ASSESSING SHOULDER KINEMATICS IN A SUBJECT WITH A SPINAL ACCESSORY NEUROPATHY

Duane A. Morrow, Brian R. Kotajarvi, Alexander Y. Shin, Kai-Nan An, and Kenton R. Kaufman
Biomechanics and Motion Analysis Laboratory, Division of Orthopedic Research, Mayo Foundation, Rochester, MN
email: kaufman.kenton@mayo.edu web: mayoresearch.mayo.edu/mayo/research/biomechanics

INTRODUCTION

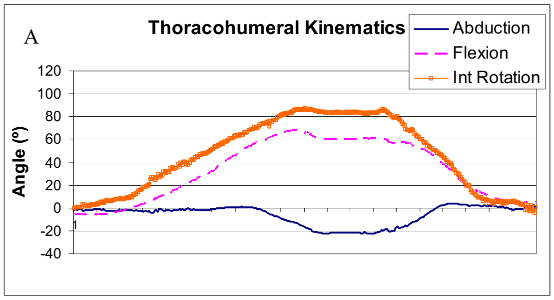
Kinematic assessment of the upper extremity, particularly the shoulder joint, remains troublesome. Due in part to the technical difficulties in quantifying scapula movement, some investigators choose to report shoulder kinematics as the relative motion between the humerus and trunk [1]. Others, using the method proposed by Karduna [2], report shoulder motion as the angle between the humerus and scapula [3]. A previous report from our laboratory pointed to some of the discrepancies that exist between thoracohumeral pseudo-joint motion and glenohumeral joint motion [4], even in a normal subject. The purpose of this abstract is to report our clinical experience using this technique, examining the results of both methods of UE motion analyses.

Figure 1. Subject with the scapula tracker resting on the scapular spine.

METHODS

UE kinematics were collected on a 17 year old patient with a right spinal accessory nerve palsy which resulted from the biopsy of an enlarged lymph node in the posterior triangle of her right neck. Sixteen retroreflective markers were used to define the head, trunk, scapula, upper arm, forearm, and hand in a six-segment biomechanical model. The three markers used to track the scapula were on a tracker [4] which was attached to the skin using double-sided tape and rested on the scapular spine (Fig. 1). Data was collected at 60-Hz using a 10-camera RealTime Motion Analysis System (Motion Analysis Corp., Santa Rosa, CA). The patient was asked to perform an UE kinematic exam consisting of moving her shoulder throughout her available Flexion/Extension (FE) and Ab/Adduction (AB) ranges of motion as well as reaching across her chest to her opposite shoulder (OS). The patient's elbow and wrist were held in their neutral alignment for the FE and AB trials, but allowed unconstrained motion during the OS trials. Three trials of each motion were collected.

Rotation matrices were calculated between anatomically-defined segment axes constructed using the guidelines established by the International Society of Biomechanics [5]. These rotation matrices were decomposed into clinically relevant coordinates using Woltring's helical-axis method [6].



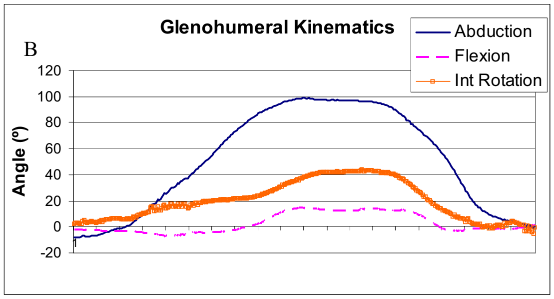


Figure 2. Thoracohumeral (A) and Glenohumeral (B) kinematics of a cross-shoulder reach.

RESULTS AND DISCUSSION

Thoracohumeral and glenohumeral joint kinematics for this subject vary widely using the two techniques. Using only trunk and humerus markers to analyze shoulder motion, it would appear that reaching to the opposite shoulder consists mainly of shoulder flexion and internal rotation (Fig. 2A). However, consideration of the scapula in examination of glenohumeral motion reveals a large contribution of shoulder abduction and substantively less internal rotation (Fig. 2B). The palsy in the spinal accessory nerve lead to weakness in the upper and lower trapezius muscles which are used to keep the scapula retracted. As a result, the patient's scapula was rotated upwards over 52° and protracted by more than 48° (Fig. 1), accounting for the large discrepancy in the kinematics results. Similar results were found for the FE and AB motions.

CONCLUSIONS

Great attention must be paid in the application of UE models used to study patients with clinical pathologies.

REFERENCES

1. Mosqueda T, et al, *J Pediatr Orthop* **24**, 695-699, 2004.
2. Karduna AR, et al, *J Biomech Eng* **123**, 184-190, 2001.
3. Rundquist PJ, and Ludweig PM, *Clin Biomech* **19**, 810-818, 2004.
4. Morrow DA, et al, *ASB Conference*, Portland, OR, 2004.
5. Wu G, et al, *J Biomech*, In Press, 2005.
6. Woltring HJ, et al, *J Biomech*, **18**, 379-389, 1985.

ACKNOWLEDGEMENTS

Funding for this study provided by the Mayo Foundation.