement Scale

- Brachial Plexus Palsy
- Infant

- J Hand Surg Am. 2002 May;27(3):470-8.
- ***The active movement scale: an evaluative tool for infants with obstetrical brachial plexus palsy.***
- Curtis C, Stephens D, Clarke HM, Andrews D.

Name:	Date of Birth:	MRN # or FIN #

ACTIVE MOVEMENT SCALE

Observation		Involved Side:	RIGHT	LEFT	
Gravity Elimitated	**Score**		**Against Gravity**		**Score**
No contraction	0		Motion < 1/2 range		5
Contraction, no motion	1		Motion > 1/2 range		6
Motion < 1/2 range	2		Full Motion		7
Motion > 1/2 range	3				
Full Motion	4				

DATE:					
Shoulder Adbuction					
Shoulder Adduction					
Shoulder Flexion					
Shoulder External Rotation					
Shoulder Internal Rotation					
Elbow Flexion					
Elbow Extension					
Forearm Pronation					
Forearm Supination					
Wrist Flexion					
Wrist Extension					
Finger Flexion					
Finger Extension					
Thumb Flexion					
Thumb Extension					

Active Movement Scale Use and Rules

1. Full AROM with gravity eliminated (muscle grade 4) must be achieved before AROM against gravity is scored (grades 5 to 7)
2. Movement scores assigned within the available PROM
3. Movement grades assessed within age appropriate ROM, with uninvolved contralateral side
4. Extension of digits assessed at the MP joints
5. MP flexion assessed by observing distance at rest between fingertips and palm, then observe AROM as a graction of that distance, with and withouth gravity
6. Digit flexion or extension is given a single grade by using the movement score of the best digit.

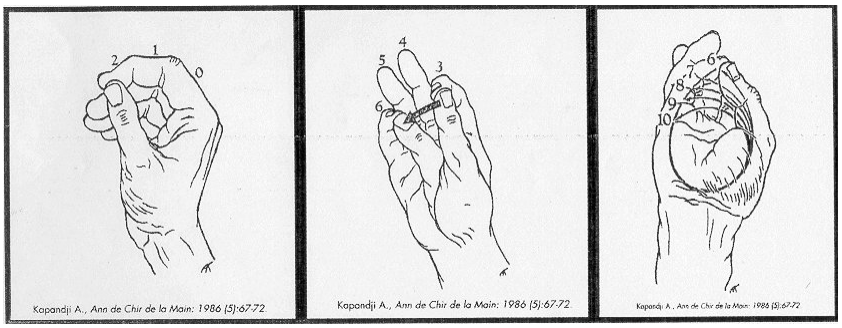
House Scale:

- CP population

L	R	Functional Use of Hand/HOUSE Scale
		0= hand not used in task
		1= uses as stabilizing weight only
		2= can hold onto object placed in hand
		3= can hold onto object and stabilize it for use by other hand
		4=can actively grasp object and hold it weakly
		5= can actively grasp object and stabilize it well
		6= can actively grasp object and manipulate it against other hand
		7= performs bimanual activities easily and occasionally uses the hand spontaneously
		8= uses hand independently of the other hand--normal
L	**R**	**Functional Use of Forearm/ Hand not Used**
		Arm not used in task
		Used as paper weight only
		Used actively for bimanual task and held weakly against forearm; weak flex/ext of elbow
		Used actively for bimanual task and stabilized well; active flexion/extension of elbow

Kapandji test for Opposition:

Kapandji A., Ann De Chir De la Main: 1986 (5); 67-72



Sensibility/Sensation

- Questions
- Light touch
- Stereognosis

Sympathetic Function:

- Sudomotor: sweating
- Vasomotor: skin color and temp.
- Pilomotor: gooseflesh response
- Trophic: skin texture, soft tissue atrophy ('penciling' of finger tips),nail changes, hair growth, rate of healing

Hunter, Mackin, Callahan; Rehabilitation of the Hand, 5th edition, Mosby

Strength

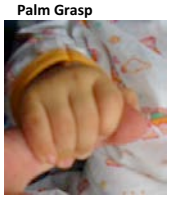
- Grip/pinch: ages
- Functional strength

Grasp Patterns

- Developmental Grasp:

Grasp Patterns:

Palm Grasp



Radial Digital Grasp

Inmature Pincer

3 Jaw Chuck

Mature Pincer

Inferior Pincer Grasp

Wounds/ Edema

- Description
- Infants: difficult to assess
- Location
- Size: length, width, depth
- Color: red, yellow, black
- Odor: pungent, musty, sweet
- Temperature
- Integrity: tunneling, undermining, sinus tracts
- Drainage: sanguinous, serosanguinous, serous, purulent, foul purulent

Scar evaluation:

- Description
- Measure

Vancouver Scar Scale: Burns

Pigmentation

Vascularity

Pliability

Height

Dexterity/coordination

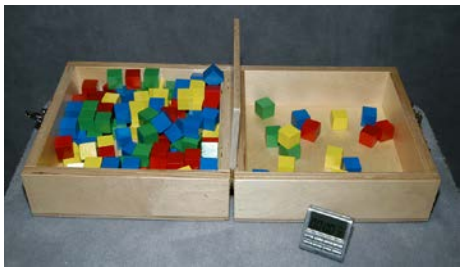
- Nine Hole Peg Test
- Box and Blocks
- Jebsen Hand Function
- BOT 2
- Functional Dexterity Test

Nine Hole Peg Test:

Norms: Ages 4 – 19
Quick
Standard and valid
Speed and dexterity with grasp/release

Box and Blocks:

- Ages: 6-19
- Simple, inexpensive, effective method of evaluating manual dexterity.
- Standard and reliable.



Mathiowetz, V., Federman, S., Wiemer, D., , Box and Block Test of Manual Dexterity: Norms for 6-19 Year Olds. CJOT, VOL. 52, No. 5, December 1985, pgs 241-245.

Jebsen Test of Hand Function:

- The JHFT consists of 7 items that measure: (a) fine motor skills; (b) weighted functional tasks; and (c) non-weighted functional tasks (Jebsen et al., 1969): Ages 8 or greater.

- Writing a short sentence (24 letters, 3rd grade reading difficulty)
- Turning over a 3x5 inch card
- Picking up small common objects
- Simulated feeding
- Stacking checkers
- Picking up large light cans
- Picking up large heavy cans

BOT 2:

Bruininks-Oseretsky Test of Motor Proficiency – 2nd Edition (BOT-2)

- Designed to assess motor skills, including differentiated measures of gross and fine motor proficiency.
- Ages 4-19

Functional Dexterity Test:

- Norms: ages 3-17 (per new article)
- Portable
- Time: 15 to 20 minutes
- Dynamic in hand manipulation

Outcome or Functional Evaluation:

- PODCI: The Pediatric Outcomes Data Collection Instrument
- CHEQ: Children's Hand-use Experience Questionnaire. Hemi involved children/adol.
- CHAQ : Childhood Health Assessment Questionnaire. Arthritis.
- PEDI: Pediatric Evaluation of Disability Inventory
- MACS: CP, functional description

Goals of Treatment:

- Parents/caregivers as providers
- Parent goal of treatment
- Return to Occupations:
  - Play
  - ADLs
  - School
  - Hobbies

The Treatment/Evaluation Setting:

- Can not see them in typical clinic setting
- Child sized table/chairs
- Toys
- Calming/comforting environment

Equipment:

- Adjustable heights
- Evaluation Equipment
- Toys: Not exercise equipment
- Mat

Therapy Equipment:

- Toys:
  - Small manipulatives
  - Large grasp items
  - Mobility toys: push/pull/ ride
  - Grip and pinch strength
  - Sports

Treatment:

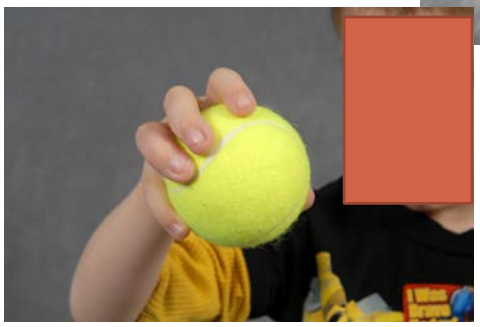
- Scar management:
  - Massage
  - Elastomer
  - Silicone gel
  - coban

Treatment:

- **Motion**
  - Active
  - Passive
  - Dynamic

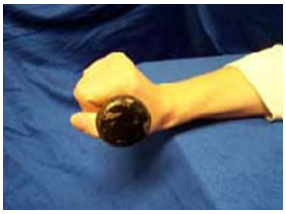
Treatment

- **Strength**
  - Grip
  - Pinch



Activities to Promote Grasp and Grip Strength

- Place rice, beans or pasta in a bucket
- Koosh balls
- Rattles
- Magnet, Velcro, and felt boards- Place numbers or letters on board
- Jenga, building block sets
- Fishing games
- Pegboards, pop beads
- Water squirt and air squirt toys
- Ping pong
- Stamp sets
- Making beaded necklaces
- Work benches and hammer games
- Drum set
- Yo-yos
- Water-filled games
- Puzzles
- Wind-up toys
- Stapler, paper puncher
- Musical accordion toys
- Mr. Potato Head
- Clay, putty, and Play-Doh
- MagnaDoodle
- Shape sorters
- Form boards
- Dominoes



Wrist Extension Activities:

- Blowing bubbles
- Stacking cups, blocks, or other objects
- Screwing and unscrewing jars or containers
- Working on an easel
- Reaching for objects above head
- Throwing a ball
- Stringing beads, large and small
- Swinging a bat
- Wringing out a washcloth or sponge
- Using a rolling pin or rolling dough into snakes
- Painting or drawing on paper on the wall or refrigerator
- Crawling on all fours
- Using the wrist wand
- Animal walks (walrus, crab, etc.)
- Writing or coloring
- Wheelbarrow walk
- Balloon volleyball
- Playing or holding cards
- Cutting food or play dough with a knife
- Playing handheld games
- Scooterboard activities using arms to propel self
- Puzzles
- Cotton ball football or soccer
- Wall push-ups
- Cat's cradle string games
- Zoom ball
- Brushing hair or washing face
- Using shaving cream on the tile wall

UE Strengthening Exercises:

- Wheelbarrow crawl around the house
- Crabwalk
- Tug-of-war games
- Pushing weighted baby strollers/grocery carts (may add weighted toys to cart)
- Placing light weights around wrists with velcro straps during play activities
- Carrying toys around house
- Hammering or pounding toys
- Throwing/Catching Games (baseball with different weighted bats or balls)
- Swimming
- Table/Board Games with arm weights on

Traumatic Injuries and Therapy: The Pediatric Patient

- Fractures
- Lacerations
- Tip Crush

Pediatric Fractures:

- A disruption of integrity of bone tissue resulting from an impact to the bone.
  - Falls
  - Impact
  - Crush

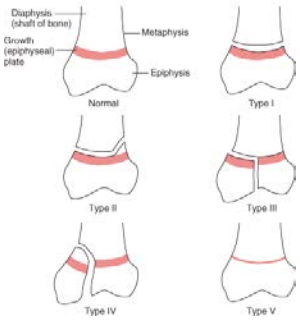
Pediatric Fractures:

- Buckle or Torus fracture (incomplete fracture)
- Greenstick fracture
- Physeal fractures

PEDIATRIC GROWTH PLATE FRACTURES

Fracture Classification: Salter-Harris

- Salter I - separation through growth plate (physis),
- Salter II - injury through physis with part of metaphysis attached
- Salter III - injury through physis; longitudinal fracture thru epiphysis



Fracture Classification: Salter-Harris

- Salter IV - longitudinal fracture
  - extends into metaphysis, physis, and epiphysis;
  - complete anatomical alignment necessary to restore articular surfaces
  - extent of physeal plate damage unknown
- Salter V - crush injury to germinal cells of epiphysis; premature closure of physeal plate

Pediatric Hand Fractures

- Presumption
  - All will do well
- Reality
  - More than 50% have sequelae
- Why?

Sequelae

1. Delay in presentation
   a) Parents overlook
   b) May be missed/ downplayed by ER
2. Difficult diagnosis
   a) Physical Examination
   b) Standardized radiographs

Sequelae

3. Unreasonable Expectations (by MD)
   - Despite rapid healing, remodeling has limits
4. Treatment/ Compliance
   - Immobilization

Pediatric Fracture Treatment: General

- **Immobilization**: Closed Reduction/External fixation
  - **Casting**
    - Pros
    - Cons
  - **Splinting:**
    - Pros
    - Cons

Internal Fixation

- Open Reduction Internal Fixation
- Indications
  - unstable fx's
  - fx's requiring early motion
  - fx's w/ high incidence of non-union

Types of internal fixation

- K-wires: open vs. closed
- Screws
- Plates
- Wires
- Intermedulary Nails
- Bone Grafts

Complications of Internal Fixation:

- Soft tissue injury
- Hardware irritation
- Adhesions
- Tendon ruptures

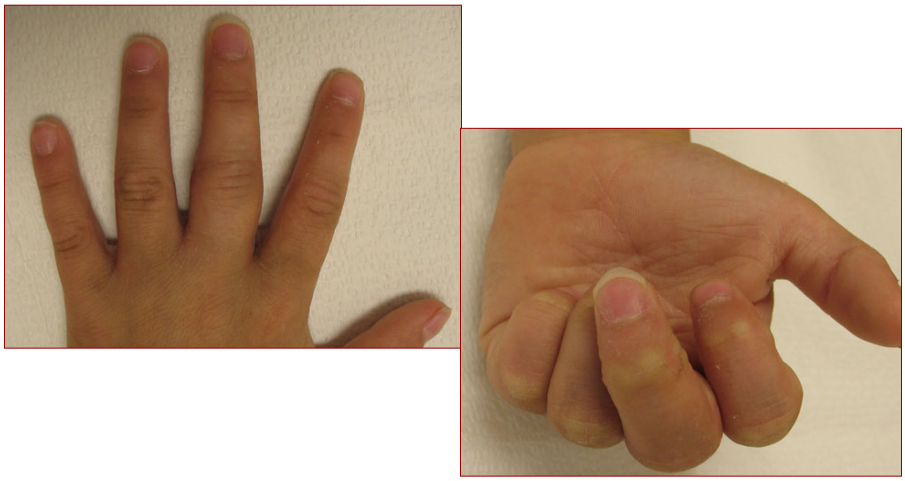
Complications To Pediatric Fractures:

- Growth alteration or arrest
- Joint stiffness
- Angulation or joint irregularity

Significance of Malunions

- Often an aesthetic issue- not a functional issue
- Frank discussion w/ family may help avoid surgery
- Rotational malunion most likely to be functional issue
  - Phalanx vs metacarpal

Rotation:



Positive remodeling potential

- Positive remodeling potential
  - Younger age
  - Close proximity to physis
  - Fracture in plane of motion

Flexor Tendon Lacerations: Pediatrics

- How do these happen?
- How do we treat these? Differently?
- Outcomes

Diagnosis

Post op Immobilization Methods

- Cast
- Splint

Alternative Immobilization:

- Suture
- Mitten Cast

FLEXOR TENDON REPAIR -- EARLY MOBILIZATION -- ZONES I-III. Ages 6 up

- **Precautions: tendon gap formation, tendon rupture**

- **1-3 days post-op:**
- Cast is bi-valved
- Wound management
- Edema management
- Fabricate a dorsal blocking splint for continuous wear with wrist in 20° flexion, finger MPs in 50-70°
- flexion, PIP/DIPs in full extension
- Modified Duran Program is initiated hourly. This includes **PROM** for flexion/extension **within the**
- **confines of the splint** to the MP, PIP, DIP joints for three weeks

- **3 weeks post-op:**
- Continue PROM. Begin AROM exercises of fingers in flexion and extension **in the splint** 4-6x/day (Continue the Modified Duran Program
- Scar management once incisions are healed
- **4-1/2 weeks post-op:**
- AROM exercises to wrist and fingers without splint
- Dorsal blocking splint is worn at all times except during exercise

- **6 weeks post-op:**
- May discontinue dorsal blocking splint
- Begin gentle PROM exercises in extension to wrist and fingers (as indicated)
- Initiate tendon gliding exercises
- Determine need for full extension resting hand splint or a long dorsal outrigger with lumbrical bar if extrinsic flexor tightness is present
- **Precaution**: no lifting or forceful use of hand
- Instruct in progressive strengthening program to begin at **8 weeks** post-op

-
- **8 weeks post-op:**
- Begin progressive strengthening exercises
- No forceful use of hand continues. Begin to use hand in light ADLs
- **12 weeks post-op:**
- Patient may use hand fully

FLEXOR TENDON REPAIR -- DELAYED MOBILIZATION -- ZONES I-IV

- **Indications: Used for young children or cognitively impaired individuals who cannot participate in the early mobilization program.**
- **Precautions: Tendon rupture**
- **<u>Immediate post-operative:</u>**
- Long arm plaster splint applied in OR. Specifically a dorsal blocking splint past fingertips with wrist in 20 degrees of flexion and MCP joints at 60-80 degrees flexion. Gauze placed between fingers and padded to minimize risk of grasping.

- **<u>4 weeks post-op:</u>**
- Post op cast removal
- Initiate scar management
- Forearm based DBS fabricated: wrist flexed 20-30 degrees, MCP joint flexed 60 degrees, IP joints extended. Full time wear with the parent removing the splint for exercises and hygiene.
- Begin active digital ROM with wrist in flexed position (if child can participate in “light” grasp activities without undue force).
- Begin passive digital flexion and active extension within boundaries of DBS

- **8 weeks post-operative:**
- Discontinue splinting
- Begin active/passive finger extension (with wrist at neutral) and joint blocking exercises
- May begin light strengthening with putty

- **12 weeks post-operative:**
- Return to full activity
- Dynamic or static progressive splinting applied as necessary.

FINGER TIP INJURIES

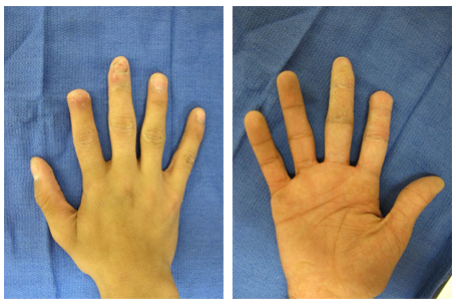
Crush: Fingertip

Therapy for Crush of Tips

- Splint
- Wound Care
- Desensitization
- Motion
- Function

Tip Amputation:

Tip Amputation



Therapy for Tip Amputation:

- Wound Care
- Edema control
- Splint/protect
- Desensitization
- Motion
- Function

Amputations: Treatment Option

- Prosthesis?
- Pros:
- Cons:

Conclusion:

- Pediatric Traumatic Hand Injuries are Unique
- Treatment Must be modified from Adult protocols. Not “small” adults.
- They don’t need a lot of “therapy”
- Setting and “equipment” is important
- Have FUN