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Management of residual internal rotation deformity in obstetric brachial plexus palsy: A case report

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Abstract
Background; Obstetric brachial plexus palsy (OBPP) often leads to residual internal rotation contracture of the shoulder with progressive glenohumeral deformity due to muscle imbalance. Surgical release and external rotation osteotomy can improve function in affected children.
Case Presentation: A 5-year-old boy presented with right shoulder deformity and difficulty in hand-to-mouth movement following birth-related Erb-Duchenne's palsy. Examination showed 55° fixed internal rotation, absent external rotation, 10° elbow flexion contracture, and Modified Mallet Grade II-III function. Imaging revealed dysplastic humeral head, absent glenoid concavity, and scapular elevation. He underwent contracture release and 40° proximal humeral external rotation osteotomy followed by immobilization and rehabilitation.
Results: At six months, deformity was corrected, hand-to-mouth function restored, and active external rotation improved to 50°. Modified Mallet grade improved to IV, with minimal residual weakness.
Conclusion: Combined contracture release and humeral osteotomy significantly improved shoulder function and deformity in OBPP. Early intervention and rehabilitation are essential for optimal outcomes.

Keywords: Obstetric brachial plexus palsy, Erb-Duchenne's palsy, internal rotation contracture, external rotation osteotomy, Modified Mallet Classification

Introduction
Obstetric brachial plexus palsy (OBPP) is a birth-related injury to the brachial plexus that commonly affects the upper trunk (C5-C6) roots, resulting in Erb-Duchenne's palsy. While many infants experience spontaneous neurological recovery, residual deformities are common, with persistent muscle imbalance between overactive internal rotators (subscapularis, pectoralis major, anterior deltoid) and weakened or paralyzed external rotators (infraspinatus, teres minor) leading to progressive internal rotation contracture of the shoulder. This chronic muscle imbalance results in secondary glenohumeral joint deformities including glenoid retroversion, posterior humeral head subluxation, and dysplasia of the humeral head, which may become irreversible by two years of age. The natural history of untreated OBPP with residual weakness is progressive glenohumeral deformity due to persistent muscle imbalance, leading to glenoid retroversion and posterior subluxation of the humeral head. Surgical management through contracture release and external rotation osteotomy of the proximal humerus has demonstrated significant functional improvement in children with established deformities, with studies reporting improvements in Mallet scores and restoration of activities of daily living. This case report describes a 5-year-old male child with residual internal rotation and adduction deformity of the right shoulder following recovered obstetric Erb-Duchenne's palsy, successfully managed with soft tissue release and proximal humeral external rotation osteotomy [1, 2].

Case Report
A 5-year-old male child presented to the orthopaedic outpatient department with progressive deformity of the right shoulder causing difficulty in bringing the hand to the mouth. He was the first-born child of non-consanguineous parents following spontaneous conception with an uneventful antenatal period and regular checkups. Delivery was prolonged due to a rigid perineum, during which manipulative traction was applied to the right shoulder, resulting in a birth injury consistent with obstetric Erb-Duchenne's palsy. His birth weight was 2.6 kg, and he cried immediately after birth. He required a 3-day neonatal intensive care unit stay for meconium aspiration but recovered completely. No neurological evaluation was performed during the neonatal period.

The child exhibited delayed gross and fine motor milestones of the right upper limb. Vaccinations were according to age, and there was no intellectual disability. On examination, there was a fixed 55° internal rotation deformity of the right shoulder with absence of active external rotation. A 10° flexion contracture of the right elbow limited the range of motion to 10°-150°. Right shoulder abduction was 100°. Postural scoliosis and an elevated, hypoplastic right scapula without rotational abnormality were observed. Wasting was noted in the right infraspinatus region. Mid-upper arm circumference measured 17 cm bilaterally, indicating no arm wasting. Neurovascular examination was unremarkable. During hand-to-mouth movement, the child utilized shoulder flexion and abduction instead of external rotation, demonstrating a marked "trumpet sign." No dysmorphic or neurocutaneous features were present. Height (116 cm) and weight (20 kg) were appropriate for age according to WHO child growth standards.

According to the Modified Mallet Classification for shoulder function assessment, the child had Grade III function characterized by: active shoulder abduction of 100° (Grade III: 30°-90° range, borderline with Grade IV which is >90°), absent external rotation at 0° (Grade II: 0° external rotation), hand-to-mouth movement possible but with marked trumpet sign requiring more than 40° of shoulder abduction (Grade II/III), hand to back of neck was difficult (Grade III), and hand to back was difficult (Grade III). The overall functional status corresponded to Modified Mallet Grade II-III, indicating moderate functional impairment with significant external rotation deficit.

Magnetic resonance imaging of the right brachial plexus and nerve conduction studies were within normal limits. Chest radiograph revealed an elevated and smaller right scapula, internal rotation of the coracoid process, absent glenoid concavity, dysplastic humeral head, and no omovertebral bar. Additional skeletal anomalies included hemivertebrae, vertebral fusion, and rib anomalies.

Based on clinical and radiological findings, a diagnosis of residual internal rotation and adduction deformity of the right shoulder with flexion contracture of the right elbow secondary to recovered obstetric Erb-Duchenne's palsy was established.

Surgical management was performed under general anesthesia using an extended deltopectoral approach extending from the shoulder to 2 cm below the deltoid insertion. The musculocutaneous nerve and cephalic vein were identified and preserved. Contracture release of the subscapularis and short head of biceps was performed. Z-plasty lengthening of the pectoralis major and release of the anterior deltoid contracture were completed. A transverse humeral osteotomy was performed at the proximal shaft between the insertions of pectoralis major and deltoid. The distal fragment was externally rotated by 40° and fixed with plate osteosynthesis. The wound was closed in layers.

Postoperatively, the child was immobilized in a shoulder spica cast maintaining 90° abduction and external rotation, elbow mid-flexion, forearm supination, and wrist extension for one week. Subsequently, a customized airplane splint maintaining abduction and external rotation with elbow extension, forearm pronation, and wrist extension was used for five weeks. Gradual muscle strengthening rehabilitation with graded active and passive physiotherapy was instituted for four weeks.

At six-month follow-up, there was satisfactory correction of the deformity with restoration of hand-to-mouth function. Active external rotation improved to 50°, active shoulder abduction remained at 100°, hand-to-mouth movement was achieved with minimal compensatory abduction (less than 40°), and hand to neck and hand to back movements were easy. According to the Modified Mallet Classification, postoperative function improved to Grade IV, indicating active abduction maintained at 100°, external rotation improved to 50° (>20°), hand-to-mouth easy with less than 40° shoulder abduction, and hand to neck/back movements became easy. Acceptable residual external rotation weakness compared to the contralateral side persisted.

Fig 1: Clinical presentation

Fig 2: Incision and exposure

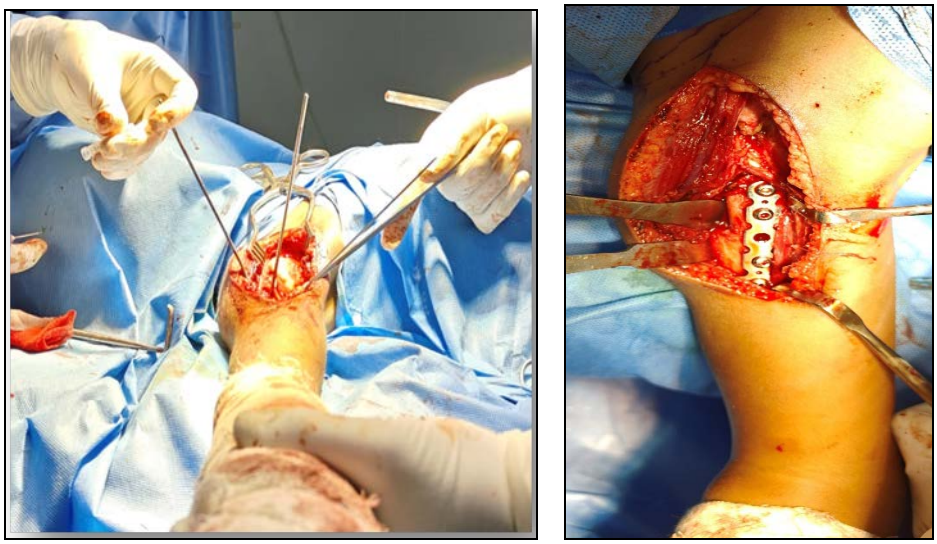

Fig 3: external rotation osteotomy and fixation

Fig 4: Post op immobilisation

Fig 5: Post op radiograph

Discussion

Obstetric brachial plexus palsy involving the upper trunk (C5-C6) results in characteristic muscle imbalance with weakened external rotators and preserved or overactive internal rotators, leading to progressive internal rotation contracture and secondary glenohumeral deformities. The pathophysiology involves chronic positioning of the shoulder in internal rotation during skeletal growth, resulting in abnormal mechanical forces on the developing glenohumeral joint. 72% of children with internal rotation contracture secondary to OBPP developed posterior glenoid deformity, including flattening, biconcave glenoid, or pseudoglenoid formation, with deformities becoming severely advanced by two years of age. This emphasizes the importance of early recognition and intervention [1, 2].

Untreated OBPP with residual weakness leads to progressive glenohumeral deformity due to persistent muscle imbalance, with significant glenoid retroversion posterior subluxation in 62% of patients, with progressive deformity correlating with increasing age. These findings support early surgical intervention before irreversible skeletal changes occur. In the present case, the child demonstrated characteristic features including internal rotation contracture, dysplastic humeral head, and absent glenoid concavity, consistent with advanced glenohumeral deformity.

The Modified Mallet Classification remains the most commonly used functional scoring system to assess shoulder function in children with OBPP, evaluating five key movements: global abduction, global external rotation, hand-to-neck, hand-to-spine, and hand-to-mouth. This classification provides reliable assessment of functional limitations and serves as a valuable tool for documenting preoperative deficits and postoperative improvements. In this case, the child presented with Modified Mallet Grade II-III function preoperatively, reflecting significant functional impairment, particularly in external rotation and activities requiring shoulder rotation [3].

Surgical management aims to restore functional shoulder positioning through release of contracted internal rotators and realignment of the humerus via external rotation osteotomy. External rotation humeral osteotomy improves shoulder function by reorienting the arc of shoulder motion into a more functional range. Studies have demonstrated significant improvements in Mallet scores following external rotation osteotomy combined with soft tissue release, with better outcomes observed in younger children and those with better preoperative range of motion. Studies show Improved functional outcomes including restoration of hand-to-occiput reach and elimination of trumpet sign following external rotation osteotomy and lengthening in late-presenting OBPP cases [4, 5].

In this case, the combined approach of contracture release (subscapularis, short head of biceps, pectoralis major, anterior deltoid) and 40° external rotation osteotomy successfully restored hand-to-mouth function and improved the Modified Mallet Classification from Grade II-III preoperatively to Grade IV postoperatively, representing substantial functional improvement. Active external rotation improved from 0° to 50° at six-month follow-up. The residual external rotation weakness, while present, is an accepted outcome that is balanced by the substantial functional gains achieved. Postoperative rehabilitation focusing on gradual muscle strengthening is critical for maintaining surgical correction and optimizing functional recovery.

Early diagnosis, appropriate imaging to assess glenohumeral joint status, functional assessment using standardized tools such as the Modified Mallet Classification, and timely surgical intervention remain paramount for optimal functional outcomes in children with residual OBPP deformities.

Conclusion

Residual internal rotation and adduction deformities following obstetric Erb-Duchenne's palsy result in significant functional impairment and progressive glenohumeral dysplasia. The Modified Mallet Classification provides a reliable tool for functional assessment and documentation of treatment outcomes. Surgical management combining contracture release and proximal humeral external rotation osteotomy effectively corrects deformity and restores shoulder function in children with established contractures, as demonstrated by improvement from Modified Mallet Grade II-III to Grade IV in this case. Comprehensive postoperative rehabilitation is essential to maintain correction and optimize muscle recovery. Early recognition and intervention are critical to prevent irreversible skeletal deformities and maximize functional outcomes.

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Nil.

Conflict of Interest

The authors declared no potential conflicts of interest with regard to the submitted article. Each author certifies that he or she has no commercial associations that might pose a conflict of interest in connection with the submitted article.

Ethical standards

Institutional ethics committee approved the study.

Informed consent was obtained from the participant (legal guardian) included in the study

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