Movement Analysis as an Assessment Tool for the Stroke Patient

Analyzing motor impairments of the shoulder after stroke.

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AOTA Student Conclave
November 10, 2012

What is movement analysis?

- Skill of the OT!
  - Knowledge of fundamental movement patterns and ability to observe deviations in healthy movement patterns.
- Observations -> Assumptions -> Further testing-> Treatment Plan Prioritization
  - Is it weakness?
  - Is it tightness? (soft tissue changes)
  - Is it coordination?
    - Patient has the selective movement but not when coordinated with multiple joints.
- Should be combined with Objective Outcome Measures.
  - Fugl Meyer UE, ARAT, Motor Activity Log, Stroke Impact Scale, Modified Ashworth Scale

Why use movement analysis?

- Prerequisite for successful rehabilitation = fundamental understanding of mechanisms involved in motor deficits
  - Cirstera & Levin, 2000
  - What are the demands involved with this activity vs. What are the deficient motor skills observed in our client that are impeding function?
- Observe in function-
  - Allows contextual observations-
    - changes in environment
    - Variable functions- find themes
    - Shows how different joints have to cooridnate
  - Quick
  - Shows how Dynamic systems interact (Trunk, BOS, cognition, neglect, sensation)

Movement analysis in EBP

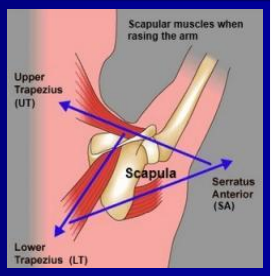
- Kinematics
- Trunk restraint therapy
- EMG Studies
- Accelerated Skill Acquisition (ICARE)

Shoulder Basics

- Mobility- sacrifice stability
  - Stability- accomplished by ligamentous attachments and complex array of muscular force couples.
  - Rotation requires equal and opposite forces!!!

Shoulder Basics- cont.

- Scapula-
  - Lower trapezius- upward rotation, scapular depression
    - Posterior tilt, scap ER – inferior medial fibers
  - Middle trapezius- retraction
  - Serratus- upward rotation, post tilt, ER of scapula
- Maintains the proper length tension relationship of RTC muscles to ER humerus



Shoulder Basics- cont.

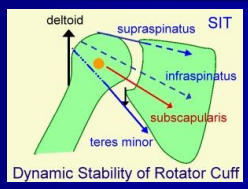
- Primary movements of scapula
  - Upward rotation- 45-55 degrees
  - Posterior tilt- 20-40 degrees
  - ER- 15-35 degrees
    - Escamilla et al, 2009
  - Retraction- improves subacromial space
  - Protraction- decreases subacromial space
  - Anterior tilt, scapular IR- decreases

Scapula in motion

- http://www.youtube.com/watch?v=FHq3K6J3Wq8
- http://www.youtube.com/watch?v=Jmxz3bEjjGM

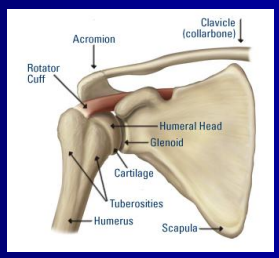
Shoulder Basics- cont.

- Force couples
  - Deltoid-
  - Rotator Cuff-
    - Controls humeral head compression



Impingement syndrome

- Greater and Lesser Tuberosity- must clear the Acromion and Coracoid (less common)
- Requires- humeral head depression + ER (humeral head) + proper scapulohumeral rhythm
- http://www.youtube.com/watch?v=TcsJOLSYcHg&feature=related



Postural control related to shoulder pain/dysfunction

- Thoracic kyphosis-
  - Reduces subacromial space
  - Scapula position-
  - Linked to reduced length in pec. Minor (Borstad, 2006)
- "Forward shoulders" (IR)
  - Reduces subacromial space
  - Tuberosities closer to acromion
  - Soft tissue mechanical disadvantage of the RTC (ER's)
- Forward head-
  - Stretch response of the levator
- Lateral Trunk flexion

Compensatory motor patterns common to the shoulder

- Stroke-
  - Decreased neural input to scapular thoracic muscles, RTC.
    - Disrupts scapulohumeral rhythm
    - Decreases upward rotation, RTC humeral depression→ IMPINGEMENT

  Common cause of shoulder pain post stroke along with subluxation, adhesive capsulitis, CRPD.

Compensatory motor patterns common to the shoulder

- Compensatory motor patterns-
  - Normal motor systems compromised → compensate with intact neural systems
  - Limb synergy-
    - Flexor synergy
    - Extensor synergy
  - Abductor Strategies
  - Trunk/Pelvis compensations

Compensatory motor patterns common to the shoulder

- Fixations
- Redundancy
- Degrees of Freedom
- Compensatory movements- argued by many to be a primary limiting factor in recovery
  - Cirstera & Levin, 2000

Reach

- Basic/Fundamental skill for UE function
- Inter-joint coordination- FF with elbow ext.
- Lever arm length affects strength demand
- Variables open to compromise
  - Sequencing of movement
  - Strength
  - Coordination
  - Velocity
  - Reciprocal innervation
  - Orientation of hand

Patient in Motion

References/Recommended Readings

- Bender L, McKenna K. Hemiplegic Shoulder Pain: Defining the Problem and its Management. *Disability and Rehabilitation.* 2001;23;16;´698-705.
- Borstad J D. Resting Position Variables at the Shoulder: Evidence to Support a Posture- Impairment Association. Physical Therapy. 2006;86;4; 549-557.
- Cirstea MC, Levin MF. Compensatory Strategies for Reaching in Stroke. *Brain.* (2000), 123; 940-953
- Fisher B. Effect of Trunk Control and Alignment on Limb Function. *Journal of Head Trauma Rehabilitation*, 2, 72-79.
- Hardwick DD, Lang CL. Scapula and Humeral Movement Patterns and Their Relationship With Pain: A Preliminary Investigation. *Int J Ther Rehabil.* 2011; April 6; 18(4): 210-220.
- Levin MF, Kleim JA, Wolf SL (2009) What do motor "recovery" and "compensation" mean in patients following stroke? *Neurorehabilitation Neural Repair* 23: 313-19.
- Ling SS, Fisher BE, Functional Improvement Using Observational Movement Analysis and Task Specific Training for an Individual with Chronic Severe Upper Extremity Hemiparesis. *Journal of Neurological Physical Therapy.* 2004, 28; 2; 91-99
- Lum PS, Mulroy S, Amdur RL, Requejo P, Prilutsky BI, Dromerick AW. (2009) Gains in upper extremity function after stroke via recovery or compensation: Potential differential effects on amount of real-world limb use. *Top Stroke Rehabil.* 16(4):237-253.
- Rueda FM, Montero FM, Torres PH, Diego A, Sanchez AM, Miangolarra Page JC. Movement Analysis of Upper Extrmeity Hemipareesis in Patients with Cerebrovascualr Disease: A Pilot Study. *Neurologia.* 2012; 27; (6): 343-347
- Skjerven LH, Kristoffersen K, Gard G., How can Movement Quality Be Promoted in Clinical Practice? A Phenemenological Study of Physical Therapist Experts. *Physical Therapy,* 90; 10; 1479-1492.
- Van Kordelaar J, van Wegen EEH, Kwakkel G. Unraveling the Interaction Between Pathological Upper Limb Synergies and Compensatory Trunk Movements During Reach-to-Grasp After Stroke: a Cross Sectional Study. *Experimental Brain Research.* (2012) 221:251-262