Improvements after mod Quad and triangle tilt revision surgical procedures in obstetric brachial plexus palsy

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AIM
To compare outcomes of our revision surgical operations in obstetric brachial plexus palsy (OBPP) patients to results of conventional operative procedures at other institutions.

METHODS
We analyzed our OBPP data and identified 10 female and 10 male children aged 2.0 to 11.8 years (average age 6.5 years), who had prior conventional surgical therapies at other clinics. Of the 20 patients, 18 undergone triangle tilt, 2 had only mod Quad. Among 18 patients, 8 had only triangle tilt and 10 had also mod Quad as revision surgeries with us. We analyzed the anatomical improvements and functional modified Mallet statistically before and after a year post-revision operations.

RESULTS
Pre-revision surgery average modified Mallet score was 12.0 ± 1.5. This functional score was greatly improved to 18 ± 2.3 (P < 0.0001) at least one-year after revision surgical procedures. Radiological scores (PHHA and glenoid version) were also improved significantly to 31.9 ± 13.6 (P < 0.001), -16.3 ± 11 (P < 0.0002), at least one-year after triangle tilt procedure. Their mean pre-triangle tilt (yet after other surgeon's surgeries) PHHA, glenoid version and SHEAR were 14.6 ± 21.7, -31.6 ± 19.3 and 16.1 ± 14.7 respectively.

CONCLUSION
We demonstrate here, mod Quad and triangle tilt as
successful revision surgical procedures in 20 OBPP patients, who had other surgical treatments at other clinics before presenting to us for further treatment.

Key words: Revision surgery; Obstetric brachial plexus palsy; Shoulder movements; Joint incongruity; Upper limb

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Core tip: We compared functional and anatomical improvements from our revision surgical treatment experiences to outcomes of other surgical treatments at other institutions in 20 obstetric brachial plexus palsy (OBPP) children. Pre-revision surgery mean modified Mallet scores and shoulder anatomical measurements were improved statistically highly significantly at least one-year after revision surgeries. We demonstrate here, mod Quad and triangle tilt as successful revision surgical procedures in 20 OBPP patients, who had other surgical treatments at other clinics before presenting to us for further treatment.

INTRODUCTION

Poor recovery of neurological function in obstetric brachial plexus palsy (OBPP) results in muscle weakness and imbalances around the shoulder[1-3]. Progressive muscle imbalance causes bony deformities at the shoulder joint, affecting it’s movements and functions[4,5]. Many traditional surgical interventions have been reported to improve the upper extremity functions in OBPP patients[6-11].

Muscle release and tendon transfer procedures have been shown[12-19] to reduce the muscle contractures and improve shoulder movements. Humeral rotational osteotomy corrects the arm at resting position, but does not address the glenohumeral and Scapular Hypoplasia, Elevation and Rotation (SHEAR) deformities. These surgical treatments do not address these two osseous deformities.

We have published extensively the effectiveness of triangle tilt surgery in correcting glenohumeral joint incongruity and thereby improving upper extremity functions in OBPP patients[20-28]. Here, we show both functional and anatomical improvements significantly after triangle tilt and mod Quad as revision surgeries in 20 OBPP patients, who had other surgical treatments at outside clinics before visiting our clinic for further treatment.

MATERIALS AND METHODS

We analyzed our OBPP data and identified 10 female and 10 male patients, aged 2.0 to 11.8 years (average age 6.5 years), who had operative procedures at other clinics.

Of the 20 OBPP patients in our present study group, 8 patients undergone only the bony procedure, triangle tilt and 10 had both triangle tilt and mod Quad (Tables 1 and 2). Therefore, these 18 patients (Table 2) have anatomical and radiological scores (PHHA, SHEAR and glenoid version), in addition to functional modified Mallet score (Table 1). Two patients, number 19 and 20 in Table 1, underwent only mod Quad procedure, as they did not have shoulder subluxation. Therefore, these two patients did not need to undergo triangle tilt procedure, which addresses shoulder subluxation. Modified Mallet and radiological scores were measured, statistically analyzed to compare. All measurements were done at least one-year after surgical treatments.

The nerve involvement was C5-6 (n = 5), C5-7 (n = 8), and total (n = 7). Traditional operative procedures that these OBPP children had in the past at other clinics are nerve transfer/graft, neurolysis, brachial plexus exploration, botox, muscle/tendon transfer and release, humeral osteotomy and anterior capsule release. Outcomes of our revision procedures in OBPP patients were compared to the results of other traditional surgical treatments at other clinics. Further, these patients’ radiological scores were measured from computed tomography and magnetic resonance images and statistically compared.

Patient examination

We examined physically all OBPP children and their video recordings pre- and post-operatively, scoring their modified Mallet parameters on a scale between one and five. One and five denote lack of movement and normal function respectively.

Anatomical measurements of shoulder

We measured PHHA, glenoid version[29] and Scapular hypoplasia, elevation and rotation[30] using computed tomography and magnetic resonance imaging pre- and post-TT operative procedure.

Operative technique

Triangle tilt[20-28] and mod Quad procedures[14,31,32] have been demonstrated successful outcomes in OBPP.

We used the student’s t test and compared pre- and post-operative results in this group of OBPP. P < 0.05 was considered statistically significant.

RESULTS

Pre-revision surgery mean modified Mallet score was 12.0 ± 1.5 (Table 1 and Figure 1 upper panels). This functional score was greatly improved to 18 ± 2.3 (P <
0.0001) at least one-year after our revision surgeries (Table 1, Figure 1 lower panels). Furthermore, their shoulder anatomical scores were improved significantly to 31.9 ± 13.6 (P < 0.001) and -16.3 ± 11 (P < 0.0002) at least one-year after triangle tilt operation (Table 2 and Figure 2, lower panels). This was in comparison to their radiological outcomes of other procedures before having triangle tilt with us (mean PHHA, glenoid version and SHEAR were 14.6 ± 21.7, -31.6 ± 19.3 and 16.1 ± 14.7 respectively; Table 2 and Figure 2 upper panels).

**DISCUSSION**

Twenty OBPP children in our present study had one or...
multiple operative procedures at other clinics before visiting our institute for further treatments (Table 1). One patient in our study group had Steindler flexoroplasty, which improves active flexion of the elbow. These conventional treatments fail to address the SHEAR deformity\(^\text{[30]}\) associated with majority of OBPP patients. Therefore, these OBPP patients in our study had persistent shoulder contractures and joint incongruency. Hence, they also had poor upper extremity functions. (Tables 1 and 2; upper panels in Figures 1 and 2). Mod Quad procedure addresses poor shoulder abduction in permanent OBPP. However, this procedure is ineffective to correct the glenohumeral joint and SHEAR deformities. Eighteen OBPP children, who had shoulder joint incongruency and SHEAR undergone TT bony operation with us. We demonstrated that this procedure effectively addressed the bony deformities of the affected upper extremity and improved it's anatomy and functions\(^\text{[20-28]}\). After undergone these two revision surgical procedures with us, these twenty patients had better results both functionally and anatomically. This is highly significant in comparison to the outcomes of
other surgical treatments at other clinics.

There was statistically significant improvement anatomically, after having triangle tilt compared to the radiological outcomes of other operative procedures.

In conclusion, we demonstrate here that mod Quad and triangle tilt as successful revision surgical procedures in 20 OBPP patients, who had conventional surgical therapies at other clinics before presenting to us for further treatment.

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