Evaluation of Long-Term Results of Oberlin Surgery in Obstetric Brachial Paralysis*

Avaliação dos resultados a longo prazo da cirurgia de Oberlin na paralisia braquial obstétrica

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Abstract

Objective To evaluate elbow flexion in children with obstetric brachial plexus paralysis submitted to Oberlin transfer.

Methods Retrospective study with 11 patients affected by paralysis due to labor who did not present spontaneous recovery from elbow flexion until 12 months of life, operated between 2010 and 2018.

Results The children were operated between 5 and 12 months of life, with a mean of 7.9 months, and the mean follow-up time was 133.2 months, ranging from 37 to 238 months. Six patients (54.5%) presented a degree of muscle strength ≥ 3, measured by the strength scale of the Medical Research Council (MRC) and, according to the active movement scale (AMS), 5 patients obtained a score of ≥ 5. A negative correlation was identified between the AMS and the Narakas classification ($r = -0.509$), as well as between the strength scale (MRC) and the Narakas classification ($r = -0.495$). A strong positive correlation was observed ($r = 0.935$) between the AMS and the MRC demonstrating that the higher the score on the movement scale, the higher the score on the muscle strength scale.

Conclusion The Oberlin surgery is a possible option for recovery of elbow flexion in children with neonatal plexopathy, demonstrating, however, very heterogeneous results, even in the long-term follow-up.

Keywords
- brachial plexus
- paralysis, obstetric
- brachial plexus neuropathies

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Resumo

Objetivo Avaliar a flexão do cotovelo em crianças portadoras de paralisia obstétrica do plexo braquial submetidas à transferência de Oberlin.

Métodos Estudo retrospectivo com 11 pacientes acometidos por paralisia decorrente do trabalho de parto e que não apresentaram recuperação espontânea da flexão do cotovelo até os 12 meses de vida, operados entre 2010 e 2018.

Resultados As crianças foram operadas entre os 5 e 12 meses de vida, com média de 7,9 meses e o tempo médio de seguimento foi de 133,2 meses, variando de 37 a 238 meses. Seis pacientes (54,5%) apresentaram grau de força muscular ≥ 3, medido pela escala de força do *Medical Research Council* (MRC), e, pela escala de movimentação ativa (*Active Momement Scale* [AMS]), 5 pacientes obtiveram pontuação ≥ 5. Foi identificada correlação negativa entre a AMS e a classificação de Narakas (r = -0,509), bem como entre a MRC e a classificação de Narakas (r = -0,495). Já entre a AMS e a MRC, foi observada forte correlação positiva (r = 0,935), demonstrando que quanto maior a pontuação na escala de movimento, maior será a pontuação na escala de força muscular.

Conclusão A cirurgia de Oberlin apresenta-se como uma opção possível para a recuperação da flexão do cotovelo em crianças com plexopatia neonatal; no entanto, demonstra resultados bastante heterogêneos, mesmo no seguimento a longo prazo.

Palavras-chave

- plexo braquial
- paralisia obstétrica
- neuropatias do plexo braquial

Introduction

Brachial plexus lesions have high disabling potential when not adequately treated. In newborns, it occurs in the expulsive period of childbirth, and it is often associated with shoulder dystocia. If excessive force is applied during the extraction maneuver, the angle between the neck and shoulder is forcibly opened, causing a stretch of the brachial plexus.[1] The result of this traction can vary from neuropraxia to avulsion of nerve roots.[2,3]

The first clinical description was made by Smellie in 1764. However, the term obstetric palsy (OP) was first attributed to Duchenne in 1872, who described in detail the clinical picture of 4 patients.[4,5] In 1874, Erb studied patients with lesions of the upper trunk of the brachial plexus and correlated their data with Duchenne's description.

In 1987, Narakas classified children with OP into four types: type 1, with C5 and C6 roots lesion only (Erb); type 2, with C5, C6, and C7 roots (extended Erb) affected; type 3, with lesion of all roots of the plexus; and type 4, which has the Claude Bernard-Horner sign associated with the total injury.[6]

Obstetric lesions of the brachial plexus most frequently affect the roots of C5 and C6 (Narakas Type 1) or C5, C6, C7 (Type 2).[7] In these cases, the objective of surgical treatment is the reestablishment of elbow flexion, when spontaneous recovery does not occur. The time to perform the surgery, however, remains controversial, with authors indicating the upper limit between 6 and 9 months of age.[6]

In 1994, Oberlin described for the first time the technique of fascicular transfer from the ulnar nerve to the motor branch of the musculocutaneous nerve that innervates the biceps, being one of the preferred techniques of surgeons in the reconstruction of the brachial plexus in adults.[8,9] The advantages of this technique are the use of a previously healthy donor nerve and the performance of a nerve suture in a region without fibrosis and closer to the muscle to be reinnervated, which generates results superior to classical reconstruction with grafts.[10–15]

In the literature, the indication of this type of neurotization in OP cases has been rarely reported, in contrast to traumatic injuries in adults, whose indications are well established and have been well described.[8]

The aim of the present study is to evaluate the long-term functional outcome, especially active elbow flexion in children with neonatal plexopathy submitted to Oberlin transfer.

Casuistic and Methods

A retrospective study was conducted with children with OP followed up at the hand and microsurgery group outpatient clinic in a reference hospital, between January 2010 and December 2018. Children who did not have spontaneous recovery of elbow flexion up to 12 months of age or with muscle strength lower than M2 were included in the study. The exclusion criteria were children over one year of age; children previously submitted to some previous surgical procedure in the brachial plexus; children with complete brachial plexus injury who did not regain hand function; bilateral lesions and associated cerebral palsy.

We selected 11 patients who underwent surgery by the Oberlin technique, in addition to neurotization of the accessory nerve to the suprascapular nerve. Intraneural dissection to identify the motor fascicle for the ulnar flexor muscle of the carpal was performed with the use of the microscope, since the caliber of these nerves is much smaller in young

children. Nerve suture was always performed with 9-0 mononylon thread.

The data collected included: age, time between surgery and evaluation, elbow flexion measurements by the strength scale of the Medical Research Council (MRC) and the active movement scale (AMS).

The statistical analysis involved descriptive data, mean, median, interquartile interval, and standard deviation, for quantitative variables: age and time between surgery and final evaluation. Qualitative variables were expressed in frequencies.

The Kolmogorov-Smirnov (KS) test was used to test the normality of the variables involved. Sequentially, the Spearman correlation was chosen to verify the correlation between elbow flexion measurements (MRC scale and AMS), Narakas classification, age, and time between surgery and final evaluation. For the classification of the correlation level, the following system was used: $r \geq 0.9$ as a very strong correlation; $0.7 \geq r \leq 0.89$ as a strong correlation; $0.5 \geq r \leq 0.69$ as a moderate correlation; $0.3 \geq r \leq 0.49$ as a weak correlation; $0 \geq r \leq 0.29$ as a very weak correlation.[16] The IBM SPSS Statistics for Windows, Version 21.0 software (IBM Corp., Armonk, NY, USA) was used for data computation, considering the significance level of 5%.

The present study did not receive any financial support from public, commercial, or for-profit sources. In addition, the use of human data was approved by the National Research Ethics Committee (CAAE 25532619.0.0000.5479)

Results

The age of the children at the time of surgery ranged from 5 to 12 months, with a mean of 7.9 months. The mean time elapsed between surgery and evaluation was 133.2 months, ranging from 37 to 238 months (►**Table 1**).

Regarding the classification of the lesion, 2 children were type 1 of Narakas, 5 were type 2, and 4 were type 3, with spontaneous recovery of the lower roots.

Considering the –MRC scale, 2 patients presented M1, 3 M2, 3 M3 and 3 M4. Regarding the AMS, 2 patients presented grade 1, 3 grade 3, 1 grade 4, 2 grade 5, and 3 grade 6 (►**Table 2**).

Regarding the correlation of the variables analyzed, a moderate and negative correlation was identified between the AMS and the Narakas classification ($r = -0.509$), as well as between the MRC scale and the Narakas classification ($r = -0.495$), the latter being considered weak. Thus, the higher the score in the scales presented, the lower the graduation of the lesion in the Narakas classification. There was a weak and positive correlation between the AMS and the patient's age at the time of surgery ($r = 0.364$) and the time between surgery and evaluation ($r = 0.343$), as well as MRC scale and age ($r = 0.411$) and evolution time ($r = 0.301$). That is, the higher the age of the children at the time of surgery or the time of evolution between the surgical act and the final evaluation, the higher the score in the scales presented. When we studied the correlation between the AMS and MRC scale, a very strong and positive correlation was identified ($r = 0.935$), demonstrating that the higher the score on the movement scale, the higher the score on the muscle strength scale (►**Table 3**).

Table 1 Complete descriptive for quantitative variables age at the time of surgery and evolution time

Descriptive	Age at the time of surgery (months)	Evolution time (months)
Average	7.9	133.2
Median	6	160
Standard deviation	2.7	63.4
Coefficient of variation	35%	48%
Minimum	5	37.08
Maximum	12	237.6
Number of individuals	11	11
Confidence interval	1.6	37.5

Table 2 Distribution of qualitative variables

		Number of individuals	%
AMS - active movement scale	AMS 1	2	18.2%
	AMS 2	3	27.3%
	AMS 4	1	9.1%
	AMS 5	2	18.2%
	AMS 6	3	27.3%
MRC - Medical Research Council	M1	2	18.2%
	M2	3	27.3%
	M3	3	27.3%
	M4	3	27.3%

Table 3 Correlation between the elbow flexion movement scale and the Narakas Classification, age of the patient at the time of surgery, and time between surgery and evaluation

		Narakas classification	Age at the time of surgery	Evolution time	MRC
MRC	Spearman correlation (r)	-0.495	0.411	0.301	
	P-value	0.121	0.209	0.369	
AMS	Spearman correlation (r)	-0.509	0.364	0.343	0.935
	P-value	0.109	0.271	0.302	< **0.001**

Abbreviations: AMS, active movement scale; MRC, Medical Research Council.

Discussion

Brachial plexus lesions at birth affect the upper trunk more frequently;[17] thus, elbow flexion is invariably compromised. Despite the high rate of spontaneous recovery in the first 6 months of life, in cases where this does not occur, the absence of elbow flexion is extremely disabling for upper limb function.[2,18] In these situations, surgical treatment is indicated for primary brachial plexus reconstruction, and can be performed up to 12 months of age, even though there is no consensus in the literature on the ideal age.[4,11,19–21]

Although Oberlin surgery is well established for the treatment of lesions in adults, in OP it has been little reported in the literature.[4,11,19,22] This fact is due to the occurrence of spontaneous bicep recovery in the vast majority of OP cases and, therefore, the indication of surgery is less frequent than in adults. This also justifies the fact that the studies found in the literature do not present large sample series, ranging from 7 to 20 cases,[20] compatible with the present study.

By performing the nerve suture closer to the muscle to be reinnervated, this technique allows the performance of primary surgeries in children up to 2 years of life with functional results, as observed by other authors.[24] For this reason, the method under study may be used to treat children who only present themselves to a specialized service later than 1 year of age. Similar to the other studies in the literature, no sensory or motor dysfunction in the hands of patients due to fascicular transfer of the ulnar nerve was observed in the present study.

One of the challenges in evaluating the results is to establish objective parameters to evaluate active elbow flexion that are reproducible among different observers. The AMS was developed to evaluate younger children with OP, being used by several authors.[2,24] However, the MRC scale, even though it is not as specific, is more widespread and preferred by other authors.[15,23] Despite the differences in graduation between the scales, we observed a correspondence between the two in the long-term result of elbow flexion muscle strength.

The results of the present study, however, were not homogeneous and were based on most of the literature, which points out good results for bicep flexion with Oberlin surgery in OP. Little el al. observed, in a retrospective study of 31 cases, 77% of recovery from elbow flexion against severity.[12]

Six out of 11 children (54.5%), on the MRC scale, presented force against gravity or more (3 children grade 3 and 3 children grade 4) and 5 presented, on the AMS scale, active movement against gravity or more (2 children grade 5 and 3 children grade 6). According to Clarke and Curtis (1995), ranges of motion that exceed 50% against gravity are considered functional, that is, AMS = 6.[25]

The divergent results of this research can be credited to simultaneous triceps activation when the patient tries to flex the elbow. This phenomenon became evident when, despite the visible and palpable contraction of the biceps, the antagonistic action of the triceps prevented movement in some cases. Some authors have described the results of the application of botulinum toxin in the triceps muscle to treat this condition and improve active elbow flexion.[2] However, there are still no studies on the use of botulinum toxin to treat co-contraction between the triceps muscle and biceps in the rehabilitation of Oberlin surgery.

The present study stands out for the long follow-up time, which was higher than that observed in the studies published to date. Siqueira et al.,[26] published the follow-up of 8 patients after a mean time of 8.3 years; however, the objective was to evaluate the function of the hand.

Theoretically, the results for elbow flexion tend to be higher the longer the evolution time.[14] However, no statistically significant differences were observed when the results were analyzed with the evolution time. Similarly, there was no relationship with the age of surgery, as Murison's study also observed.[24] A larger sample could add more evidence to those observations. Still, as this is an infrequent indication, multicenter studies gathering experiences from various specialized groups could be conducted to achieve this purpose.

Conclusion

Oberlin surgery is a possible option for the recovery of elbow flexion in children with neonatal plexopathy, demonstrating, however, very heterogeneous results, even in long-term follow-up.

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Conflict of Interests
The authors declare that there is no conflict of interests.

References

1 Chang KWC, Wilson TJ, Popadich M, Brown SH, Chung KC, Yang LJS. Oberlin transfer compared with nerve grafting for improving early supination in neonatal brachial plexus palsy. J Neurosurg Pediatr 2018;21(02):178–184
2 Figueiredo RdeM, Grechi G, Gepp RdeA. Oberlin's procedure in children with obstetric brachial plexus palsy. Childs Nerv Syst 2016;32(06):1085–1091
3 Gilbert A, Brockman R, Carlioz H. Surgical treatment of brachial plexus birth palsy. Clin Orthop Relat Res 1991;(264):39–47
4 Gilbert A, Pivato G. Obstetrical palsy: The french contribution. Semin Plast Surg 2005;19(01):5–16
5 Terzis JK, Kokkalis ZT. Elbow flexion after primary reconstruction in obstetric brachial plexus palsy. J Hand Surg Eur Vol 2009;34 (04):449–458
6 Narakas AO. Obstetrical Brachial Plexus Injuries. In: Lamb DW, ed. The paralysed hand. Edimburgh: Churchill Livingstone; 1987:116–135
7 Rodrigues DB, Viegas MLC, Rogério JS, Pereira ELR. Tratamento cirúrgico das lesões traumáticas do plexo braquial. Arq Bras Neurocir 2014;33(02):125–131
8 Rezende MR, Rabelo NTA, Silveira CCJ, Petersen PA, De Paula EJL, Mattar RJ. Resultado da neurotização do nervo ulnar para o músculo bíceps braquial na lesão do plexo braquial. Acta Ortop Bras 2012;20(06):317–323
9 Corrêa MG, Cardoso MM, Gepp RA, Quiroga MRS, Beraldo PSS. Brachial plexus injuries with ulnar musculocutaneous transfer: 78 cases study focused on possible postoperative complications. Arq Bras Neurocir 2019;38(01):7–11
10 Al-Qattan MM, Thallaj A, Abdelhamid MM. Ulnar nerve to musculocutaneous nerve transfer in an ulnar ray-deficient infant with

brachial plexus birth palsy: case report. J Hand Surg Am 2010;35(09): 1432–1434
11 Leechavengvongs S, Witoonchart K, Uerpairojkit C, Thuvasethakul P, Ketmalasiri W. Nerve transfer to biceps muscle using a part of the ulnar nerve in brachial plexus injury (upper arm type): a report of 32 cases. J Hand Surg Am 1998;23(04):711–716
12 Little KJ, Zlotolow DA, Soldado F, Cornwall R, Kozin SH. Early functional recovery of elbow flexion and supination following median and/or ulnar nerve fascicle transfer in upper neonatal brachial plexus palsy. J Bone Joint Surg Am 2014;96(03):215–221
13 Oberlin C, Béal D, Leechavengvongs S, Salon A, Dauge MC, Sarcy JJ. Nerve transfer to biceps muscle using a part of ulnar nerve for C5-C6 avulsion of the brachial plexus: anatomical study and report of four cases. J Hand Surg Am 1994;19(02):232–237
14 Shigematsu K, Yajima H, Kobata Y, Kawamura K, Maegawa N, Takakura Y. Oberlin partial ulnar nerve transfer for restoration in obstetric brachial plexus palsy of a newborn: case report. Journal of Brachial Plexus and Peripheral Nerve Injury 2006;1(01): e39–e43
15 Siqueira MG, Socolovsky M, Heise CO, Martins RS, Di Masi G. Efficacy and safety of Oberlin's procedure in the treatment of brachial plexus birth palsy. Neurosurgery 2012;71(06):1156–1160, discussion 1161
16 Hulley SB, Cummings SR, Browner WS, Grady DG, Newman TB. Delineando a pesquisa clínica: uma abordagem epidemiológica. 3a. ed. São Paulo: Artmed; 2008
17 Kozin SH. Nerve transfers in brachial plexus birth palsies: indications, techniques, and outcomes. Hand Clin 2008;24(04): 363–376
18 Arias AV, Gonçalves VMG, Campos D, Santos DCC, Goto MMF, Campos Zanelli TM. Desenvolvimento das habilidades motoras finas no primeiro ano de vida. Rev Neurocienc 2010;18(04): 544–554
19 Ghanghurde BA, Mehta R, Ladkat KM, Raut BB, Thatte MR. Distal transfers as a primary treatment in obstetric brachial plexus palsy: a series of 20 cases. J Hand Surg Eur Vol 2016;41(08):875–881
20 Fisher DM, Borschel GH, Curtis CG, Clarke HM. Evaluation of elbow flexion as a predictor of outcome in obstetrical brachial plexus palsy. Plast Reconstr Surg 2007;120(06):1585–1590
21 Pondaag W, Malessy M. The Evidence for Nerve Repair in Obstetric Brachial Plexus Palsy Revisited. Biomed. Res Int 2014:1–11
22 Garg R, Merrell GA, Hillstrom HJ, Wolfe SW. Comparison of nerve transfers and nerve grafting for traumatic upper plexus palsy: a systematic review and analysis. J Bone Joint Surg Am 2011;93 (09):819–829
23 Noaman HH, Shiha AE, Bahm J. Oberlin's ulnar nerve transfer to the biceps motor nerve in obstetric brachial plexus palsy: indications, and good and bad results. Microsurgery 2004;24(03): 182–187
24 Murison J, Jehanno P, Fitoussi F. Nerve transfer to biceps to restore elbow flexion and supination in children with obstetrical brachial plexus palsy. J Child Orthop 2017;11(06):455–459
25 Clarke HM, Curtis CG. An approach to obstetrical brachial plexus injuries. Hand Clin 1995;11(04):563–580, discussion 580–581
26 Siqueira MG, Heise CO, Pessa M, Zacariotto M, Martins RS. Long-term evaluation of hand function in children undergoing Oberlin and Oberlin-like procedures for reinnervation of the biceps muscle. Childs Nerv Syst 2020;36(12):3071–3076