

## **Quantitative Clinical and Biomechanical Analysis of UE Movement Dysfunction**

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**Purpose:** To introduce and describe clinical application of quantitative motion-capture techniques for movement dysfunction in the upper extremity.

**Intended Audience:** Clinicians (occupational therapists, physical therapists), engineers, biomechanists, and kinesiologists who treat, assess, and/or measure children and adults with upper extremity movement disorders. Prior experience analyzing and interpreting motion analysis data is beneficial, but not required.

### **Abstract:**

Clinical and biomechanical movement analysis of the upper extremity is complex due to the multiple degrees of freedom and wide range of tasks afforded to the upper limb. Standardized protocols are not as well developed and described as in the lower limb. The aim of this tutorial is to present a framework to assess and measure quantitative joint motion of the upper extremity. A review and description of existing biomechanical models, upper extremity joint coordinate systems, and standardized marker placement protocols will be presented in the context of functional movements and activities. New advances in subject specific musculoskeletal modeling and simulation with specific applications to the upper extremity will be examined. Clinical applications will be discussed with case presentations to illustrate use and interpretation of data.

**Learning Objectives:** At the end of this session attendees will be able to:

1. Discuss how three dimensional (3D) data is collected and used to describe and evaluate upper extremity joint position and motion.
2. Identify indications for use of motion analysis study in hand and upper extremity practice.
3. Read and interpret basic graphs representing kinematic data of the upper extremity.

### **Outline:**

1. Introduction (15 minutes- Kontaxis/Wolff)
  - a. Complexity of upper extremity (UE) movement
  - b. Challenges
  - c. Framework to approach UE movement dysfunction
  - d. Qualitative vs quantitative measures
2. Assessment of arm posture during gait (20 minutes- Wolff)
  - a. Upper Extremity Joint coordinate systems (*Wu, 2005*)

- b. Marker Placement Protocols – (Rab, 2002)
  - c. Composite Index Scores – (Jaspers 2011, Riad 2011)
  - d. Case presentation – cerebral palsy
- 3. Assessment of reach (20 minutes-Kontaxis)
  - a. Scapulo-thoracic vs gleno-humeral motions
  - b. Scapular tracker (Ebaugh, 2005)
  - c. Case presentation – brachial plexus injury
- 4. Assessment of grasp (20 minutes-Wolff)
  - a. Wrist joint coordinate system (Hillstrom, 2014)
  - b. Grasp kinematics – hand marker protocols (Carpinella, 2006)
  - c. Case presentation – cerebral palsy
- 5. Subject specific modeling (20 minutes-Kontaxis)
  - a. Computational models
  - b. Dynamic EMG use for musculoskeletal modeling
  - c. Case Presentation – reverse shoulder arthroplasty
- 6. Questions and Discussion (15 minutes)

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