FROM CEREBRAL PALSY TO SUBACROMIAL PAIN SYNDROME: NEW METHODS AND CLINICAL APPLICATIONS OF UPPER LIMB MOTION ANALYSIS

Synopsis
The aim of the symposium is twofold. Firstly, we will present both standard and innovative/state-of-the-art methods in upper-limb motion analysis. Secondly, we wish to demonstrate how clinicians can use motion analysis as a tool in their decision-making.
Topics will include (but will not be limited to):
1) the use of motion analysis as an outcome measure to assess treatment response of children with unilateral CP or to assess movement patterns in adult stroke patients;
2) subacromial pain and scapular motion disorders;
3) the use of EMG analysis and the advantages of voluntary activation of the rotator cuff;
4) the ISB standard protocol and other specialised solutions for glenohumeral osteoarthritis;
5) the risks of standard prediction bands to assess scapulo-humeral coordination and how these can be minimised using state-of-the-art solutions;
6) U.L.E.M.A. open-access software for upper-limb kinematic data processing.

COURSE OVERVIEW

1. Oliver Rettig, Sebastian Wolf (Heidelberg University Hospital, Germany)
“Shoulder motion: modelling aspects, conventions and application”
Oliver.Rettig@med.uni-heidelberg.de
Sebastian.Wolf@med.uni-heidelberg.de

2. Phil McClure (Arcadia University, PA, USA)
“Subacromial pain syndrome: Analysis of scapular dyskinesis and infraspinatus voluntary activation”
mcclurep@arcadia.edu

3. Ellen Jaspers (ETH Zurich, Switzerland; KU Leuven, Belgium), Liesbet de Baets (Hasselt University, Diepenbeek, Belgium)
”Objective upper limb assessment in adult stroke and unilateral CP: from measurement to interpretation”
ellen.jaspers@hest.ethz.ch

4. Andrea Giovanni Cutti (Centro Protesi INAIL, Bologna, Italy)
“What do we really know about ‘normality bands’? Lessons learned from the analysis of the scapulo-humeral coordination”
ag.cutti@inaill.it
ABSTRACTS OF THE TALKS WITH USEFUL REFERENCES

1. “Shoulder motion: modelling aspects, conventions and application”
   Oliver Rettig, Sebastian Wolf (Heidelberg University Hospital, Germany)

A common methodology in the field of motion analysis is based on optical tracking of markers placed on the skin. The way/path from functional anatomy via marker positions to clinically interpretable joint angles includes a number of steps that can follow different strategies depending on the specific application.

In this presentation modelling strategies (deterministic, global optimization, cluster-based), joint center and axis determination methods (static calibration, functional methods), as well as angle definitions (Euler/Cardan-, direction cosine-, projection-angles) are briefly introduced and discussed in the context of ISB recommendations.

Clinical examples of patients with glenohumeral osteoarthritis before and after intervention are presented using the Heidelberg upper extremity measurement procedure (HUX) with an extension to observe shoulder girdle elevation and pro/retraction. Simple clinical tests such as active shoulder abduction are monitored via 3D-motion capture and altered shoulder joint movement and coordination is detected in different movement tasks.

Key references
2. “Subacromial pain syndrome: Analysis of scapular dyskinesis and infraspinatus voluntary activation”
Phil McClure (Professor of Physical Therapy, Arcadia University, PA, USA)

Subacromial pain syndrome is the most prevalent disorder at the shoulder. This session will discuss the possible role of scapular dyskinesis in the etiology and perpetuation of the problem as well as the difficulties involved documenting causation. To date we have shown various discrepancies in scapular motion in subjects with subacromial pain compared to controls, but in general these effects have been small and varied. Potential directions for both research and clinical application will be discussed.

Another area to be discussed is quantifying voluntary activation of the rotator cuff (infraspinatus) as an indicator of neural drive. This technique represents a potentially useful alternative to traditional electromyographic analysis with some important advantages. To date we have shown that voluntary activation is affected by effort, fatigue and subacromial pain. This technique may provide an important measure to explain the true source of “weakness” so common with subacromial pain syndromes and potential clinical application will be discussed.

Key References
3. "Objective upper limb assessment in adult stroke and unilateral CP: from measurement to interpretation"

Ellen Jaspers (ETH Zurich, Switzerland; KU Leuven, Belgium), Liesbet de Baets (Hasselt University, Diepenbeek, Belgium)

Adequate assessment of arm function in e.g. children with unilateral CP or adult stroke patients is crucial not only to outline treatment, but also to measure its efficacy and to allow follow-up over time. Apart from commonly used clinical assessments, three-dimensional (3D) movement analysis has found its way into the upper limb evaluation protocol. The main advantage of such 3D analysis is that it offers a more detailed and objective description of upper limb movement patterns. In this session, a brief overview of the methodology for a clinically feasible and reliable 3D upper limb analysis will be provided. By means of case presentations (unilateral CP and adult stroke), the measurement protocols,\(^1,2\) data analysis tools,\(^3\) and reports\(^3,4\) will be presented. Results from the upper limb 3D analysis will be discussed and interpreted.

Key references
4. "What do we really know about ‘normality bands’? Lessons learned from the analysis of the scapulo-humeral coordination"

Andrea Giovanni Cutti (Centro Protesi INAIL, Bologna, Italy)

It is common practice in motion analysis to compare the kinematic pattern of a patient with respect to the one of controls. It is equally common in shoulder clinical examinations to compare a patient’s affected side with the contralateral. But to which extent can the calculation of a point-by-point average for controls, “surrounded” by bands that assume a normal distribution of data, really be of help? What is the risk of patient misclassification? And what is the typical difference between one side and the other? And finally, is it acceptable to use bands for young subjects when examining patients over fifty years of age?

The aim of this talk is to answer some of these questions, with specific reference to the scapulo-humeral coordination and to present clinical examples of use the “prediction bands” in longitudinal assessments, e.g. during the course of a rehabilitation program.

**Key References**