



Case Series

Treatment of obstetrical brachial plexus palsy sequelae: Preliminary results about 18 cases



Badara Diop^{a,*}, Mohamed Daffe^b, Badara Demele^b, Rokhaya Dia^b,
Mouhamed El Khalifa Fall^b, Alioune Badara Diouf^b, Jean Claude Sané^a, Ibrahima konate^a,
Ndeye Fatou Coulibaly^b, Charles Bertin Diemé^b

^a Department of Surgery, Gaston Berger University, Saint-Louis, Senegal

^b Department of Orthopedic Surgery, Cheikh Anta Diop University, Dakar, Senegal

ARTICLE INFO

Keywords:

Brachial plexus
Obstetrical palliative surgery
Tendon transfer
Rotation osteotomy

ABSTRACT

Background: Severe obstetrical injuries of the brachial plexus lead to a complete or incomplete paralysis resulting in a significant functional handicap of the limb.

This study aimed to assess the preliminary results of our management.

Materials and methods: This prospective study involved 18 patients, with an average age of 7.7 years. The choice of the surgical technique depended on the type of palsy. We evaluated our patients using the Mallet, Gilbert-Raimondi, Brachial plexus World Group Heerlen, and Raimondi scores.

Results: Patients in groups I and II of Narakas had an anterior shoulder release (n = 2) and transfer of the latissimus dorsi (n = 8). For those in group III, we performed 5 biceps rerouting and 2 radius derotation osteotomies, one of which was associated with a Zancolli I and an arthrodesis of the thumb MCP joint. In the wrist and hand, we performed two tendon transfers from the flexor carpi ulnaris to the extensor tendons of the fingers. After a mean follow-up of 30.52 months, in the first 9 patients, active external rotation of the shoulder increased from a mean value of -22.5° – 38.8° and mean active abduction from 78.3° to 141.1° . In Group III, the mean spontaneous supination position of 75.5° was improved to 45° pronation. Regarding the two patients with tendon transfers, active wrist extension increased from 0° to 45° and from -60° to 0° , respectively.

Conclusion: Palliative surgery in the treatment obstetrical brachial plexus palsy sequelae retains an important place in the restoration of upper limb function.

1. Introduction

Obstetrical brachial plexus palsy (OBPP) most often occurs after labor dystocia and results in a transient or permanent paralysis of the upper limb. However, it remains a rare pathology. Its worldwide incidence is estimated between 0.05 and 0.145% of births [13,26]. If half of the cases of OBPP evolve favorably with complete recovery, others lead to more or less disabling sequelae [13].

In ruptures and avulsions, microsurgery performed in the early stages give good results [29]. In the sequelae stage, several palliative surgical techniques are proposed to improve the upper limb functions of these patients. The different techniques involve either soft tissue surgery (muscle disinsertion, tendon transfers, tenodesis) and or bone surgery (osteotomies) [15]. Soft tissue surgery is not widely performed in

developing countries [9]. The functional results depend on the severity of the injury and the age of the patient.

This study aims to assess the preliminary results of the treatments used in obstetrical brachial plexus palsy sequelae.

2. Patients and methods

The work has been reported in line with the PROCESS criteria [2].

This was a prospective and descriptive study performed over 4 years 4 months from November 2016 to March 2021. We included all patients operated of OBPP sequelae.

Data collected involved anamnestic information concerning the patient, the maternal risk factors, factors related to pregnancy and delivery. It equally included parameters related to the lesion and the type

* Corresponding author.

E-mail address: diopba40@gmail.com (B. Diop).

<https://doi.org/10.1016/j.amsu.2022.104339>

Received 3 July 2022; Received in revised form 27 July 2022; Accepted 31 July 2022

Available online 5 August 2022

2049-0801/© 2022 The Author(s). Published by Elsevier Ltd on behalf of IJS Publishing Group Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

of palsy according to NARAKAS. We also collected data on the therapeutic method used, the preoperative and postoperative evaluation which was segmental and according to the type of palsy. For the shoulder, we used the Mallet score [22], for the elbow, the Gilbert and Raimondi score [19], for the forearm, the BPWGH score (Brachial plexus World Group Heerlen) [19] and for the wrist and hand, the Raimondi score [19].

We included 18 patients. The mean age at the time of surgery was 7.7 years with extremes of 2 and 28 years. Thirteen (13) patients (72.2%) were Less than or had attained 6 years.

Eight (8) patients were male and ten (10) were female giving a sex ratio of 0.8. According to obstetrical data, obesity was identified in 6 cases (38%) and multiparity in 14 cases (82.4%). We had a cephalic presentation in 17 patients (95%), a breech presentation in (5%) and no case of cesarean section. The average birth weight was 3809.3 g (extreme 3200 and 4200) with a notion of macrosomia in 11 patients (61.1%). Dystocia was found in 16 cases, involving 15 shoulders (83.3%) and 1 breech presentation.

All the children included in our study, since their diagnosis, had undertaken outpatient functional rehabilitation during their first year of life with at least 2 sessions per week. Thirteen (13) patients, (72.2%), had a right-sided injury. One patient had a fracture of the proximal humerus. According to the Narakas classification, 5 patients (27.8%) were in group I (C5 C6), 4 (22.2%) in group II (C5 C6 C7), and the other 9 (50%) in group III (C5 to T1) with partial recovery.

The operative technique depended on the type of palsy.

3. Results

For Narakas I and II, we performed 9 surgical procedures of the shoulder. We had one isolated anterior shoulder release and 8 transfers of the latissimus dorsi. The later were associated with the release of the subscapularis muscle according to Carlioz and Brahimi [7] and one case of teres major muscle transfer. The approach was dorsal for all 8 patients. The dorsal pedicle was isolated in all patients. In 5 patients we used the Hoffer method [18] for reinsertion of the latissimus dorsi

tendon, and in the other 3, we inserted it according to Episcopo [12]. Immobilization of the shoulder was performed at 90° of abduction and 90° of external rotation with a thoracic-brachial cast. All patients underwent sustained and supervised functional rehabilitation.

After a mean follow-up of 30.52 months, active external rotation had increased from a mean preoperative value of -22.5° to a mean of 38.8° , for an overall gain of 68.8° . Four patients went from Mallet grade II to grade IV, 3 patients from grade III to grade IV and 1 patient remained at grade II with an external rotation of -30° but with a gain of 15° (Fig. 1). Active abduction, which averaged 78.3° , was increased to 141.1° that is an average gain in amplitude of 62.8° , of which 2 patients went from Mallet grade II to grade IV and 3 patients from grade III to grade IV (Fig. 1). Hand-mouth maneuvers were possible without a trumpet sign in 8 cases. It was possible in all patients to easily bring the hand to the neck.

For Narakas III, the procedures were primarily performed on the elbow, wrist, and hand. In the elbow, 5 biceps reroutings were performed using the classic technique. In addition, we performed 2 osteotomies of the radius, which were fixed with a 6-hole DCP screw plate. Immobilization was by BABP with the forearm pronated for 2 months and 2.5 months, respectively. Functional rehabilitation was effective in all patients.

For the biceps rerouting ($n = 5$), the Gilbert and Raimondi score of the elbow remained identical postoperatively and the vicious attitude of the hand in supination was corrected by putting the wrist in a functional position. This average spontaneous position was reduced from 75.5° supination to 45° pronation. The average active pronation was improved from 0 to 80° and the average active supination from 0 to 15° . According to the BPWGH score, all patients had moved to 3 for pronation. As for supination, the score was 1 for four patients and zero for one patient.

For radius osteotomies ($n = 2$), the Gilbert and Raimondi elbow score also remained the same postoperatively and the mean spontaneous position went from 75.5° supination to 25° pronation. Pronation had increased to 70° for one and 90° for the other, that is a BPWGH score of 3. As for supination, it had increased to 15° for both Patients corresponding to 1 on the BPWGH score.

For the wrist and hand, four procedures were performed in 3

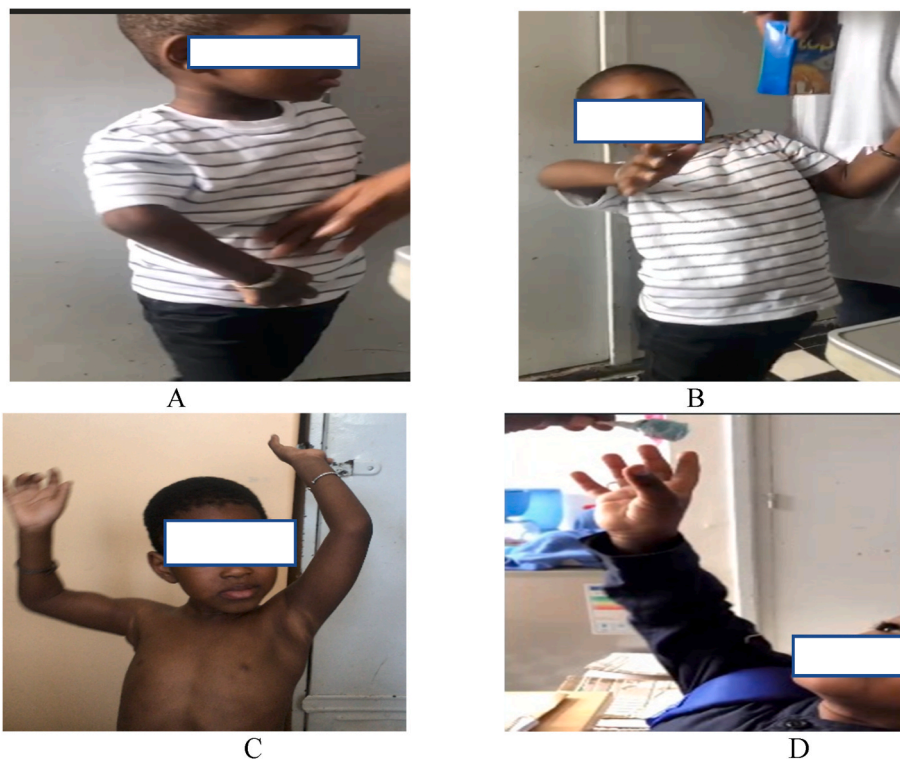


Fig. 1. Limitation of external rotation (A) and abduction (B); Restoration of external rotation (A) and abduction (B).

patients, the first of whom underwent a transfer of the flexor carpi ulnaris (FCU) to the extensors, combined with a Zancolli I capsuloplasty of the 4 long fingers. In the second, we performed a transfer of the pronator ring to the flexor carpi radialis longus with a transfer of the FCU to the extensors of the fingers. For the last patient, given an adduction contracture of thumb, a Zancolli I capsuloplasty was performed on the MP joint (Fig. 2).

The isolated transfer of the FCU resulted in a 45° gain in active wrist extension and the Raimondi score was increased to 2. For transfer of the FCU associated with the pronator ring, active wrist extension was increased from -60 to 0° but the score remained the same. Capsuloplasty was performed in two patients. In the first, the hyper-extension of the MP joint of the last four fingers was reduced to 30° of flexion after surgery. In the second, capsuloplasty could not correct the adduction contracture of thumb, and a revision surgery with an arthrodesis of the MP joint associated with an opening of the first commissure was performed at the age of 13 years (Fig. 2).

In all, sixteen patients (88.9%) were very satisfied and satisfied with the results.

4. Discussion

From November 2016 to March 2021, we managed 18 cases of obstetrical brachial plexus palsy sequelae. At the level of the shoulder, our indications depended on the age of the patient, the type of palsy, the functional deficit, the vicious attitude, and the shoulder joint. Regarding the age, patients less than 2 years had no surgery. In fact, before 2 years, the surgeries are of nerve type and are essentially intended for total OBPP or lower root avulsion [6,28]. One patient, aged less than 6 months presented with a partial OBPP. Our patients presenting with total OBPP were all greater than 4 years and for these patients, surgeries of nerve type were outdated. We are not refractory to this surgery and we reserve it for cases of total OBPP seen early. We prefer tendon transfer surgery between 2 and 7 years as long as the joints are flexible and the state of the joint dysplasia permits. We believe that it provides

an active functional movement base rather than a static functional position [10]. Furthermore, in cases of anterior retraction, the first patient operated had an isolated anterior shoulder release. However, the results were not satisfactory because, after an initial improvement, a return to the vicious attitude was noted. This prompted us to perform an associated transfer of the latissimus dorsi to reinforce external rotation and/or abduction. In all the other patients, the posterior approach alone was sufficient to perform the subscapular release procedure and the transfer of the latissimus dorsi. Frequently after an early subscapular release there is a substantial improvement in active external rotation thanks to the reestablishment of correct muscular balance, which allows reinforcement of a weak external rotator [10]. First of all, these retractions could have been avoided with good functional rehabilitation. Botulinum toxin injections, on the other hand, provide an additional benefit in the fight against secondary retractions [16]. Some authors only proceed with the release associated with the injection of botulinum toxin to cancel the effect of the internal rotators during the strengthening of the external rotators [16,17]. Due to the nonavailability of this product in our country, muscle transfer allowed us to fill this gap. The anterior shoulder release can also be performed in a less invasive manner thanks to endoscopic surgery and it seems to give promising results [25].

Bone surgery is reserved for children above 7 years presenting with joint stiffness and significant dysplasia [31]. It allows attitude correction by conferring a static external rotation. We did not perform this procedure in our series because all patients with C5-C6 and C5-C6-C7 involvement were seen before 2 years and could benefit of a tendon transfer.

Bone surgery has been the subject of several publications [3,20,21,31]. Still in upper palsy, four patients had flessum-like elbow stiffness with an average deficit of 20°. No intervention was performed for the flessums. However, functional rehabilitation allowed an average gain of 10°.

Latissimus dorsi transfer (n = 8) allowed all our patients to recover an abduction and external rotation of the shoulder significantly, as shown by other authors in their different series [8,14,18,27,30]

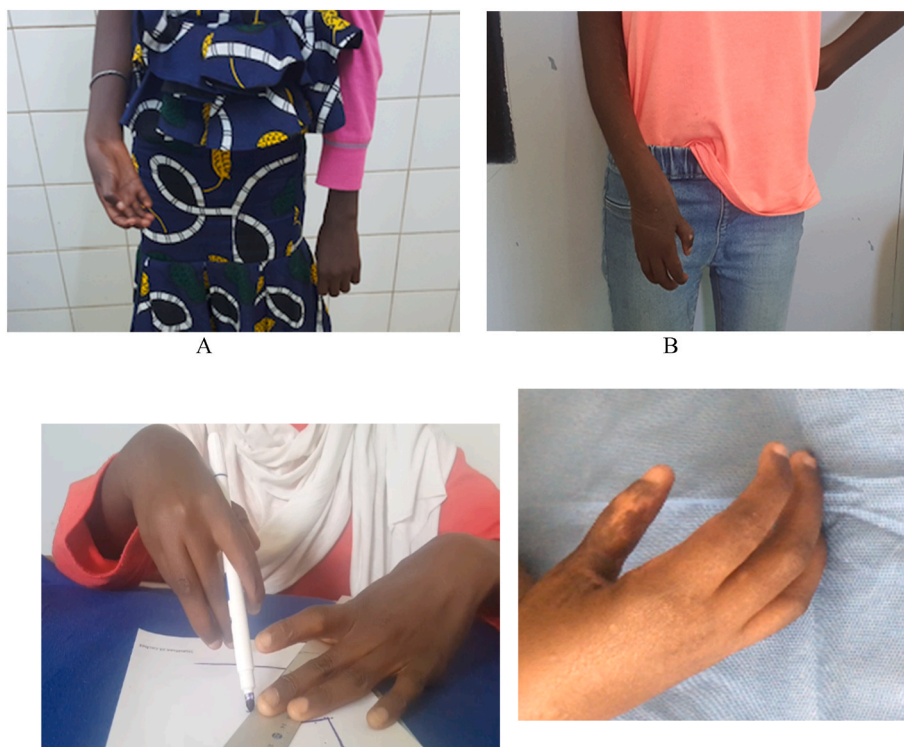


Fig. 2. A: hand in supination position associated with a adduction contracture of thumb; B and C: correction in the functional position with a persistent adduction contracture of thumb; C: adduction contracture of thumb correction after arthrodesis.

Table 1

Gain comparison in external rotation (ER) and abduction (ABD) in the different series.

Series	follow-up (mois)	Gain ER	Gain ABD	Global Mallet
Vallejo I [30].	46	21	42	IV
Severo L [27].	46	60		IV
Ghanem I [14].	30	65	47	IV
Cohen G [8].	108	62	20	IV
Hoffer M.M [18].		45	>16	IV
Our study	30.52	68.8	62.8	IV

(Table 1). Our results could be explained by the fact that we took off the latissimus dorsi widely to release it well and obtained a good length which was inserted according to Hoffer. In addition, our rigorous choice of indication allows us to take options regarding its insertion, which we place superiorly on the supraspinatus in the case of a defect in the abduction and inferiorly on the infraspinatus if the deficit concerns external rotation rather than elevation.

The isolated anterior shoulder release could not significantly improve the ER of our patient (15° gain), in contrast to Abid A [1]. and Pearl M. [25], who respectively found an ER gain of at least 76.8° and 45°. The latter had performed a release technique under arthroscopy.

In total palsy, the patients had staggered deficits in the limb. We focus primarily on the function of the hand, although a significant abduction deficit was noted in the shoulder in 8 patients (Mallet III).

The pronation position, in the case of a supinated hand, will optimize its function. In addition, we can perform a tendon transfer at the wrist or a capsuloplasty at the fingers of the hand. During our practice, we mainly used biceps rerouting in patients with a soft interosseous membrane (5 patients). In cases of supination retraction, isolated radius osteotomy was performed (2 patients). This almost always allowed us to regain a functional pronated attitude. In our series, we had excellent results in improving the average spontaneous position. Nouri. S [24] in his series found a clear improvement in the mean spontaneous position, which went from 71° supination to 26° pronation for rerouting. Alkar. F [4] found that in reeded radius osteotomies, the average preoperative spontaneous position was 63°, which was reduced to 37° of pronation. Metsaars W. [23], who performed rerouting after a forearm osteotomy, had excellent results with passive pronation of 0°–80°. Rerouting is an attractive technique that, when performed under the required conditions, can give very good results on a hand that was previously excluded by placing it in a functional position. Unlike osteotomies, where the major risk is the frequency of recurrence, early rerouting allows a durable result [24].

Tendon transfers can improve hand function, but no major series have been published to date. Two patients have benefited from tendon transfers. This procedure improved limb function with active wrist extension from 0 to 45° and from –65 to 0° respectively. However, this relatively modest gain was due to the weakness of the muscles which are re-innervated and transferred. Duclos [11] obtained 75% good results while Bincz [5] reported 50% good and 50% excellent results. Among the patients with total OBPP, two of them equally had a static disorder of the MP joint of the long fingers in the form of a claw and an adduction contracture of thumb. We treated them with Zancolli capsuloplasty. For the adduction contracture of thumb, we observed a recurrence and an arthrodesis of the thumb's MP joint making it possible to stabilize the thumb's column. For the long fingers, this technique allowed a correction of 30° flexion.

In total, the aesthetic aspect was significantly improved except in one patient. Although the deficient shoulder has not yet been surgically managed for total OBPP, its generally neutral position gives it acceptable aesthetics for useful function. Sixteen patients, or 88.9%, were very satisfied and pleased with the results. The other 2 had a forearm deficit including the wrist, and hand. Indeed, due to re-innervation of the distal muscles, we have minimal therapeutic possibilities and this constitutes one of the technical limitations of the surgery.

5. Conclusion

OBPP can constitute a major residual handicap depending on the initial anatomical lesions. Surgery has its right time after clinical monitoring. This surgery allowed us to significantly improve the functional limb limitations of almost all our patient's thanks to a redistribution of the remaining forces. It has also allowed an aesthetic improvement of the upper limb.

The treatment requires a perfect collaboration between the doctor, the physiotherapist, and the parents while knowing that the best is prevention.

Ethical approval

No ethics approval is required for this manuscript.

Sources of funding

The authors declare they have received no funding for the preparation of this document.

Financial support and sponsorship

None.

Authors contribution

Authors: Badara Diop, Mohamed Daffe, Badara Dembele, Rokhaya Dia, Mouhamed El Khalifa Fall, Alioune Badara Diouf, Jean Claude Sané, Ibrahima konate, Ndeye Fatou Coulibaly, Charles Bertin Diemé these authors participated in the making and correction of this document. all authors agreed with the publication of the document.

Registration or research studies

Researchregistry7825.

Guarantor

Badara Diop.

Consent

Informed consent was obtained from all patients for inclusion in this case series.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Declaration of competing interest

All authors declared that there are no conflicts of interest.

Acknowledgments

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amsu.2022.104339>.

References

- [1] Abid A, Kany J, Accadbled F, Darodes P, Knorr G, Sales de Gauzy J, Cahuzac JP. Arthrolyse antérieure de l'épaule sous arthroscopie dans les séquelles de paralysie obstétricale du plexus brachial. Résultats préliminaires. *Revue de Chirurgie Orthopédique et Réparatrice de l'Appareil Moteur*, 94(7), 643–648. doi:10.1016/j.rco.2008.01.003. .
- [2] R.A. Agha, T. Franchi, C. Sohrabi, G. Mathew, For the SCARE group the SCARE 2020 guideline: updating consensus surgical CAse REport (SCARE) guidelines, *Int. J. Surg.* 84 (2020) 226–230.
- [3] S. Al Zahrani, Modified rotational osteotomy of the humerus for Erb's palsy, *Int. Orthopaedic*. 17 (1993) 202–204.
- [4] F. Alkar, C. Dana, A. Salon, C. Glorion, Ostéotomie en roseau du radius chez l'enfant dans la paralysie de la pronation du plexus brachial obstétrical, *Chir. Main* 32 (6) (2013) 387–392.
- [5] Bincaz L, Cherifi H, Alnot J. LEs transferts palliatifs de réanimation de l'extension du poignet et des doigts. À propos de 14 transferts pour paralysie radiale et dix transferts pour lésion plexique. *Chir. Main*, 21(1), 13–22. doi:10.1016/s1297-3203(01)00081-6. .
- [6] R. Birch, Obstetric brachial palsy, *J. Hand Surg.* 27 (2002) 3–8.
- [7] Carlioz H, Brahimi L. LA place de la désinsertion interne du sous-scapulaire dans le traitement de la paralysie obstétricale du membre supérieur chez l'enfant, *Ann. Chir. Infant.* 12:159. .
- [8] G. Cohen, V. Rampal, F. Aubart-Cohen, R. Seringe, P. Wicart, Traitement des séquelles scapulaires de paralysie obstétricale du plexus brachial par arthrolyse et transfert tendineux, *Rev. Chir. Orthopédique Traumatol.* 96 (4) (2010) 397–403.
- [9] N.F. Coulibaly, Aa Lubenga, Mb Diagne, Ab Gueye, F. Moutet, Py Milliez, F. Dap, A. Ndiaye, Traitement des séquelles de paralysie obstétricale du plexus brachial : résultats préliminaires à propos de 8 observations 1er Congrès Panafricain de Chirurgie de la Main et 4ème Congrès International de Chirurgie Plastique Reconstructive Esthétique Kinshasa du 14 au 16 Août 2017, *Annales Africaines de Médecine* 10 N°3 (2017).
- [10] B.D. Courtivron, Chapitre 11 in orthopédie pédiatrique, in: Pierre Journeau and Jérôme Cottalorda, Elsevier Masson, Paris, 2009, pp. 83–88.
- [11] L. Duclos, A. Gilbert, Restoration of wrist extension by tendon transfer in cases of obstetrical brachial palsy, *Ann. Chir. Main.* 18 (1999) 7–12.
- [12] Episcopo JB. Tendon transplantation in obstetrical paralysis, *Am J Surg* 25:122. .
- [13] S.L. Foad, C.T. Mehlman, J. Ying, The epidemiology of neonatal brachial plexus palsy in the United States, *J. Bone Joint. Surg. Am* 90 (6) (2008) 1258–1264.
- [14] I. Ghanem, E. Naoum, E. Saghbini, A. Assi, La libération du sous-scapulaire dans le traitement des rétractions en adduction-rotation interne chez l'enfant atteint de paralysie obstétricale du plexus brachial, *Rev. Chir. Orthopédique Traumatol.* 100 (7) (2014) S269–S270.
- [15] A. Gilbert, R. Rockman, H. Carlioz, Surgical treatment of brachial plexus birth palsy *Clin, Ortho* 264 (1991) 39–47.
- [16] D. Gobets, H. Beckerman, V. Groot, G. Becher, Indications and effects of botulinum toxin a for obstetric brachial plexus injury: a systematic literature review', *Dev. Med. Child Neurol.* 52 (2010) 517–528.
- [17] M. Haerle, A. Gilbert, Management of complete obstetric brachial plexus lesions, *J. Pediatr. Orthop.* 24 (2) (2004) 194–200.
- [18] Hoffer MM, Wickenden R, Ropper B. BRachial plexus birth palsies: results of tendon transfer to rotator cuff, *J. Bone Joint Surg.* 60A:691–695. .
- [19] Howard M., Clarke, Christine G., CUrtis. Examination and Prognosis Treated Obstetric Brachial Plexus Injuries, edit by alain gilbert institut de la main, Paris france. .
- [20] J.M. Kirkos, I.A. Papadopoulos, Late treatment of brachial plexus palsy secondary to birth injuries: rotational osteotomy of the proximal part of the humerus, *JBJS* 80 (10) (1998) 1477–1483.
- [21] J.M. Kirkos, I.A. Papadopoulos, Late treatment of brachial plexus palsy secondary to birth injuries: rotational osteotomy of the proximal part of the humerus, *J. Bone Joint Surg. Am.* 80 (1998) 1477–1483.
- [22] J. Mallet, Paralysie obstétricale du plexus brachial, *Rev. Chir. Orthopédique* 58 (1) (1972) 115–120.
- [23] Metsaars, W., Biegstraaten, M. et Nelissen, R. Réacheminement du biceps après une ostéotomie de l'avant-bras: une stratégie de traitement efficace pour la déformation sévère de la supination dans la paralysie du plexus obstétrique. *Journal de la main et microchirurgie*, 09 (01), 001–005. doi: 10.1055/s-0037-1598088. .
- [24] S. Nouri, A. Benamirouche, S. Rezik, A. Bendifallah, Prise en charge de la main en supination dans la paralysie obstétricale du plexus brachial, *Hand Surg Rehabil* 37 (6) (2018) 416.
- [25] M.L. Pearl, Arthroscopic release of shoulder contracture secondary to birth palsy : an early report on findings and surgical technique, *Arthroscopy* 19 (6) (2003) 577–582.
- [26] A. Rubin, Birth injuries: incidence, mechanisms, and end results, *Obstet. Gynecol.* 23 (2) (1964) 218–221.
- [27] Severo AL, Carvalho PGL, Lemos MB, Nunes, MC Scaranto M, et Barros, FK. Paralisia obstétrica: avaliação da técnica Sever-L'Episcopo modificada por Hoffer. *Revista Brasileira de Ortopedia*, 55 (06), 787–795. doi: 10.1055/s-0040-1712990. .
- [28] Strombeck C, Krumlinde-Sundholm L, Forssberg H. FUnctional outcome at 5 years in children with obstetrical brachial plexus palsy with and without microsurgical reconstruction, *Dev. Med. Child Neurol.* 42(3):148–157. .
- [29] Ubachs JMH, Slooff ACJ, Peeters LLH. OBstetric antecedents of surgically treated obstetric brachial plexus injuries, *Br. J. Obstet. Gynaecol.* 102:513–517. .
- [30] Vallejo, GI, Toh, S., Arai, H., Arai, K. et Harata, S. Résultats du transfert du tendon du Latissimus Dorsi et du Teres Major sur la coiffe des rotateurs pour la paralysie du plexus brachial à la naissance. *Journal scandinave de chirurgie plastique et reconstructive et de chirurgie de la main*, 36 (4), 207-211. doi: 10.1080/02844310260259860.
- [31] P.M. Waters, D.S. Bae, The effect of derotational humeral osteotomy on global shoulder function in brachial plexus birth palsy, *J. Bone Joint. Surg. Am* 88 (2006) 1035–1042.