OBJECTIVES

- To test the hypothesis whether gleno-humeral deformities in children and adolescent with obstetrical brachial plexus palsy (OBPP) are three dimensional (3D)
- To assess the inter-rater reliability of the typically used 2D measures (glenoid version, HHM) and a newly developed 3D methodology

INTRODUCTION

- Obstetrical brachial plexus palsy (OBPP) has an incidence rate up to 5.1/1000.
- Muscle strength imbalance and contractures resulting from OBPP often lead to glenoid deformities, the main precipitating factor in humeral head subluxation.
- Current knowledge, evaluation and treatment planning for OBPP are based in 2D axial plane measures.
- 3D quantification of the skeletal changes associated with OBPP may enable clinicians and surgeons to make more informed interventional decisions.

METHODS

Population
- 13 children with unilateral OBPP (9M/4F)
- 11.8 ± 4.5 years of age (6.7 – 18.8 years)
- No surgery in the past 6 months
- Non-impaired shoulder was used as the control

3D Static MRI
- 3D axial gradient recalled echo (GRE) images
- Resolution = 0.55 mm² – 0.75 mm² (adjusted to subject size) with 1.2 mm slice thickness

2D Measures
- At the mid glenoid slice (2.4 mm below the coracid process)
- Glenoid Antero-posterior (AP) version: angle between scapular axis and glenoid axis (Fig 1)
- Humeral Head Migration (HHM): Ratio of the maximal radius of the humeral head orthogonal to the scapular axis over the portion of this line that was anterior to the scapula

RESULTS

A three dimensional deformity

- All 3D gleno-humeral parameters were significantly different between sides (Figure 3)
- Compared to the non-impaired side, the deformed glenoid was more retroverted (7.91°, p=0.003) and more inferiorly oriented (7.28°, p=0.009). The humeral head was also migrated more posteriorly (5.54 mm, p=0.007), inferiorly (3.96 mm, p=0.013) and medially (3.63 mm, p=0.002).

The 3D measures had higher reliability than 2D

- The inter-rater reliability was good to excellent for all 2D and 3D measures (Table 1). However, the SEM of the 3D AP version was markedly smaller than both the 2D AP version, especially in the impaired side (0.87° vs 3.00°-3.40°).

Figure 2: Identified coordinate locations of the trignum spineae scapulae (TS) and the angulus inferior (AI). GC was set as origin of the local coordinate system.

Figure 1: 2D measures of anterior/posterior (AP) version on impaired (left) and non-impaired glenoid (right).

Figure 3: Comparison of measures on impaired and non-impaired shoulder. Comparisons were done by use of a Wilcoxon signed-rank test. AP- Anterior/Posterior, SI- Superior/Inferior.

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Table 1: Inter-observer reliability of 2D & 3D Measures. ICC- Intraclass correlation coefficient, SEM- Standard error of the mean

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<th>Non-Impaired</th>
<th>Impaired</th>
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<tr>
<td></td>
<td>ICC</td>
<td>SEM</td>
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DISCUSSION

Clinical Relevance

- First evidence of the three dimensionality of the GH deformity in OBPP
- Confirms well known glenoid posterior version likely due to an external/internal rotator imbalance
- Originally demonstrates a significant inferior glenoid version associated to an inferior subluxation of the humeral head likely explained by
  - Weakness of the sustainers of the humeral head (supraspinatus, deltoid, etc.)
  - Contractions of the latissimus dorsi/infraspinatus
- Current surgical techniques and rehabilitative strategies often target the glenoid retroversion and posterior humeral.
- This study suggests that consideration should be given to adapting surgical techniques to simultaneously address both pathological posterior and inferior components of the GH deformity.

Comparison of 2D & 3D Measures

- Typical 2D measures had high level of ICCs as previously reported
- But the metrological properties of the 3D measurement, especially in case of deformity, were significantly better
- This study suggests the use of a 3D reconstruction (or at least 3D reformatted planes) for the pre-intervention evaluation of the GH deformity

REFERENCES