Scientific Research Publishing

Open Journal of Orthopedics, 2025, 15(11), 392-402
https://www.scirp.org/journal/ojo
ISSN Online: 2164-3016
ISSN Print: 2164-3008

Functional Evaluation of the Treatment of POPB Sequelaes by Humeral Derotational Osteotomy at the Order of Malta Hospital Center

Alioune Badara Gueye*, Johnson Djogo Tsague, Khalifa Ababacar Faye, Mouhamadou Moustapha Niane, Yacine Sock, Charles Valerie Alain Kinkpe

Order of Malta Hospital Center, Dakar, Senegal
Email: *badouzas@gmail.com

How to cite this paper: Gueye, A.B., Djogo Tsague, J., Faye, K.A., Niane, M.M., Sock, Y. and Kinkpe, C.V.A. (2025) Functional Evaluation of the Treatment of Popb Sequelaes by Humeral Derotational Osteotomy at the Order of Malta Hospital Center. *Open Journal of Orthopedics*, **15**, 392-402.
https://doi.org/10.4236/ojo.2025.1511040

Received: October 17, 2025
Accepted: November 22, 2025
Published: November 25, 2025

Abstract

Humeral derotational osteotomy is currently considered the definitive treatment for sequelae of POPB involving a fixed internal rotation deformity of the shoulder. Its purpose is to position the arm in a more functional orientation, thereby improving patients' quality of life. This study aimed to evaluate the effects of this procedure on shoulder function. **Methods:** Thirteen patients underwent humeral derotational osteotomy at the Order of Malta Hospital in Dakar between January 2016 and December 2024. The humeral osteotomy was performed via an anterolateral approach just below the insertion of the deltoid muscle and fixed using stainless steel plates and screws. The mean age of the patients at the time of surgery was 9.23 years. Functional outcomes were assessed using the modified Mallet score. Results: At a mean follow-up of 43.54 months, improvements were noted in external rotation, with the mean Mallet score increasing from 2 to 3.38, and in abduction, with the mean score rising from 2.85 to 3.31. Complications occurred in three (3) patients, including hardware loosening and radial nerve injury. **Conclusion:** Humeral derotational osteotomy is a valuable treatment option for managing the sequelae of congenital brachial plexus palsy in patients with internal rotation contracture of the shoulder and advanced glenohumeral dysplasia, which contraindicates soft tissue release and tendon transfers

Keywords

Sequelae, Osteotomy, Derotational, Humeral

1. Introduction

Obstetric brachial plexus palsy (OBPP) is a traumatic nerve injury of the upper

limb that most often occurs during difficult childbirth [1]. Despite advances in obstetric care and increased understanding of the risk factors for this condition [2], it remains relatively common. Its overall incidence, based on data compiled from the literature between 1964 and 2014, has been estimated at 1.4 per 1000 births (ranging from 0.1 to 6.3) [3].

Approximately 80% to 95% of these injuries are mild, with children recovering within the first two months of life [4] [5]. However, some children experience functional sequelae [6]. In cases involving high C5 - C6 root injury, there is internal rotation contracture of the shoulder, along with deficits in external rotation and abduction [7]. Such impairments cause significant disability, affecting the child's independence and daily activities—for example, difficulties in feeding themselves or buttoning their clothes [8].

Early management of these sequelae includes soft tissue release and tendon transfers [9]-[14]. If the contracture is not corrected, the humeral head remodels to fit the deformed glenoid cavity, leading to posterior subluxation and eventual dislocation around the age of four, which precludes soft tissue surgery.

In older children, humeral derotational osteotomy can transfer the functional range of motion to a more useful position [15].

The aim of this study is to evaluate the functional outcomes of humeral derotational osteotomy in managing the sequelae of OBPP at the Order of Malta Hospital Center

2. Materials and Methods

We conducted a descriptive, retrospective study from January 2016 to December 2024 in the Orthopaedics and Traumatology Department of the Order of Malta Hospital. We included all patients who underwent humeral derotational osteotomy and who were followed up for at least one year, after obtaining parental consent and approval from the ethics committee. Patients who did not meet the inclusion criteria were excluded.

A total of 13 patients who underwent humeral derotational osteotomy with a minimum follow-up of one year were selected. The mean age at the time of surgery was 9.23 years (range: 3 to 22 years). Females predominated (8 girls), with a sex ratio of 0.62. High lesions involving C5 - C6 were found in 9 patients, with extension to C7 in 2 patients, and 2 complete lesions. The humeral head was subluxated in 7 patients and dislocated in 3 patients. Electroneuromyography (ENMG) revealed a predominance of nerve elongations (12 patients). Preoperatively, all patients exhibited a positive Bugle sign (**Figure 1** and **Figure 2**). The mean external rotation was −26.15˚ (range: −50˚ to 10˚), and the mean abduction was 68.46˚ (range: 10˚ to 100˚).

All patients underwent surgery under general anaesthesia with orotracheal intubation. They were positioned supine on a standard operating table, with the upper limb resting on an armrest, without a tourniquet (**Figure 3(a)**). The surgical approach was anterolateral, with an incision of approximately 8 cm (**Figure 3(b)**).

Figure 1. Internal rotation position of the shoulder.

Figure 2. Positive bugle sign.

After exposing the bone, the osteosynthesis plate was positioned proximally, and the osteotomy site was marked (**Figure 3(c)**). A hole for a proximal screw was drilled, and then the plate was temporarily removed. The osteotomy was performed, and the plate was fixed proximally with two screws, using the first drilled hole as a reference point (**Figure 3(d)**). The distal segment was then externally rotated; the degree of derotation was determined intraoperatively by hand-to-mouth and hand-to-neck positions. Finally, the plate was fixed distally (**Figure 3(e)** and **Figure 4**). Closure was performed in layers.

Postoperatively, the elbow was immobilized against the body for three weeks, or at least the upper limb was supported with a sling. Rehabilitation began on day

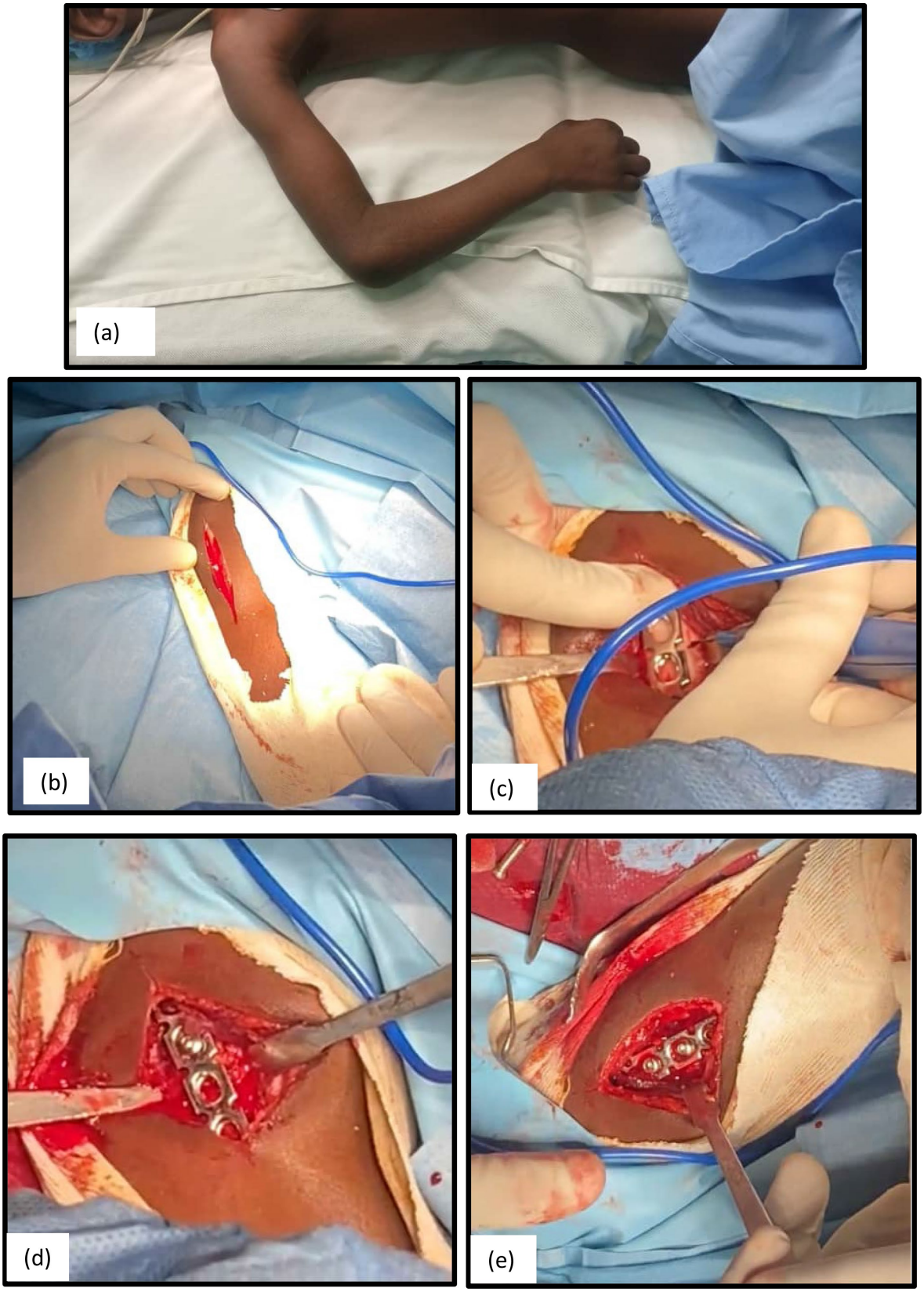

Figure 3. Steps of the procedure. (a) Positioning of the patient, (b) approach, (c) bone exposure and cut line, (d) proximal fixation of the plate and derotation, (e) distal fixation of the plate.

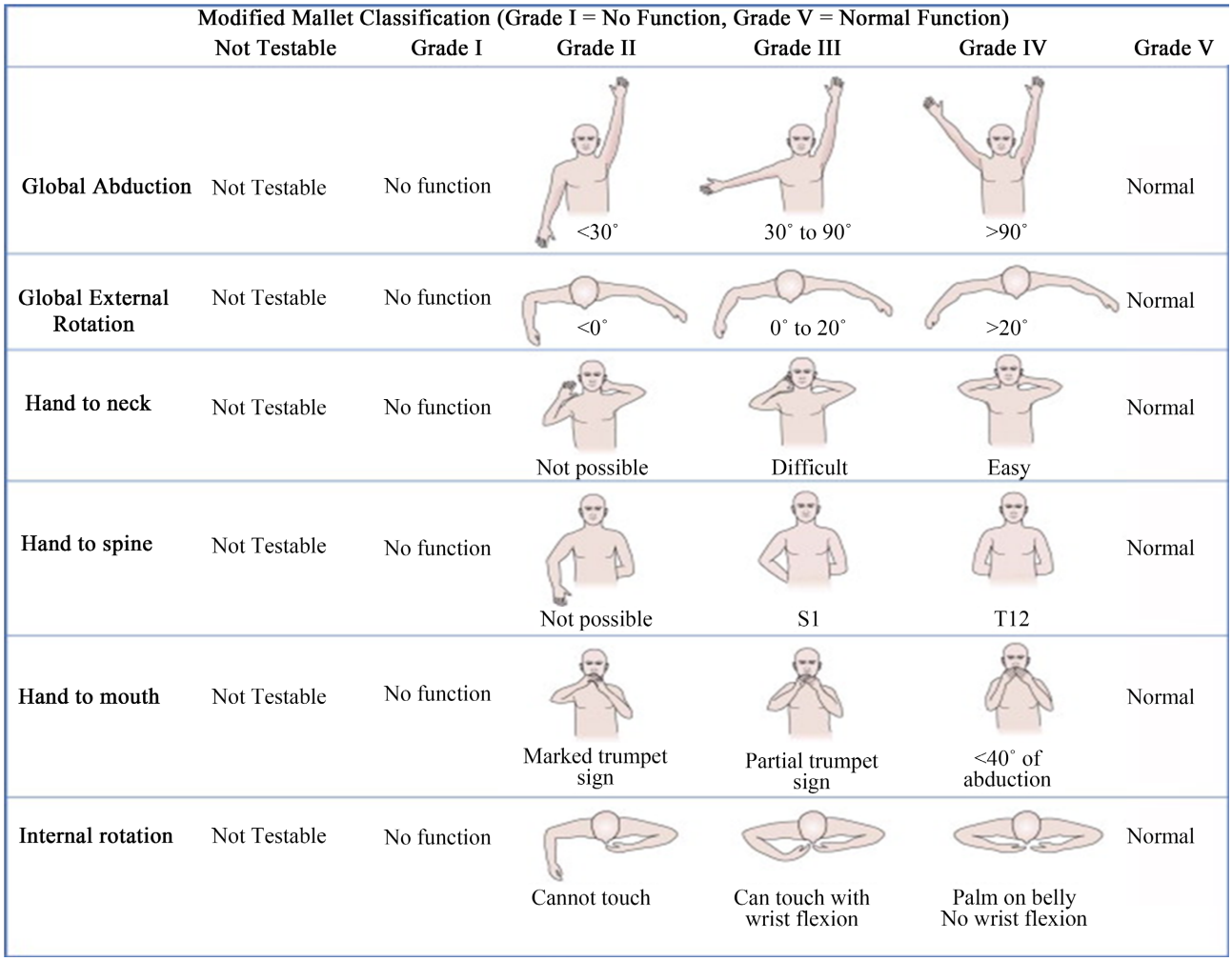

Figure 4. Mallet classification.

21, starting with passive then active lateral rotation exercises, with the elbow kept close to the body and in abduction, as well as hand-to-mouth movements with the elbow as close to the body as possible.

Functional assessment was performed using the modified Mallet score [16], which evaluates various shoulder movements (abduction, external and internal rotations, as well as hand-to-neck and hand-to-mouth positions) (**Figure 4**).

Data analysis was performed using EPI INFO software version 7.2.6.0. Statistical tests were used to compare preoperative and postoperative Mallet scores.

3. Results

Consolidation was observed by 3 months (**Figure 5**) in all patients except two, who required reoperation following hardware removal.

The osteosynthesis material was removed in 10 patients, with an average time to removal of 16.66 months.

Three patients (23.07% of cases) experienced complications, including hardware loosening in two patients and radial nerve injury in one.

Patients were regularly assessed, with a mean follow-up of 44 months (range: 14 to 96 months). External rotation improved from −26.15˚ (range: −50˚ to −10˚) intraoperatively to 20.38˚ (range: −10˚ to 40˚) postoperatively (Figures 6-8). A clear functional improvement was observed in all items of the Mallet score (Table 1).

Figure 5. Consolidation.

Figure 6. Postoperative external rotation grade 4.

Figure 7. Postoperative grade 4 hand-mouth manoeuvre.

Figure 8. Postoperative internal rotation grade 3 (right).

Table 1. Summary table of functional assessment.

	Preoperative			Postoperative		
	Average range of motion	**Mallet grade**	**Mallet average**	**Average range of motion**	**Mallet grade**	**Mallet average**
External rotation	-26.15 [-50; -10]	Grade 2 (13 cases)	2	20.38˚ [-10; 40]	Grade 2 (2 cases) Grade 3 (4 cases) grade 4 (7 cases)	3.38
Abduction	68.46˚ [10; 100]	grade 2 (3 cases) Grade 3 (9 cases) grade 4 (1 case)	2.85	84.23˚ [20; 130]	Grade 2 (2 cases) grade 3 (5 cases) grade 4 (6 cases)	3.31

Continued

Manoeuvre hand-to-mouth	grade 1 (1 case) grade 2 (9 cases) grade 3 (3 cases)	2.15	grade 1 (1 case) grade 3 (9 cases) grade 4 (2 cases) grade 5 (1 case)	3.15
Internal rotation	grade 2 (3 cases) Grade 3 (2 cases) Grade 4 (6 cases) Grade 5 (2 cases)	3.54	grade 2 (3 cases) grade 3 (7 cases) grade 4 (3 cases) Grade 5 (1 case)	3.38
Manoeuvre neck hold	grade 1 (1 case) grade 2 (10 cases) grade 3 (2 cases)	2.08	grade 1 (1 case) grade 2 (6 cases) grade 3 (5 cases) Grade 4 (1 case)	2.46
Labourer backhand	grade 1 (1 case) Grade 2 (1 case) grade 3 (5 cases) grade 4 (6 cases)	3.23	grade 1 (1 case) grade 2 (1 case) Grade 3 (8 cases) grade 4 (3 cases)	3

4. Discussion

The treatment of internal rotation contractures of the shoulder following obstetric brachial plexus palsy (OBPP) involves muscle release and tendon transfer. These techniques are effective only when the glenohumeral joint remains intact. If the contracture persists, the glenoid cavity becomes deformed under pressure from the humeral head, which gradually migrates posteriorly and inferiorly until complete dislocation occurs.

In the presence of such dysplasia, humeral derotational osteotomy is considered the treatment of last resort. Its goal is to improve the patient's daily life by positioning the hand to facilitate activities requiring external rotation, such as washing hair, placing the hand on the neck, eating, and throwing a ball.

The limitations of this study include the small sample size, retrospective design, and lack of a control group.

We chose an anterolateral approach, differing from the more commonly used deltopectoral approach. This technique facilitates the procedure but carries an increased risk of radial nerve injury [15].

Postoperative complications occurred in three patients, mainly involving hardware loosening (two cases) and one case of radial nerve injury. Abdeslam B *et al.* [17], in Algiers, reported three cases of radial nerve injury and one case of hardware loosening. Khadija S [18], in Marrakesh, reported one case each of hardware loosening and accidental radial nerve sectioning. The hardware loosening may be explained by humeral osteoporosis secondary to disuse syndrome, while the radial nerve injury likely occurred accidentally during bone sectioning.

The Mallet score in our study increased from 2.07 to 3.49. Al Qattan *et al.* [19], in their series of 17 patients treated with humeral derotational osteotomy and followed for an average of 2 years, reported an increase from 2.11 to 4. Amr *et al.* [20] reported an increase from 1.1 to 3.1. The significant gain in external rotation is due to the osteotomy positioning the arm functionally, despite not restoring active external rotation of the shoulder.

Osteotomy also contributed to increased abduction range of motion in this study, with the average Mallet score rising from 2.85 to 3.31. Khadija S [18], in her doctoral thesis on 42 patients, reported an increase from 3.2 to 3.7, while Abzug *et al.* [21], in their series of 23 patients, reported an increase from 3.5 to 3.7. The osteotomy may allow the long head of the biceps to become more active as a shoulder abductor.

All our patients had a positive Bugle sign preoperatively; this sign persisted in one patient postoperatively. The average Mallet score for the hand-to-mouth movement increased from 2.15 to 3.15. Waters PM and Bae D [22] reported an increase from 3 to 4, and Amr *et al.* [20] reported an increase from 2.9 to 3.6.

Humeral derotational osteotomy resulted in a deficit of internal rotation in our study. This mechanical reduction in range of motion is secondary to external derotation and has also been reported by Abzug *et al.* [21].

5. Conclusion

Our study demonstrates that humeral derotational osteotomy improves shoulder function, particularly for activities requiring external rotation. Careful assessment of the degree of external rotation is essential to avoid impairing internal rotation.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Sever, J.W. (1916) Obstetric Paralysis: Its Aetiology, Pathology, Clinical Aspects and Treatment, with Report of Four Hundred and Seventy Cases. *American Journal of Diseases of Children*, **XII**, 541-578. https://doi.org/10.1001/archpedi.1916.04110180003001

[2] Gilbert, W.M., Nesbitt, T.S. and Danielsen, B. (1999) Associated Factors in 1611 Cases of Brachial Plexus Injury. *Obstetrics & Gynecology*, **93**, 536-540. https://doi.org/10.1097/00006250-199904000-00013

[3] Chauhan, S.P., Blackwell, S.B. and Ananth, C.V. (2014) Neonatal Brachial Plexus Palsy: Incidence, Prevalence, and Temporal Trends. *Seminars in Perinatology*, **38**, 210-218. https://doi.org/10.1053/j.semperi.2014.04.007

[4] Osorio, M., Hartman, K.C. and Mendoza-Sengco, P. (2025) Neonatal Brachial Plexus Palsy. *Physical Medicine and Rehabilitation Clinics of North America*, **36**, 575-586. https://doi.org/10.1016/j.pmr.2025.03.005

[5] Sjöberg, I., Erichs, K. and Bjerre, I. (1988) Cause and Effect of Obstetric (Neonatal) Brachial Plexus Palsy. *Acta Paediatrica*, **77**, 357-364.

https://doi.org/10.1111/j.1651-2227.1988.tb10660.x

[6] Pearl, M.L. and Edgerton, B.W. (1998) Glenoid Deformity Secondary to Brachial Plexus Birth Palsy. *The Journal of Bone & Joint Surgery*, **80**, 659-67. https://doi.org/10.2106/00004623-199805000-00006

[7] Waters, P.M., Smith, G.R. and Jaramillo, D. (1998) Glenohumeral Deformity Secondary to Brachial Plexus Birth Palsy. *The Journal of Bone & Joint Surgery*, **80**, 668-677. https://doi.org/10.2106/00004623-199805000-00007

[8] Spaargaren, E., Ahmed, J., van Ouwerkerk, W.J.R., de Groot, V. and Beckerman, H. (2011) Aspects of Activities and Participation of 7-8 Year-Old Children with an Obstetric Brachial Plexus Injury. *European Journal of Paediatric Neurology*, **15**, 345-352. https://doi.org/10.1016/j.ejpn.2011.03.008

[9] Carlioz, H. and Brahimi, L. (1971) The Role of Internal Detachment of the Subscapularis in the Treatment of Obstetric Paralysis of the Upper Limb in Children. *Annales de chirurgie infantile*, **12**, 159-167.

[10] Fairbank, H. (1913) Birth Palsy: Subluxation of the Shoulder Joint in Infants and Young Children. *Lancet*, **1**, 1217-1223.

[11] Sever, J.W. (1918) The Results of a New Operation for Obstetrical Paralysis. *The Journal of Bone and Joint Surgery*, **2**, 248-257.

[12] L'Episcopo, J.B. (1934) Tendon Transplantation in Obstetrical Paralysis. *The American Journal of Surgery*, **25**, 122-125. https://doi.org/10.1016/s0002-9610(34)90143-4

[13] Hoffer, M.M., Wickenden, R. and Roper, B. (1978) Brachial Plexus Birth Palsies. Results of Tendon Transfers to the Rotator Cuff. *The Journal of Bone & Joint Surgery*, **60**, 691-695. https://doi.org/10.2106/00004623-197860050-00019

[14] Razali, S. (2016) Trapezius Transfer for Restoration of External Rotation of the Shoulder in Obstetrical Brachial Plexus Palsy. *Hand Surgery and Rehabilitation*, **35**, 463.

[15] Jerome, J.T.J. (2025) Medial Approach Derotational Humeral Osteotomy in Patients with Brachial Plexus Birth Palsy. *JBJS Essential Surgical Techniques*, **15**, e24.00016. https://doi.org/10.2106/jbjs.st.24.00016

[16] Mallet, J. (1972) Paralysie obstétricale du plexus brachial. *Rev Chir Orthop Reparatrice Appar Mot*, **58**, 115-120.

[17] Benamirouche, A., Nouri, S., Rezzik, S. and Benbouzid, A. (2016) Ostéotomie de dérotation humérale pour séquelles de paralysie obstétricale du plexus brachial. *Hand Surgery and Rehabilitation*, **35**, 425. https://doi.org/10.1016/j.hansur.2016.10.008

[18] Khadija, S.A.A.D.I. (2017) Humeral Derotation Osteotomy in Obstetric Brachial Plexus Palsy in Children. Ph.D. Thesis, Cadi Ayyad University.

[19] Al-Qattan, M.M., Al-Husainan, H., Al-Otaibi, A. and El-Sharkawy, M.S. (2009) Long-term Results of Low Rotation Humeral Osteotomy in Children with Erb's Obstetric Brachial Plexus Palsy. *Journal of Hand Surgery* (*European Volume*), **34**, 486-492. https://doi.org/10.1177/1753193409104552

[20] Abdelgawad, A.A. and Pirela-Cruz, M.A. (2014) Humeral Rotational Osteotomy for Shoulder Deformity in Obstetric Brachial Plexus Palsy: Which Direction Should I Rotate? *The Open Orthopaedics Journal*, **8**, 130-134. https://doi.org/10.2174/1874325001408010130

[21] Abzug, J.M., Chafetz, R.S., Gaughan, J.P., Ashworth, S. and Kozin, S.H. (2010) Shoulder Function after Medial Approach and Derotational Humeral Osteotomy in Patients with Brachial Plexus Birth Palsy. *Journal of Pediatric Orthopaedics*, **30**, 469-474. https://doi.org/10.1097/bpo.0b013e3181df8604

[22] Waters, P.M. and Bae, D.S. (2006) The Effect of Derotational Humeral Osteotomy on Global Shoulder Function in Brachial Plexus Birth Palsy. *The Journal of Bone and Joint Surgery-American Volume*, **88**, 1035-1042. https://doi.org/10.2106/00004623-200605000-00014