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Original Article

Clinical Outcomes of Humeral Derotation Osteotomy in Obstetric Brachial Plexus Palsy: A Retrospective Cohort Study.

Awais Wali[1],Muhammad Qasim[2],Asad Ullah Jan[3],Tahir Hassan[4],Muhammad Ihtisham Khattak[5]

1. Specialist Registrar, MTI HMC Peshawar
2. Fellow Pediatric Orthopaedic Surgery, MTI HMC Peshawar
3. Assistant Professor, Department of Orthopedics and Spine Surgery, HMC Peshawar
4. Postgraduate Resident, Hayatabad Medical Complex, Peshawar
5. TMO, Orthopedic B Ward, HMC MTI Peshawar

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Corresponding Author

Asad Ullah Jan
Assistant Professor, Department of Orthopedics and Spine Surgery, HMC Peshawar

Email:asadjankmcb@gmail.com

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ABSTRACT

Objective: To evaluate the clinical and functional outcomes of humeral derotation osteotomy in patients with OBPP, with emphasis on improvement in shoulder external rotation, functional scores, and postoperative complications.

Methods: This retrospective cohort study included 46 children with OBPP who underwent HDO at a tertiary orthopedic center. We retrospectively assessed demographic, surgical, radiographic, functional, complication, and follow-up data. We compared shoulder range of motion and Mallet scores preoperatively and postoperatively using paired t-tests.

Results: Mean external rotation improved from −25.6° ± 8.4° to 32.8° ± 10.2°, while abduction increased from 62.5° ± 14.3° to 118.7° ± 16.9% ($p<0.001$). Mallet scores improved from 9.2 ± 2.1 to 16.8 ± 2.4 ($p<0.001$). Minor complications included stiffness, implant irritation, and infection.

Conclusion: Humeral derotation osteotomy is an effective surgical procedure for correcting internal rotation deformity in patients with OBPP. It provides significant functional and cosmetic improvement with a low complication rate. Early identification and appropriate surgical intervention can substantially enhance quality of life in affected children.

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INTRODUCTION

Obstetric brachial plexus palsy (OBPP) is a significant peripheral nerve injury that occurs during childbirth due to traction or compression of the brachial plexus nerves. It is most commonly associated with difficult deliveries, shoulder dystocia, macrosomia, and instrumental delivery. The incidence of OBPP varies globally, ranging from 0.5 to 2 per 1000 live births, although higher rates have been reported in resource-limited settings due to inadequate obstetric care and delayed recognition of birth trauma [1,2]. The clinical presentation of OBPP depends on the extent and location of nerve injury, ranging from mild transient weakness to complete paralysis of the upper limb. While some infants recover spontaneously within the first few months of life, a significant proportion develop persistent deficits leading to long-term functional impairment [3]. The upper trunk (C5–C6) lesions, commonly known as Erb's palsy, are the most frequently encountered pattern and are strongly associated with shoulder dysfunction and deformity [4].One of the most disabling sequelae of OBPP is the development of shoulder internal rotation contracture. This deformity arises due to muscle imbalance between internal rotators (subscapularis, pectoralis major, latissimus dorsi) and weakened external rotators (infraspinatus and teres minor). Over time, this imbalance leads to glenohumeral joint dysplasia, posterior subluxation, and progressive loss of external rotation [5]. Clinically, affected children present with the "arm-internal rotation posture," inability to externally rotate the shoulder, difficulty in overhead activities, and significant cosmetic deformity.Functional impairment in OBPP has a profound impact on activities of daily living, including self-care, dressing, feeding, and play activities. In addition, psychological and social consequences may arise due to visible limb deformity and disability [6]. Therefore, restoring shoulder balance and improving functional range of motion is a primary goal in the management of these patients.Management of OBPP includes a spectrum of approaches ranging from conservative physiotherapy to complex reconstructive surgeries. Early physiotherapy remains the cornerstone of initial treatment and aims to maintain joint mobility and prevent contractures. However, in cases with persistent deformity, surgical intervention becomes necessary [7]. Various surgical options have been described, including soft tissue releases, tendon transfers, and bony procedures, depending on severity and age of the patient.Among these, humeral derotation osteotomy (HDO) is an established corrective surgical procedure for children with fixed internal rotation deformity of the shoulder. The procedure involves surgical osteotomy of the humerus followed by external rotation and fixation using plates or intramedullary devices. This realigns the limb in a more functional and anatomically favorable position without directly altering muscle function [8]. HDO is particularly indicated in older children where soft tissue procedures alone are insufficient to correct established bony deformities. It is also preferred in cases where glenohumeral joint deformity has already developed. The procedure improves the resting position of the limb, enhances external rotation, and allows better hand positioning in space, thereby improving functional outcomes [9].Several studies have demonstrated that humeral derotation osteotomy significantly improves shoulder positioning and functional scores in OBPP patients. Improvements are commonly measured using standardized assessment tools such as the Mallet classification system, which evaluates global shoulder function including abduction, external rotation, hand-to-mouth, and hand-to-neck movements [10].Despite increasing use of humeral derotation osteotomy worldwide, there is limited regional data evaluating its functional outcomes in children with OBPP in developing healthcare systems. Understanding local outcomes is important to guide clinical decision-making, improve surgical planning, and optimize rehabilitation protocols.Therefore, the present retrospective cohort study was conducted to evaluate the clinical and functional outcomes of humeral derotation osteotomy in patients with obstetric brachial plexus palsy. The study aims to assess improvement in shoulder external rotation, functional

scores, and postoperative complications in order to determine the effectiveness of this procedure in a tertiary care orthopedic setting.The findings of this study are expected to contribute valuable evidence regarding the role of humeral derotation osteotomy in improving functional independence and quality of life in children affected by OBPP.

Materials and Methods

Study Design and setting

This retrospective cohort study was conducted in the Department of Orthopedics and Spine Surgery, HMC Peshawar from January 2016 to January 2023.

Inclusion Criteria

Patients were included if they had a confirmed diagnosis of OBPP, persistent shoulder internal rotation deformity, failed conservative management including physiotherapy, a minimum postoperative follow-up of 6 months, and complete clinical and follow-up records.

Exclusion Criteria

Patients were excluded if they had undergone other shoulder reconstructive procedures without osteotomy, had incomplete medical records or inadequate follow-up, had associated neuromuscular disorders unrelated to OBPP, or had undergone previous failed shoulder osteotomy or revision surgery.

Surgical Procedure

All patients underwent HDO under general anaesthesia. The humerus was exposed through a proximal or mid-shaft approach according to the deformity. A transverse or oblique osteotomy was performed, followed by correction of internal rotation by 30°–70°, depending on the severity of deformity. Fixation was performed using a dynamic compression plate or locking plate; intramedullary fixation was used in selected cases according to surgeon preference. Postoperatively, the limb was immobilised using a shoulder spica or brace.

Outcome Measures

The primary outcomes were improvement in shoulder external rotation and abduction range of motion. Secondary outcomes included the Mallet functional score, cosmetic improvement and limb positioning, and parental satisfaction.

Postoperative Care and Rehabilitation

Patients were immobilised for 3–6 weeks according to fixation stability. Physiotherapy was subsequently initiated with gradual range-of-motion exercises focusing on shoulder abduction and external rotation. Follow-up assessments were performed at 6 weeks, 3 months, and 6–12 months postoperatively.

Data Collection

Data were extracted from hospital medical records, operative notes, preoperative and postoperative radiographs, physiotherapy records, and follow-up documentation.

Statistical Analysis

Data were analysed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Preoperative and postoperative outcomes were compared using the paired *t*-test. A *p*-value <0.05 was considered statistically significant.

Results

A total of 46 children with OBPP who underwent HDO were included. The mean age at surgery was 7.4 ± 2.6 years; 26 (56.5%) were male and 20 (43.5%) were female. The mean follow-up duration was 18.2 ± 6.3 months (Table I). Mean shoulder external rotation improved from −25.6° ± 8.4° preoperatively to 32.8° ± 10.2° postoperatively ($p<0.001$) (Table II).Mean shoulder abduction increased from 62.5° ± 14.3° preoperatively to 118.7° ± 16.9° postoperatively ($p<0.001$) (Table II).The mean Mallet score improved from 9.2 ± 2.1 preoperatively to 16.8 ± 2.4 postoperatively ($p<0.001$) (Table III).

Table I. Demographic and clinical characteristics of children with obstetric brachial plexus palsy

Characteristic	Value
Total patients, n	46
Age, years, mean ± SD	7.4 ± 2.6
Male, n (%)	26 (56.5)
Female, n (%)	20 (43.5)
Follow-up duration, months, mean ± SD	18.2 ± 6.3

Data are presented as mean ± standard deviation (SD) or frequency with percentage, as appropriate.

Table II. Preoperative and postoperative functional outcomes following humeral derotation osteotomy

Outcome measure	Preoperative, mean ± SD	Postoperative, mean ± SD	*p*-value
Shoulder external rotation, °	−25.6 ± 8.4	32.8 ± 10.2	<0.001
Shoulder abduction, °	62.5 ± 14.3	118.7 ± 16.9	<0.001
Mallet score	9.2 ± 2.1	16.8 ± 2.4	<0.001

Values are presented as mean ± standard deviation. Comparisons between preoperative and postoperative measurements were performed using paired *t*-tests. A *p*-value <0.05 was considered statistically significant.

Table III. Postoperative complications and parental satisfaction

Outcome	n (%)
Postoperative complications	
Stiffness	6 (13.0)
Implant irritation	4 (8.7)
Infection	1 (2.2)
Nonunion	0 (0)
Neurovascular complications	0 (0)
Parental satisfaction	
Good/excellent	40 (87.0)
Moderate	6 (13.0)

Data are presented as frequency with percentage. Postoperative complications were recorded during the follow-up period. Parental satisfaction was categorised as good/excellent or moderate according to the study records.

Discussion

Obstetric brachial plexus palsy (OBPP) is a well-recognized neonatal peripheral nerve injury that results from traction to the brachial plexus during complicated deliveries, most commonly associated with shoulder dystocia, macrosomia, and instrumental delivery. Although many infants experience spontaneous neurological recovery, a significant proportion develop persistent motor deficits leading to long-term functional impairment of the upper limb. Among these, shoulder internal rotation contracture is one of the most common and disabling sequelae, significantly affecting both function and cosmesis [10,11].The present retrospective cohort study evaluated the clinical and functional outcomes of humeral derotation osteotomy (HDO) in patients with OBPP. The findings demonstrated a significant improvement in shoulder external rotation, abduction, and Mallet functional scores following surgery. These results support the effectiveness of HDO as a reliable corrective procedure for established internal rotation deformity of the shoulder.One of the most important findings of this study was the marked improvement in shoulder external rotation following humeral derotation osteotomy. Preoperatively, patients exhibited severe internal rotation deformity with limited ability to externally rotate the arm. Postoperatively, there was a statistically significant correction, resulting in functional positioning of the upper limb. This improvement is consistent with previous literature, which has demonstrated that bony rotational correction directly improves limb alignment even in cases where muscular imbalance persists [13].Similarly, shoulder abduction showed significant improvement after surgery. Although HDO does not directly address muscle strength or joint contracture, repositioning of the humerus into external rotation allows improved biomechanical advantage of the deltoid and supraspinatus muscles. This leads to better shoulder elevation and functional use of the limb in daily activities [14].The Mallet scoring system, which evaluates global shoulder function including abduction, external rotation, hand-to-mouth, and hand-to-neck movements, showed significant improvement in this study. This indicates that HDO not only corrects deformity but also translates into meaningful functional gains in activities of daily living. These findings are consistent with studies by Al-Qattan and Waters, who reported significant improvement in Mallet scores following humeral osteotomy in children with OBPP [15,16].The results of this study are in agreement with multiple international studies that support the role of humeral derotation osteotomy in managing fixed internal rotation deformities. Kozin et al. reported that HDO is particularly effective in older children where soft tissue procedures alone are insufficient to correct established bony malalignment [17]. Similarly, Sibinski et al. highlighted that

rotational osteotomy provides predictable improvement in limb positioning and function, especially in cases with long-standing deformity [18].Al-Qattan emphasized that HDO is not primarily a muscle-strengthening procedure but rather a positional correction surgery that improves function through biomechanical realignment [19]. This explains why even in patients with persistent muscle weakness, functional improvement is still observed postoperatively.The timing of humeral derotation osteotomy plays a crucial role in determining outcomes. In this study, most patients underwent surgery at a mean age of approximately 7 years, which is consistent with recommended timing in literature. Early intervention before the development of severe glenohumeral dysplasia is associated with better functional outcomes [20].However, delayed presentation is common in developing countries, including Pakistan and similar healthcare settings, where patients often present after significant deformity has already developed. In such cases, soft tissue procedures alone are insufficient, making HDO the preferred option for correction [21].The complication rate observed in this study was low, with no major neurovascular injuries or nonunion cases reported. Minor complications such as temporary shoulder stiffness and implant irritation were the most common findings. These are consistent with previously published studies, which report HDO as a relatively safe procedure with low morbidity when performed by experienced surgeons [22].The absence of major complications such as nerve injury or fixation failure highlights the safety of the procedure. Proper surgical technique, careful preoperative planning, and stable internal fixation contribute significantly to reducing complications. Early physiotherapy also plays a critical role in preventing stiffness and ensuring functional recovery.An important aspect of OBPP management is not only functional improvement but also cosmetic correction. Internal rotation deformity often leads to an abnormal limb posture that is socially and psychologically distressing for both patients and parents. Following HDO, significant improvement in limb positioning was observed, resulting in enhanced cosmetic appearance and improved self-esteem.Parental satisfaction was high in this study, reflecting both functional and aesthetic benefits of the procedure. This is particularly important in pediatric populations, where psychosocial development is closely linked to physical appearance and functional independence [23].Postoperative rehabilitation is a critical component of successful outcomes following HDO. In this study, patients underwent immobilization followed by structured physiotherapy programs focusing on shoulder range of motion and strengthening exercises. Early initiation of rehabilitation contributed significantly to functional recovery and prevention of postoperative stiffness.Studies have shown that delayed or inadequate rehabilitation can compromise surgical outcomes, even when technical correction is successful. Therefore, a multidisciplinary approach involving orthopedic surgeons, physiotherapists, and caregivers is essential for optimal recovery [24].

Limitations

This study has several limitations. First, it is a retrospective design, which may introduce selection and documentation bias. Second, the sample size is relatively small, which may limit the generalizability of the findings. Third, long-term follow-up beyond 2–3 years was not available for all patients, which limits assessment of durability of correction. Additionally, the study did not include a control group treated with alternative surgical procedures such as tendon transfers or soft tissue releases, which would have allowed direct comparative analysis. Future prospective randomized studies are needed to better define the role of HDO in the management algorithm of OBPP.

Conclusion

Humeral derotation osteotomy significantly improved shoulder external rotation, abduction, and Mallet functional scores in children with OBPP. The procedure provided functional and cosmetic improvement with few reported complications and may be considered after failed conservative management.

Authors' Contributions

All authors contributed to the conception and design of the study. **A.W.** and **M.Q.** contributed to data collection and acquisition. **A.U.J.** and **T.H.** contributed to data analysis and interpretation. **M.I.K.** contributed to the surgical aspects, critical revision, and supervision. All authors contributed to drafting and critically revising the manuscript, approved the final version, and agreed to be accountable for all aspects of the work. All authors meet the **ICMJE** criteria for authorship. All authors contributed substantially to the conception and design of the study, acquisition, analysis, and interpretation of data, drafting or critical revision of the manuscript, approved the final version, and agreed to be accountable for all aspects of the work

Ethics Statement

Ethical approval for the study was obtained from the relevant Institutional Review Board/Ethics Committee of the participating institution..**Aproval MTI/HMC/422/02/2015.**

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