Muscle transposition for the treatment of paralytic strabismus. Retrospective review of 23 cases

Transposição muscular para o tratamento do estrabismo paralítico. Revisão retrospectiva de 23 casos

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Abstract

Introduction: *Muscular transposition procedures are used when there is no ocular rotation in a particular direction due to alterations of the extraocular muscles such as paralysis, agenesis or congenital anomalies. The objective of this study is to characterize the patients treated with this procedure and determine the percentage of correction of the deviation angle obtained after surgery in the Pediatric Ophthalmology, Strabismus and Neuro-ophthalmology Unit. "Dra. Ana María Illescas Putzeys", Hospital de ojos y oídos "Dr. Rodolfo Robles V.* ***Methods:*** *A retrospective, descriptive, observational study was conducted with review of records of patients operated on muscle transposition during the years 1999 to 2016.* ***Results:*** *Twenty-three rectus muscle transposition procedures were performed. Thirteen were male (56.5%). The mean age was 42 years. In our series, an average correction of 42 PD (82%) was obtained regardless of the type of paralysis or the surgical procedure performed.* ***Conclusion:*** *In selected cases of paralytic strabismus, the main approach may be only muscle transposition with augmentation (posterior intermuscular fixation suture), with good results, similar to those obtained with muscle transposition using adjuvants such as botulinum toxin treatment.*

Keywords: *Paralitic Strabismus, Vertical Rectum Transposition, Muscular Transposition, augmentation suture, deviation angle.*

Resumo

Introdução: Os procedimentos de transposição muscular são utilizados quando não há rotação ocular em nenhuma direção determinada devido a alterações dos músculos extraoculares, como paralisia, agenesia ou anomalias congênitas. O objetivo deste estudo é caracterizar os pacientes tratados com este procedimento e determinar a porcentagem de correção do ângulo de desvio obtida após a cirurgia na Unidade Pediátrica de Oftalmologia, Estrabismo e Neuro-Oftalmologia. "Dra. Ana María Illescas Putzeys", Hospital de ojos y oídos "Dr. Rodolfo Robles V. **Métodos:** Foi realizado um estudo retrospectivo, descritivo, observacional, com revisão dos registros de pacientes operados para transposição muscular nos anos de 1999 a 2016. **Resultados:** Foram realizados vinte e três procedimentos de transposição do músculo reto. Treze pacientes eram homens (56,5%). A idade média foi de 42 anos. Em nossa série, foi obtida uma correção média de 42 PD (82%), independente do tipo de paralisia ou do procedimento cirúrgico realizado. **Conclusão:** Em casos selecionados de estrabismo paralítico, a principal abordagem pode ser apenas a transposição muscular com aumento (sutura de fixação intermuscular posterior), com bons resultados semelhantes aos obtidos com a transposição muscular com a utilização de adjuvantes como o tratamento com toxina botulínica.

Palavras-chave: Estrabismo Paralítico, Transposição Vertical do Reto, Transposição Muscular, sutura de aumento, ângulo de desvio.

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Introduction

Muscle transposition procedures are used when there is no eye rotation in a particular direction due to alterations of the extraocular muscles such as paralysis, agenesis or congenital anomalies. Secondary strabismus due to conditions such as sixth nerve palsy, double elevator palsy and third nerve palsy can be improved with this procedure. [1]

In 1907 Hummelsheim described the procedure of transferring part of the action of the superior rectus (SR) and inferior rectus (IR) to the lateral rectus (LR) in cases of paralysis of the sixth nerve. This procedure has undergone numerous modifications in the last century, but most maintain the basic principle: the action of muscles that are normally antagonistic is transferred to the field of action of the paretic muscle located between these antagonists. [2]

The success of these surgical procedure lies in improving the primary position not the action of the paralyzed muscle. The improvement in the deviation angle reported in the literature for these procedures is variable, ranging from 32 to 36 prismatic diopters (PD) in vertical rectus transposition alone without muscle recession or posterior suture augmentation; from 30 to 50 PD for vertical rectus transposition with muscle recession or botulinum toxin injection and 40 to 55 PD for vertical rectus transposition with augmentation suture. [3-6]

In our center, complete tendon transposition with augmentation has been used. The objective of this study is to characterize patients treated with this procedure during the years 1999-2016 and determine the correction rate of the deviation angle obtained after surgery in the Pediatric Ophthalmology, Strabismus and Neuro-ophthalmology Unit. "Dra. Ana María Illescas Putzeys ", Hospital de Ojos y Oídos" Dr. Rodolfo Robles V.

Methods

A retrospective, descriptive, observational study was conducted. We reviewed medical récords of all patients who underwent muscle transposition surgery in the Pediatric Ophthalmology, Strabismus and Neuro-ophthalmology Unit "Dra. Ana María Illescas Putzeys ", Hospital de ojos y oídos " Dr. Rodolfo Robles V. " Instituto de Ciencias de la Visión", Benemérito Comité Pro-ciegos y Sordos, from 1999 to 2016.

We collected information about visual acuity (Snellen chart), ocular motility, deviation measurements (Krimsky method or prism alternate cover test), slit lamp biomicroscopy and fundoscopic eamination.

To characterize the population, the following information was collected: age, gender, diagnosis, etiology, initial angle of deviation in primary position, procedure performed, postoperative deviation after 2 months in primary position, follow-up (one year) and calculation of the correction rate the angle of the deviation.

The transposition technique was: the rectus muscles (full tendon and muscle bellies) were transposed to the paretic muscle following the spiral of tillaux. Two 4-0 nonabsorbable polyester suture were placed 8 mm posterior to the insertion of the paretic muscle, 1/3 of the width of each belly transposed muscle to the corresponding border of the paretic muscle. [7] (See figure 1). In some cases, this procedure was combined with contralateral rectus recession or botulinum toxin injection. (Table 1).

The data was recorded and analyzed in a sheet designed for this purpose using the EPI-INFO program. (Database and statistics for public health professionals, Centers for Disease Control and Prevention 2008).

Results

The medial record review identified 23 patients treated with rectus muscle transposition procedures during the study period. All of them were performed for paralytic strabismus. 13 were male (56.5%) and 10 female (43.5%). The mean age of the patients was 42 years ranging from 1 to 61 years. (Patients characteristics and surgical procedure performed are summarized in table 1). The etiologie of the paralysis was: trauma (11 patients), congenital (6 patients), tumors (4 patients), idiopathic (1 patient) cerebral aneurysm (1 patient). No infectious or metabolic causes were found. The left eye was mostly affected (15 cases) and in 5 cases the paralysis was bilateral. Etiologies included 14 cases with VI nerve palsy, 4 cases with IR paresis, 4 cases with double elevator paralysis and 1 with bilateral type 1 Duane syndrome.

Ten patients (43.5%) completed post operative follow-up for 1 year and the deviation angle was stable. No issues related to the procedure were described.

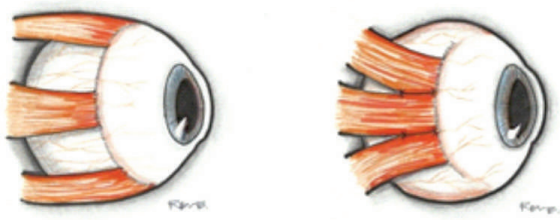

Figure 1: Schematic of transposition vertical muscles

Transposition of vertical rectus following the spiral of Tillaux with augmentation suture 8 mm posterior to the insertion of the paretic muscle.

Discussion

Treatment in patients with paralytic strabismus has limitations since normal ocular motility can not be restored. The transposition procedures aim to improve the deviation angle in primary position, anomalous head postures and in some cases, eliminate diplopia or expand the binocular vision field. [4, 5, 8, 9]

Similar to other studies, sixth nerve palsy, male sex and unilateral affection were the most frequent characteristics in this series. [4,5,8,9]

Muscle transposition procedures are useful to improve the range of ocular rotation in patients with a paralyzed or non-functional muscle. [3] Variations have been described from the original technique by Hummelsheim; complete tendon transposition was considered the best in terms of results; [9] until Buckley in 1995, described a technique using a posterior intermuscular unión suture without scleral fixation. In 1997 Foster described another augmentation suture technique, with posterior scleral fixation. [4,9,10] The additive effect of these sutures occurs because a larger portion of the rectus muscles is moved to a new position, increasing the mechanical effect since the force vectors become more parallel to the affected muscle. [8,10]

In other studies the deviation improvement permorming a vertical rectus transposition alone or with posterior sutures (Foster or Buckley) is 32-36 PD [4,5] and 41-50 PD (5,9) respectively.

Nº	Age(years)	Sex	Diagnosis	Etiology	Surgical procedure pre/post surgical (PD)	Deviation angle	Correction PD/ (%)
					Sixth nerve palsy		
1	19	F	VI nerve palsy OD	Trauma	SR and IR CTT LR OD with augmentation to suture + MRR 4.5mm OS	55/6	49/89
2	28	F	VI nerve palsy OS	Trauma	SR and IR CTT to LR OS with augmentation suture+ MRR 6mm OD	20/0	20/100
3	50	F	VI nerve palsy OS	Trauma	SR and IR CTT to LR OS with augmentation suture + MRR 7mm OD	80/12	68/85
4	2	F	VI nerve palsy OS	Congenital	SR and IR CTT to LR OS with augmentation suture + MRR 7mm OD	90/10	80/89
5	55	M	VI nerve palsy OS	Trauma	SR and IR CTTto LR OS with augmentation suture + MRR 4mm OD	60/15	45/75
6	23	M	VI nerve palsy OS	Brain aneurysm	SR and IR CTTto LR OS with augmentation suture + MRR 7mm OD	95/15	80/84
7	61	M	VI nerve palsy OD	Tumor	SR and IR CTTto LR OD + MRR 8mm OS	90/20	70/78
8	52	M	VI nerve paralysis bilateral	Trauma	SR and IR CTTto LR OU with augmentation suture	90/15	75/83
9	30	M	VI nerve palsy OS	Trauma	SR and IR CTTto LR OS with augmentation suture	35/10	25/71
10	22	M	VI nerve palsy OS	Trauma	SR and IR CTTto LR OS with augmentation suture	35/0	35/100
11	38	M	VI nerve palsy bilateral	4th ventricle Tumor	SR and IR CTTto LR OU with augmentation suture	90/15	90/100
12	17	M	VI nerve palsyOS	Trauma	SR and IR CTTto LR OS	65/35	30/46
13	44	F	VI nerve palsy OS	Idiopathic	SR and IR CTTto LR OS	90/25	65/72
14	16	M	VI nerve palsy OD	Juvenile Nasal Angiofibroma Tumor	SR and IR CTT to LR OD +botulinum toxin injection MR OD	75/30	45/60
					Inferior rectus muscle paralysis		
15	28	F	RI palsy OS	Trauma	MR and LR CTT to IR OS with augmentation suture	20/0	20/100
16	30	M	RI palsy OS	Optic nerve tumor	MR and LR CTT to IR OS with augmentation suture	25/0	25/100
17	18	M	RI palsy OS	Trauma	MR and LR CTT to IR OS with augmentation suture	18/0	18/100
18	17	F	RI palsy OS	Trauma	MR and LR CTT to IR OS with augmentation suture	25/0	25/100
					Double elevator palsy		
19	3	F	Double Elevator Palsy OS	Congenital	MR and LR CTT to SR OS	20/6	14/70
20	4	F	Double Elevator Palsy OS	Congenital	MR and LR CTT to SR OS	16/0	16/100
21	17	M	Double Elevator Palsy OD	Congenital	MR and LR CTT to SR OD with augmentation suture	65/40	25/39
22	1	F	Double Elevator Palsy OS	Congenital	MR and LR CTT to SR OS with augmentation suture and MRR OD 7mm y SR hangback Recession 7 mm OD	55/20	35/64
					Duane syndrome		
23	4	M	Bilateral Type 1 Duane Syndrome	Congenital	SR and IR CTT to LR with augmentation suture	45/8	37/82

M: male, F: female, OD: right eye, OS: left eye, OU: both eyes, SR: superior rectus, IR: inferior rectus, LR: lateral rectus, MR: medial rectus, CTT: complete tendon transposition, MRR: medial rectus recession

In our series, the mean of correction was as follows: 42 PD (82%) regardless of the type of paralysis or the surgical procedure performed, with an average initial deviation of 54 PD. 44 PD (86%) with posterior suture and 40 PD (71%) without these sutures; similar results were obtained by other authors. [4,9] It has been reported a correction of 34 to 55 PD using botulinum toxin injection combined with the vertical rectus transposition.[8,9] In this review only 1 patient had botulinum toxin injection with a correction of 45 PD (65%).

In this series, 5 different techniques were used for the treatment of sixth nerve palsy, the first was SR and IR complete tendon transposition to LR with augmentation (Buckley suture) and recession of the contralateral MR with an average improvement of 57 PD (87%); the second procedure was SR and IR complete tendón transposition to LR with Buckley suture, with an average improvement of 56 PD (89%) similar to other studies (40-55 PD); [3,5,9] the third procedure was SR and IR complete tendon transposition to LR, associated to recession of the contralateral MR, obtaining an average improvement of 70 PD (78%), wich is higher than in other studies, that report an improvement of 30-50 PD;[3] the fourth procedure was SR and IR complete tendon transposition to LR, obtaining an average improvement of 48 PD (59%), (other studies report an improvement of 32-36 PD)[3,5] and finally SR and IR complete tendon transposition to LR with botulinum toxin injection in the ipsilateral antagonist, obtaining an improvement of 45 PD (60%). It has been reported that the esotropia correction with botulinum toxin injection or a recession is the same (30-50 PD).[3]

Transposition of the rectus muscles is less effective in patients with third nerve palsy tan with VI nerve palsy, because 4 muscles may be altered. A previous study reported a correction of 46 PD in patients with III nerve palsy performing complete tendon transposition with augmentation (Buckley suture).[9] In this series, patients with III nerve palsy only involved the IR with a mean deviation of 22 PD, obtaining a 100% correction performing the transposition with augmentation (Buckley suture). The amount of the initial deviation could contribute to the total correction since is less than in previous studies (67 ± 17 PD). [3,4,8,9] The most common etiology was trauma in 3 patients and tumor in 1 patient, data similar to previous studies. [3,4,8,9]

In double elevator paralysis deviations of 50 ± 28 PD [9] have been reported, with a correction of 37 ± 12 PD with complete tendon transposition and augmentation suture. In our series 1 patient underwent this technique, achieving an improvement of 25 PD (39%), which could be due to the fact that he had the greatest preoperative deviation in this serie (65 PD); 2 patients underwent MR and LR complete tendon transposition to SR without augmentation suture with an average correction of 15 PD (85%). It is worth mentioning that one of the patients corrected 100% of the inicial deviation with MR and LR complete tendon transposition to SR with augmentation and thus could be due to the fact that it was a lower amount of initial deviation (16 PD). One patient underwent MR and LR complete tendon transposition to SR with augmentation suture with contralateral MR recession, (since the patient had an esodeviation), obtaining an improvement of 35 PD (64%).

In a review of cases with limited congenital abduction (mostly Duane Syndrome), a significant decrease in primary deviation associated with improvement of abduction with no adduction limitation was reported. [10] In this series we had a patient with bilateral Duane syndrome with 45 PD esotropia who underwent bilateral complete tendon vertical rectus transposition with augmentation suture improving 82%. In this study, no improvement in ductions was assessed.

Conclusion

1. In selected cases of paralytic strabismus, the main approach could be muscle transposition with augmentation suture only, with good results, (similar to those when using adjuvants).
2. The most frequent indication for muscle transposition procedures in paralytic strabismus was due to VI nerve paralysis of traumatic etiology, obtaining an average correction of 82% (42 PD).
3. In procedures with augmentation suture, an average correction of 86% (44 PD) was obtained. In cases without this suture the mean of correction was 71% (40 PD).

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