Use of Video EMG Analysis to Assess Candidacy for Tendon Transfer Surgery

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Acknowledgements

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Adam Rozumalski, PhD
Mike Schwartz, PhD
Wrist Deformity: Joint Contracture vs. Muscle Contracture?

Muscle Release vs. Tendon Transfer?

Muscle Imbalance

Wrist Extension

Wrist Radial Deviation

Wrist Ulnar Deviation

Wrist Flexion

Brand: Biomechanics of the Hand
Possibilities

Method:

**Synchronized**
Real-time EMG Capture
Real-time Video Capture

**EMG**
FW – Flexor Carpi Ulnaris
FW – Pronator Teres
Surf – Extensor Carpi
    Radialis Longus/Brevis
Surf – Biceps Brachii

**Functional Tests**
Jebsen Taylor
Assisting Hand Assessment
Why Flexor Carpi Ulnaris & Pronator Teres?

Largest Deforming Forces!

Analysis:
Is Muscle Phasic or Continuously Active?
Function of Agonist/Antagonist Muscle Groups?

Lieber et al JHS 1992
Brand et al. 1981
Analysis:

Follow-Up Motion Laboratory Analysis for Patients With Spastic Hemiplegia Due to Cerebral Palsy: Analysis of the Flexor Carpi Ulnaris Firing Pattern Before and After Tendon Transfer Surgery

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JHS • Vol 35A, February 2010

Images from deRoode, James, Van Heest: Techniques in Hand & Upper Extremity Surgery 14: 2010

Image courtesy of Dr. Hutchinson
Purpose:
To compare the pre-operative and post-operative firing of the FCU in a grasp and release functional activity after FCU to ECRB transfer surgery for wrist flexion deformity in children with cerebral palsy.

Methods:
N=7 children; Pre-and Post-operative EMG/video was evaluated for firing pattern during a grasp and release task; Categorized as Active or Relaxed during grasp or during release.

Conclusion:
1. FCU does not predictably change phase when transferred from a position of wrist flexion to wrist extension.
2. Tendon transfers improve joint positioning but functional impairments still persist
3. The better voluntary control before tendon transfer, the better voluntary control after tendon transfer

Pre-Op:
Post-Op:

Challenges/Obstacles

1. Difficulty getting kids back for post-operative studies with needle insertion
2. What about the thumb?

Opportunities/Future Directions

Feasibility of Using the Intel Depth-Camera for Quantifying the Dynamic Thumb Motion of Individuals with Cerebral Palsy

Aim #1: Evaluate the feasibility of the Intel depth camera for measuring thumb active range of motion (AROM) among typically developing controls and individuals
Aim #2: Expand the static House system using quantitative, dynamic data.
Aim #3: Evaluate the feasibility of measuring thumb motion during functional activities
Protocol for Isolated Thumb Motion

Protocol for Functional Tasks

- 9 hole peg test
- Jebsen Taylor Test of Hand Function
  - Checkers
  - Small Objects
- Box and Blocks
- Cylinders of Different Sizes
- Measure opening of the thumb
Challenge #1 Thumb in Palm could not be differentiated

Challenge #2 Complexity of Programming Required for Pattern Recognition Using Alternate Methods
Simplified Technology Solution:
View Thumb Position Using a Mirror
Simplified Technology Solution: Thumb Passive and Active ROM Protocol

Surgical Treatment Plan: Determined by Joint Impairment

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<tr>
<th>Release Candidates</th>
<th>Action</th>
<th>Joint</th>
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<tbody>
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Take Home Messages:

1. Providing a Clinical Service necessitates a methodology that can be implemented and analyzed in a timely fashion. Patient & family Risk: Reward Ratio must be optimized.

2. Feasibility studies remain important. The process of understanding the limitations of technology allows new directions, protocols, and avenues to be pursued that may eventually lead to success and improvements in technology.

3. Continued Advancement Requires Collaboration between Technology, Clinical Need, Clinicians, Engineering, and Basic Science

Thank You
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