INTEGRATED ASSESSMENT OF GLENOHUMERAL JOINT FUNCTION DURING DYNAMIC TASKS: A PRELIMINARY STUDY

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Introduction

The shoulder complex is characterized by distinctive biomechanics and its peculiar functions exploits the presence of different joints, including glenohumeral, scapulothoracic, sternoclavicular and acromioclavicular ones [1]. Indeed, its inherent structure allows for high mobility, but at the same time - in case of injuries, traumatic events, or pathologies – the shoulder is easily exposed to articular and periarticular problems.
In literature, to evaluate the functional aspects of the shoulder complex, human movement analysis approaches [2] and surface electromyography (EMG) systems [3] are the most adopted. However, in the last years, ultrasonography has been reported to enable the quantitative assessment of glenohumeral joint by measuring the translation of the humeral head [4].
The aim of this study was to present a non-invasive *in vivo* testing procedure aiming at overall assessing the function of the shoulder complex, within a multi-dimensional approach, specifically focusing on the glenohumeral joint.

Materials and methods

The proposed setting included the integration of marker-based optoelectronic stereophotogrammetric system, surface electromyography, and ultrasonography.
In this feasibility analysis the subjects were asked to execute two specific dynamic tasks, which characterize the glenohumeral joint function. The proposed protocol allowed an instrumental evaluation able to provide information about overall kinematics, muscular activations and synergies, and joint tissues constraining behavior in terms of humeral head displacement. From this feasibility study, we aim at obtaining simultaneous information about the complex kinematics in terms of multiple degrees of freedom characterizing the shoulder, the corresponding muscular activations – which define the active constraining behaviors of the involved periarticular structures - and, above all, the possibility of tracking the humeral head displacement – which reflects both the active and passive role of shoulder stabilizers; indeed, these data can be acquired during the realization of dynamic tasks and not only in static conditions.
The experimental setup and two examples of images of the glenohumeral joint acquired via ultrasonography are reported in Figure1.

Conclusion and future works

This work represents a preliminary feasibility analysis of the protocol on a reduced number of subjects, but on-going studies are involving a cohort of subject affected by shoulder disorders in order to characterize their movement patterns in terms of shoulder joint kinematics, muscles activation, and humeral head displacement, and compare them with respect to a control group of healthy subjects.
Therefore, the main purpose of this work was to analyze in depth the complexity of shoulder joint and define reliable features and characteristics for the identification of altered patterns of function by exploiting non-invasive integrated approaches for in vivo assessment in inpatient settings.

Figure 1: Experimental setup comprehensive of passive reflective markers, surface EMG electrodes and ultrasonography probe are shown (top). Examples of ultrasonography images of the humeral head from 2 probe locations (i.e., anterior axillary line and posterior aspect).

References

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