Upper Extremity Evaluation
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Rationale
• Establish baselines
• Determine limitations
• Create a treatment plan
• Set treatment goals
• Determine treatment results and outcomes
• Progress or modify plan of care
• Determine efficacy of treatment

Criteria
• Accurate
• Standardized
• Reliable
• Reproducible
• Valid
• Feasible
• Systematic

Methods
• Observation
• Interview
• Clinical exam
• Measurements
• Conclusion

Observation
• Posture
• Positioning
• Neglect
• Nail condition
• Atrophy
• Edema
• Color
• Tremors
Interview

• Demographics: Age, hand dominance, occupation, hobbies, medications
• History:
  • Date of injury, surgery, or onset
  • Diagnostics performed
  • Previous treatment
• Full medical history:
  • Other conditions or illnesses
  • Alcohol or tobacco use

History: Past medical history

• health conditions
  • smoker, allergies
• cardiac (contraindication for many electrical modalities)
• vascular
• arthritis (pre-existing limitations?)
• diabetes (reduces peripheral circulation, slows healing)
• previous injuries and treatments (pre-existing limitations?) prior level of function

Interview

• Symptoms (objectify):
  • pain, numbness / tingling, weakness, deformity, poor coordination, functional deficits

• Patient Goal of treatment
• Secondary gain?

Pain

“The fifth vital sign” American and Canadian Pain Societies

• Affects quality of life
• Used to evaluate the effectiveness of interventions
• Patient report is gold standard
• Consider: quality, intensity, location, behavior, interference, impact on function

Numeric Rating Scale – measures pain intensity

• Ordinal 11-point scale: 0 = "no pain"; 10 = ? (undefined)
• Tracks change over time (2 pts = "substantial change")
• Psychometric properties for UE unavailable (results open for interpretation)
• Verbal or written
• No cost to use

Method

• Gather 1-4 responses
• Record and interpret each score separately or average the 4 measures
• Current pain
• Worst/least/average pain in past 2 weeks

Pain

Visual Analog Scale (VAS)

• Similar to NRS in that anchors are describe in the same way
• Consists of a single straight line
• Patient marks point on line where pain intensity falls
• Evaluator measures in mm from "0" point
• Ratio-level continuous scale, often preferred by researchers (lends itself to statistical analysis)
Pain

**Brief Pain Inventory (BPI)** – measures change over time in intensity and interference. ~5 minutes
• 4 subscales: location, intensity, medication usage, interference
• Requires 6th grade reading level

**McGill Pain Questionnaire (MPQ)** – measures sensory, affective, evaluative, and intensity aspects of pain experience. ~10 minutes
• 3 domains: present pain intensity, body diagram, and pain rating index (which itself has 4 domains: sensory, evaluative, affective, miscellaneous)

**Pain Quality Assessment Scale (PQAS)** – evaluates intensity and change over time in neuropathic pain conditions. Also used for non-neuropathic pain conditions.
• Written format
• 3 subscales: paroxysmal, superficial, and deep pain; 20 items

**Pressure and Thermal Pain Threshold** – used for fibromyalgia syndrome
• Not for hyposensate
• Must be able to remember and follow directions
• Method: application of pressure, heat apparatus, immersion in ice water, or electrodes. Patient reports when stimulus changes from pressure to pain

**Pain**

- Not mentioned in 2015 Clinical Assessment Recommendations

**Wong-Baker Faces Scale**
Useful for children, non-English speaking, and cognitively impaired

**Palpation**
• Provides anatomical landmarks as source of pain
• Begin proximal and distal to target area, move towards it
• Start with gentle pressure

**Clinical Exam**
• Appearance
• Wound
• Edema
• ROM
• Sensibility
• Strength
• Diagnostic

**Appearance**

**Normal cascade**

**Deformities** – swan neck, boutonniere
• Arthritic Nodes–Heberden’s (DIP)
  ~Bouchard’s (PIP)
Appearance

• CMC “Shouldering”
• Nail condition, e.g. nail “clubbing”
• Congenital conditions
• Pre-existing injuries

Vascular

PALE: may indicate arterial insufficiency
RED: may indicate infection/irritability
CYANOTIC: may indicate venous insufficiency due to decreased circulation

Appearance

Vascular

Assess pulses

• Subclavian – sternal end of clavicle in scalene (mm.)
• Axillary – center of armpit.
• Brachial- superior to antecubital fossa, medial to biceps tendon.
• Radial- just proximal to wrist crease, volar-radial wrist.
• Ulnar – just proximal to wrist crease, volar-ulnar wrist.
• Capillary refill test: apply pressure to pulp of nail, normal= 3 sec.

Appearance

Allen’s Test for radial or ulnar arterial patency

• Palpate radial and ulnar arteries at the wrist, and apply pressure to occlude both.
• Exsanguinate the hand by having the patient open and close fist several times, then open the hand to a relaxed open position.
• Release one of the arteries
• Note quality and time for the hand to re-perfuse.
• Normal is 3-5 seconds.

Wound

• Tissue: slough, eschar, granulation, macerated, dessicated, necrotic
• Wound edges: defined, attached

• Signs of infection: pain, redness, streaking, warmth, pus, fever, odor

Wounds

• Shape
• Color – black, yellow, red
• Size: length x width x depth
• Wound edges: defined, thickened, fibrotic, attached
• Undermining: involving what % of margin
• Tunneling: depth (if determinable)
• Exudate: serous, sanguinous, serosanguinous, purulent
• Tissue: slough, eschar, granulation, macerated, dessicated, necrotic
• Location
• Signs of infection: inflammation, erythema, streaking, pain, heat, pus, odor, malaise, fever
Assessment of Wound

- **Describe Drainage** (where applicable)
  - Bloody/Sanguinous/Red (healthy, bloody drainage)
  - Serous (thin yellowish/clear fluid)
  - Serosanguinous (combination of above)
  - Purulent (often thick, greenish or yellowish, signs of infection, often malodorous)

Wound

How would you describe this?

- Location
- Size:
- Color
- Odor
- Temperature
- Integrity (undermining, tunneling)
- Exudate
- Anything else?

Edema

- Volumetry
- Figure-of-eight method
- Circumferential measurement - ASHT does not recommend for routine use unless consistent tension applied with specific landmarks utilized

Volumeter

Pros
- Accuracy of measurement (validity)
- Reproducibility (reliability)

Cons
- Time consuming
- Messy
- Not for wounds

Document
- Sitting or standing
- Time of day
- Evaluates hand **mass** via water displacement.
- Preferred method for edema measurement
- Mild difference from right to left hand (~3%), test both hands, but compare injured extremity to itself

Volumeter

Method
- Forearm neutral position; palm faces patient
- Water 68-95 degrees F
- Volumeter on level surface
- Dry beaker below spout
- Remove jewelry
- Hand vertical, slowly immerse, don’t touch sides
- 3rd web space rests on dowel until water ceases to flow out
- Measure ml of water collected, or weigh contents
- Compare to contralateral
**Figure-of-eight method**

**Pros**
- Reliable
- Valid
- Easier than volumeter
- Ok with wounds

**Cons** - requires training to perform correctly

**Document**
- Time of day
- Contralateral measurement

**Circumferential measurement**

**Pros**
- Easy
- Reliable (intra and inter-rater)

**Cons**
- Questionable validity, dependent on consistent tension

**Document**
- Time of day
- Anatomical landmarks used

**Method**
- Use flexible tape measure
- Do not indent skin with tape measure
- Compare to contralateral

**Range of Motion (ROM)**

**Goniometer** – most common method of measurement; measures motion in one plane.

If measuring:
- One joint: place adjacent joints in relaxed position
- Muscle/tendon length: place all joints such that soft tissues are at full length

**MCID**: measurement changes should exceed 5 degrees per joint with same examiner

**ASHT and AMA recommendations for ROM:**
- “0” is neutral
- “+” is hyperextension
- “−” is an extension deficit
- Measurements should be written as extension/flexion (e.g. -10/85)
- “A volar/dorsal placement is generally preferred over lateral placement for finger or wrist E/F; although deformities, swelling, or other factors..... Suggest lateral placement could be used.
ROM

Accessory measurements of ROM

- Linear Measurements in cm:
  - Distance to distal palmar crease (recorded as 4/3/3/2)
  - Digital abduction from midline
  - Webspace (e.g. thumb IPJ to index PJ)

• Kapandji Scale – opposition

• Paper tracing

• Tongue depressor “yardstick” to gauge progress

• Active and Passive
  - Active = muscle generates the ROM
  - Passive – external force generates the ROM
  - Document which is being measured
  - Requires consistency in tool, positioning, and landmark orientation

- Total active motion (TAM) – combined active motion of ≥ 2 joints
- Total passive motion (TPM)

AMA Guide to Evaluation of Permanent Impairment, severity scale for ROM Deficits

<table>
<thead>
<tr>
<th>Grade Modifier</th>
<th>Severity</th>
<th>Range of Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal</td>
<td>10% to full</td>
</tr>
<tr>
<td>1</td>
<td>Mild</td>
<td>60-90%</td>
</tr>
<tr>
<td>2</td>
<td>Moderate</td>
<td>30-60%</td>
</tr>
<tr>
<td>3</td>
<td>Severe</td>
<td>&lt;30%</td>
</tr>
<tr>
<td>4</td>
<td>Very Severe</td>
<td>Joint ankylosis</td>
</tr>
</tbody>
</table>

TAM example:

Add flexion of all joints measured; subtract extension deficits

Example:

MP 0/90
PIP -10/85
DIP -5/55

TAM = (90 + 85 + 55) – (10 + 5) = 215

Total passive motion (TPM) – same formula
Some factors affecting limited A/PROM

- Pain
- Capsular or ligament tightness
- Passive insufficiency (muscle/tendon shortness)
- Bony blocks
- Weakness
- Loss of tendon integrity
- Scar adhesions

If PROM > AROM then the joint is being limited by adhesions, weaknesses or tendon integrity. Document AROM and PROM.

### ROM

**Intrinsic Tightness Test**

- Hold MP in ext and passively flex PIP. Measure PIP flexion.
- Hold MP in flexion and passively flex PIP. Compare PIP flexion to first measure.
- Test is positive if PIP flexion is greater with MPJ in flexion than extension.

**Extrinsic Tightness Test for Extensors**

- Hold MPJ in extension and passively flex IPJs. Measure IPJ flexion.
- Hold MPJ in flexion and passively flex IPJs. Measure and compare IPJ flexion to first measure.
- Test is positive if greater IPJ flexion with MPJ in extension than flexion.

**Oblique Retinacular Ligament Tightness Test**

- Hold PIP in extension and passively flex DIP. Measure DIP flexion.
- Hold PIP in flexion and passively flex DIP. Measure DIP flexion.
- Test is positive if DIP has greater flexion with PIP in flexion than extension.

**Extrinsic Flexor Tightness Test**

- Place wrist in neutral and passively extend the digits; then slowly increase wrist extension (elbow extended and forearm supinated).
- Positive test if patient is unable to passively maintain IPJs in extension as the wrist extension is increased.
- Rule out PIP or DIP joint tightness by evaluating the individual joint status with wrist in neutral or slight flexion.

**What does it mean if IPJ flexion is the same regardless of MPJ position?**
Sensibility

3 Nerves supply motor and sensory function to hand: median, ulnar, radial

Sensibility evaluation involves only sensory function, not motor

Sensibility evaluation should include examination of the skin for sudomotor function.

Sensibility

Hierarchical classification of sensory modality tests

<table>
<thead>
<tr>
<th>Sensibility Modality</th>
<th>Tests/Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Touch threshold</td>
<td>Monofilaments, vibrometers</td>
</tr>
<tr>
<td>Light to deep pressure,</td>
<td></td>
</tr>
<tr>
<td>static and moving</td>
<td></td>
</tr>
<tr>
<td>2. Spatial discrimination</td>
<td>Spatial threshold tests:</td>
</tr>
<tr>
<td>Localizing and determining</td>
<td>2 PD, GOT, Touch Localization</td>
</tr>
<tr>
<td>spatial resolution</td>
<td></td>
</tr>
<tr>
<td>3. Identification</td>
<td>Moberg pick-up test, Modified Moberg, STI</td>
</tr>
<tr>
<td>Shape, texture, and object ID</td>
<td></td>
</tr>
</tbody>
</table>

Sensibility

Sudomotor function - Assessed through observation and palpation

• 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

Semmes-Weinstein

Test Administration

• position patient, seated, hand supinated, resting on towel or putty
• vision occluded, quiet atmosphere
• clearly explain the test to the patient
• show them the monofilaments on your own hand - "thinnest is like a hair" and "thickest is like a toothpick"
• “some are easy to feel and some are hard to feel”
• “I will move around and touch different fingers, let me know when you feel a touch”

Semmes-Weinstein

Test Administration

• monofilament applied to skin per protocol
• apply perpendicular to skin for 1.5 seconds, to bending, lift for 1.5 seconds
• repeat x3 for filaments 1.65 - 4.08
• 1x only for filaments 4.17 - 6.65
Semmes-Weinstein Test Administration

- Volar surface first
- Follow digital nerve innervation
- Progress testing distal to proximal
- Progress to filaments of increasing pressure
- Randomize sequencing and timing to minimize anticipation of responses

Semmes-Weinstein Scoring/Norms

- Normal: 1.65 - 2.83
- Diminished light touch: 3.22 - 3.61
- Dim. protective sensation: 3.84 - 4.31
- Loss of protective sens: 4.56 - 6.65
- Untestable: greater than 6.65

Sensibility: Touch Threshold Tests

Vibration Threshold – measures pallaesthesia (Gr. “vibratory sense”)

- Originally used to test fast-adapting mechanoreceptors (Meissner and Pacinian)
- Measures change after nerve repair/reinnervation
- Weak to moderate correlation to functional sensibility tests.
- Results not quantifiable
- No longer considered necessary as SWM measure all mechanoreceptors

Sensibility: Spatial Discrimination Tests

2 Point Discrimination – Test of spatial threshold; dependent on receptor density

- Measures smallest distance at which 2 points are perceived as 2
- Important in tactile gnosis e.g. grasp, manipulating objects, and identifying shape, form, texture without vision
- Population – nerve repairs, Hansen’s Dz, diabetic neuropathy, nerve compression

Sensibility

2PD - Method

- Hand supinated and supported, vision occluded
- Points are applied to digital pulps in longitudinal orientation
- Median nerve: Thumb and index
- Ulnar nerve: small finger
- Start with wide space (e.g. 12 mm); apply randomly in decreasing order until patient begins to give incorrect answers

Sensibility

- Apply enough pressure to detect pressure; blanching not a good indicator
- Must have 7 correct to progress to next lower width
- Some authors suggest 2 out of 3; or 4 of 7...
- Compare with contralateral hand

ASBH Interpretation of results

- <6 mm normal
- 6-10 mm = fair
- 11-15 mm = poor

- Sensitivity 32%, Specificity 81%
Sensibility: Spatial discrimination tests

Localization – locognosia. Also dependent on receptor density (like 2PD).

• Patient points to hand chart to signify where his hand is being touched.
• Compare to contralateral

Sensibility: Identification Tests

Assess usefulness of sensibility

Moberg Pick-up Test (also Modified Moberg)
**Both versions include test of motor and sensory

• Moberg: Tests ability to grasp and place small objects using thumb, index and long fingers
• Modified: Tests ability to ID objects without vision
• Not standardized; norms not available
• Required: 10-12 small metal objects, stopwatch, blindfold

Shape-Texture Identification (STI) Test – Patient identifies 3 shapes of decreasing size (cube, hexagon, cylinder) and 3 discs with raised dots of decreasing size.

ASHT/CAR recommendations:

• Evaluation of touch threshold in patients with nerve compression should be a core assessment
• Evaluation of touch threshold combined with an identification test should be performed on all patients with nerve repair
• Therapists should be aware that there is a basic lack of standardization on many sensory tests.
• Minimizing distractions, using standardized techniques when available, and using calibrated tools enhances validity of measurements.

Strength

• Dynamometer
• Pinch Meter
  Lateral
  Tripod
  Tip
Strength

**Grip** - method
- 2nd rung (note if using any other)
- Examiner supports base of dynamometer
- Pt seated, arm adducted, elbow 90, forearm neutral
- Avg of 3 trials (unless painful)
- Hold grip ≥3 seconds; 15 second rest between

Grip Strength

- no good norms, compare to contralateral hand
- Average Grip Range
  - Male: 80-140 lb.
  - Female: 40-80 lb.
- 10% rule: "normal" difference between dominant and non-dominant hands
  - tends to be less than 10% in left handed people (often right hand is stronger)
  - may be more than 20% in people who extensively use one-handed tools requiring tight grip (e.g. wrench, pliers)

Strength

**Pinch** – tripod, tip and lateral
Method-
- Sitting, shoulder Ad, elbow 90/neutral, or pronation for tip and tripod pinch
- Examiner supports pinch gauge
- Tripod: gauge on side and held between pulps of thumb and index/long. I/LF on dial side
- Tip pinch: held between tips of thumb and index
- Lateral: dial faces up. Thumb pulp on dial side, radial P2 of index on bottom.
- “Pinch as hard as you can.” x 3; average

Strength

**Tripod**
- (3 Jaw Chuck)
  - Thumb against IF and MF.
  - Median n. injuries

**Lateral**
- (key)
  - Thumb against radial side of IF
  - Ulnar N. (AdPol, 1st DI)

**Tip**
- to tip
  - Thumb against IF
  - AI N

Functional Strength

- BTE
- Cybex
- Performance of activities

Functional Tests

- Self reports
- DASH
- Quick DASH
- Patient-Rated Wrist Evaluation (PRWE)
- Performance tests - e.g. Sollerman, Jebsen-Taylor
- Functional Capacity tests
Patient Rating Scales: symptom or satisfaction ratings.

- **DASH:** Disabilities of the Arm, Shoulder and Hand
  - 30 items
  - *Quick DASH* has 11 items covering ADL performance and symptoms
  - NOT specific to injured extremity
  - Established reliability and validity of both
  - [www.dash.iwh.on.ca/](http://www.dash.iwh.on.ca/)

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**Patient Rating Scales**

- Patient rated wrist/hand evaluation (PRWHE):
  - High test-retest reliability
  - Specific to injured extremity
  - 5 items covering pain
  - 10 items on function
  - 2 optional items on appearance
  - Poor-moderate correlation to impairment ratings (MacDermid et al 2002)
  - MCID – 12/24 points (Schmitt and Di Fabio 2004)
  - Established reliability and validity

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**Evaluation**

- Summarize data to get full picture
- Documentation is important
- Set goals for components to achieve long term functional goals
- Re-examine at intervals to determine progress and outcome from treatment

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**Bibliography**