SCAPULAR KINEMATICS IN CHILDREN WITH BRACHIAL PLEXUS BIRTH PALSY

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INTRODUCTION

Scapular kinematics have been previously studied in adults and healthy children (1,2) and differences have been observed between adults and children (1). Brachial Plexus Birth Palsy (BPBP) often affects the shoulder musculature and these children display impairments in humeral elevation in the affected limb, glenohumeral (gh) joint deformities and compensatory changes in scapulothoracic (st) motion (3,4). Kinematics of the upper limb has been studied previously in children with BPBP (5), although this analysis did not include scapular kinematics. Since children with BPBP demonstrate scapular compensations during humeral elevation, analysis should include scapulothoracic motion to assess overall shoulder motion. The purpose of this study was to describe the scapular kinematics in children with BPBP on both their involved and their non-involved sides.

METHODS

Sixteen children with BPBP (8 F/ 8 M), 4-12 years of age participated in this study. Three trials of humeral elevation were collected on both the involved and uninvolved upper limbs. The independent variable was humeral elevation. The dependent variables were the scapular angles and the glenohumeral elevation angles from which the glenohumeral to scapulothoracic ratios (gh:st) were calculated. Kinematic data were collected using a magnetic tracking device (Polhemus 3Space® Fastrak, Colchester, VT). This method has been previously validated in adults (2). Based on the amount of humeral elevation achieved, the children were divided into 2 groups; group 1 able to achieve up to 75° and group 2 able to achieve greater than 75°. 75° was used since clinically it was thought to be functional. The degrees of excursion for GH elevation and for the scapular variables during elevation to 75° were compared between groups and sides using a Repeated Measures ANOVA. A one-way ANOVA was also conducted between sides for children in group 2 during elevation from 15°-135°.

RESULTS AND DISCUSSION

Figure 1- Shoulder Variables
Figure 1 shows the mean excursions for gh elevation and all five scapular variables on the involved and non-involved sides. The results show that for gh elevation significant differences for group (p<0.0001), side (p<0.0001) and an interaction between group and side (p<0.0001) were seen. Significant differences were not found for scapular upward rotation (UR) or clavicular elevation, though the mean excursions for both tended to be higher for the involved sides of both groups. For scapular posterior tilt there was a significant difference between sides only (p<0.05). For scapular external rotation there was a significant difference between groups (p<0.05). Figure 2 shows on the involved sides the average gh:st for the motion from 15° to 75° in group 1 was 0.3:1 and in group 2 was 1.6:1. For the non-involved side the ratio for group 1 was 2.2:1 and for group 2, 1.9:1. The gh:st between sides were not significantly different for group 2 for elevation from 15° to 135°. The average gh:st ratio on the involved side in group 2 was 1.5:1 and on the non-involved side 1.81:1.

Two patterns of scapulohumeral motion were seen among the children with BPBP. In group 1, humeral elevation was limited to less than 75° and greater scapular mobility was noted to enhance elevation capabilities of the affected limb. These children appear to have reduced strength of the rotator cuff muscles and hence are unable to move at their glenohumeral joint appropriately. This combination directly influenced scapular motion as seen by decreased gh:st ratio. In group 2, humeral elevation was greater than 75° and the scapular contribution to overall motion was less resulting in a better gh:st ratio that was even higher than previously reported in children with typical development (1). These children appear to have better strength of the rotator cuff and enhanced glenohumeral joint motion. EMG

**Figure 2** - Mean GH:ST Ratios

**SUMMARY/CONCLUSIONS**

This study revealed differences in scapular contribution to humeral elevation between the involved and uninvolved upper limbs of children with BPBP. Children with limited humeral elevation (<75°) exhibited greater contribution from the scapulothoracic joint than the children with higher elevation. They also demonstrate the feasibility of using a magnetic tracking device to analyze shoulder motion in children with BPBP which could also be used for pre-operative planning and post-operative evaluations to study the efficacy of treatment.

**REFERENCES**


**ACKNOWLEDGEMENTS**

Our thanks to Andy Karduna for his insights and assistance with the project.