Mots clés : Membre supérieur ; Hémiplégie ; Chirurgie neuro-orthopédique ; Spasticité ; Ténotomies ; Cinématique ; Pointage

Introduction.– La chirurgie neuro-orthopédique à visée fonctionnelle du membre supérieur du patient cérébrolésé impose souvent une réflexion sur la nécessité de proposer une stabilisation du poignet par arthrodèse ou ténodèse [1]. Au-delà de l'intérêt purement orthopédique de ce geste, son influence sur la cinématique globale du membre supérieur n'a jamais été étudiée.
Matériel et méthode.– Deux sujets témoins et six patients hémiparétiques (âge moyen : 51 ans) chroniques (délai/AVC : 7,5 ans) ont été évalués en analyse tridimensionnelle du mouvement avec et sans stabilisation orthétique du poignet. Les sujets effectuaient trois taches de pointage dans trois directions différentes de l'espace. L'enregistrement a été effectué à l'aide de quatre capteurs électromagnétiques Polhémus disposés sur leur membre supérieur.
Résultats.– Pour quatre patients, la longueur de la trajectoire du point de travail du membre supérieur et la vitesse de réalisation des trois tâches de pointage sont améliorées par la stabilisation du poignet. De la même façon, la synergie épaule coude (évaluée par la relation entre les variations angulaires de flexion/extension de l'épaule et de flexion/extension du coude) est améliorée par le port de l'orthèse. La stabilisation du poignet ne modifie par la cinématique des mouvements chez le sujet témoin et chez les deux autres patients.
Discussion.– La stabilisation du poignet, probablement parce qu'elle simplifie la chaîne polyarticulaire du membre supérieur, semble améliorer la cinématique globale des mouvements du membre supérieur du patient cérébrolésé. La confirmation de ces résultats préliminaires pourrait avoir des conséquences sur nos méthodes de rééducation et sur nos stratégies chirurgicales.

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English version

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Motion lab and upper limb: Progress and prospects

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The motion analysis of the upper limb by external markers based on various methods (optical or electromagnetic). If the elbow or wrist poses no difficulties for the measurement of their movement, the shoulder girdle by the multiplicity of its bony structures is the main difficulty for motion analysis of the upper limb. Thus most of the works focalised on methodologies for defining the movement of the scapula. It moves around the humeral head in a spherical way but in a complex movement of translation and rotation around the chest. This motion is constrained by the length of the clavicle. The motion measurement devices first measured the orientation of the humerus relative to the rib cage. Early works used the electromagnetic systems [1]. By comparing the mobility of the acromion to that of metal pins inserted in the scapula this surface has been shown to allow a reliably assessment of the motion of the scapula [2]. Although some obstacles limit the use of this technique it is to date the reference for the exhaustive measure of the mobility of the shoulder girdle. Recently video-photogrammetric methods (optical) have included these data that have shown their diffusion in most clinical motion labs. They have been exported to standardized protocols for the measurement of the upper limb movement that are beginning to be published in children. These protocols include analytic and functional movements which cover the main degrees of freedom of the upper limb. This standardization phase emerging after a validation phase of the techniques can make the biomechanical analysis of the upper limb as easy and valid as gait analysis and should help to develop the quantified measurement of prehension.

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Relevance of skin deformation to track the scapula during forward humeral elevations

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Scapulothoracic muscle activity: Effect of experimental task

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Keywords: Shoulder; Scapulothoracic joint; Trapezius; Serratus anterior; Subacromial impingement; EMG

Introduction.– Several investigators have studied neuromuscular control in subjects with shoulder dysfunction. Alteration of scapulothoracic muscle activity has been reported in subjects with subacromial impingement syndrome compared with healthy subjects. However most of these studies were based on experimental set up involving constraint arm elevation. The main objective of this study was to compare the muscular pattern of trapezius and serratus anterior during a constraint and a functional arm elevation task.
Materials and methods.– Sixteen healthy subjects were instructed to perform elevation and lowering of the arm for two different tasks. For the constraint task, humeral elevation was guided by a flat surface oriented in the scapular plane. For the functional task the subjects were asked to lift and place an object on a height-adjustable surface. Muscular activities of the scapulothoracic muscles were assessed by surface electromyography. A 3D motion capture system and a custom-built goniometer were used to define magnitude of humeral elevation relative to the vertical axis. Onset time of upper trapezius (UT), middle trapezius (MT), lower trapezius (LT) and serratus anterior (SA) relative to middle deltoid was determined for each task. Scapulothoracic muscle balance ratios were also calculated. These two parameters were compared between the constraint and functional tasks.
Results.– The three portions of trapezius muscle were activated significantly earlier in the functional task than the in the constraint task. However onset time of SA did not differ between tasks. Results from the scapulothoracic muscle balance ratios showed several significant differences between tasks for both elevation and lowering phases of arm motion.
Discussion.– These differences may be explained by the greater complexity involved in the multiarticular functional task than in the monoarticular constraint task. It was hypothesized that the multiarticular arm motion require specific motor organisation. Indeed, optimal scaplothoracic muscle activity pattern is essential to provide an accurate upper-limb motion. To conclude, our findings suggest that experimental task should be more ecological to better represent neuromuscular control involve during daily life activities.

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