Int Ophthalmol (2019) 39:111–116
https://doi.org/10.1007/s10792-017-0794-x

ORIGINAL PAPER

Simplified approach of Gokyigit's technique for complete cranial nerve third palsy

Ebru Demet Aygit · Asli İnal · O. Bulut Ocak · Selcen Celik · Korhan Fazıl · Burcin Kepez Yildiz · Muhittin Taskapili · Birsen Gokyigit

Received: 22 May 2017 / Accepted: 11 December 2017 / Published online: 23 December 2017

Abstract
Purpose To evaluate a simpler approach of the medial transposition of split lateral rectus technique in patients with complete third nerve palsy.
Methods All eyes with complet third nerve palsy were followed in our Strabismus Department between 2014 and 2016. All patients had complete oculamotor nerve palsy. All patients assed routine ophthalmologic examination. Also the ocular deviation, horizontal and vertical ocular alignments were measured at 6 m and at 1/3 m using the Krimsky corneal reflection test and alternate prism cover test with best optical correction. Same surgeon (BG) performed all procedures in general anesthesia. In this procedure, same Gokyigit's technique except upper and lower part of lateral rectus muscle was passed under the superior oblique tendon and inferior oblique tendon. Final deviation from 0 to 14 PD was considered a successful result.
Results Eight patients were included in the study. The average ages were 39.4 years and male to female ratio 5:3. Patients had a preoperative horizontal deviation -42.5 ± 2.7 PD and postoperative horizontal deviation -1.7 ± 2.6 PD. All patients follow-up time were at least 6 months.
Conclusions Achieved to acceptable alignment in primary position, manage to diplopia and cosmetical appearance are the main aims of patients with third nerve palsy.

Keywords Third nerve palsy · Strabismus surgery · Surgical management of third nerve palsy

Introduction

Third cranial nerve (CN 3) palsy is usually caused in elderly patients by such life-limiting conditions and frequently seen systemic diseases as microvascular disease, aneurysms of the central nervous system, and neoplasm. Complete surgical treatment for CN 3 palsy is always challenging. Many of the available surgical techniques for treating CN 3 palsy are quite effective [1]. The goals of the management of CN 3 palsy are achieving acceptable alignment in the primary position and managing diplopia.

One recent popular surgical approach for CN 3 palsy treatment is Gokyigit's medial transposition of the Y-split lateral rectus muscle. That technique and its modifications have the transient but boring complication of choroidal effusion. Another problem with this technique is that performing the operation is difficult for less-experienced ophthalmologists.

E. D. Aygit (✉) · A. İnal · O. B. Ocak · S. Celik · K. Fazıl · B. K. Yildiz · M. Taskapili · B. Gokyigit
Beyoglu Eye Training and Research Hospital, University of Health Sciences, Bereketzade Cami Sokak No: 2 Beyoglu, Istanbul, Turkey
e-mail: ebrudemet@hotmail.com

Our first two cases underwent the established procedure. During the procedure, the arms of lateral rectus did not pass through under the 'superior oblique and superior rectus complex' and under the 'inferior oblique and inferior rectus complex' but only passed under the superior rectus and under the inferior rectus. During both operations, it was difficult to reach the medial rectus area, and the postoperative success did not satisfy us. In two later cases, we performed a simpler type of operation because of the anatomical indispensability. We obtained better results than in the first two cases. After these good results, we used the simpler form of operation in four more cases.

In this study, we describe a simpler approach of the medial transposition of the split lateral rectus technique in patients with complete CN 3 palsy and assessed the preoperative and postoperative head posture, ocular alignments, and primary position ocular deviation.

Materials and methods

There were eight patients in this retrospective and observational study. Patient data were collected between 2014 and 2016 in University of Health Sciences Beyoglu Eye Training and Research Hospital. The study was approved by the Local Ethics Committee and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all subjects.

The inclusion criteria of our study were complete oculomotor nerve palsy and at least 6 months of nerve palsy. Exclusion criteria were patients with incomplete oculomotor nerve palsy; mechanical causes for limited elevation, depression, or adduction of the eye; or congenital cranial dysinnervation disorders (CCDD).

All patients had undergone standardized orthoptic and ocular evaluations. The ocular deviation and horizontal and vertical ocular alignments were measured at 6 m and at 1/3 m using the Krimsky corneal reflection test as well as the alternate prism and cover test with best optical correction in place. Ocular ductions and versions were evaluated, pre- and postoperatively, from 0 to − 5, with 0 indicating full movement in both eyes, − 4 indicating the inability to move the affected eye past the midline, and − 5 indicating the inability to move the affected eye to the midline.

A diagnosis of complete oculomotor nerve palsy was made in the presence of deficit adduction (− 4/− 5) of the eye; defective vertical movements of the superior rectus, inferior rectus, or inferior oblique muscles; a fixed dilated pupil; and same-side eyelid ptosis.

At the same time, preoperative and postoperative Hess screen tests were applied and recorded in all patients.

The Botulinum Toxin-A (Botox^R, Allergan) was applied to all patients before the operation, and surgery was planned after two weeks to three months after Botox^R injection, according to the injection effects. When there was no effect, we planned an early operation; if we recorded any effects, we waited for three months before performing the operation. Botox^R produces dose-related weakness or paralysis of ocular antagonist muscles by blocking calcium-dependent acetylcholine from nerve endings, which provides functional denervation to the antagonist lateral rectus muscle. We also provided relaxation of the long-standing muscle contraction to the lateral rectus.

A complete palsy, no adduction, or vertical action of the superior or inferior rectus or the inferior oblique muscle areas were recorded if the pupil was dilated and unresponsive to light and ptosis was present.

All patients were assessed at baseline and followed up at one week, one and three months after the operation. Postoperative evaluations were performed using the Krimsky and Hirschberg corneal reflection tests.

The criteria for a successful outcome included achieving orthophoria in ± 14 pd as well as slight esotropia or exotropia in the primary position without any head position with reasonable ocular alignment.

Surgical procedure

A standardized surgical technique was used in all cases in the study. The operation was performed under general anesthesia and performed by the same surgeon (BG). The surgical technique was the same as Gokyigit's technique except the arms of lateral rectus were not passed through under the oblique muscles but only under the rectus muscles.

Surgical technique was same the Gokyigit's technique until muscle separated two halves [2]. A 300° conjunctival limbal peritomy is made from the 4 o'clock to the 2 o'clock meridian in the right eye and

from the 10 o'clock to the 8 o'clock meridian in the left eye. The lateral rectus muscle was cleared of adherent tissues; the intermuscular membranes attached to the borders of the muscle were cut for a distance of 15 mm posterior to the insertion. The muscle was split at up to 15 mm toward the posterior septum without damage to the septum or the pulley structure. Creating a slit in the posterior portion of the Tenon's sleeve can enhance the effect of our procedure; a slit seems to prevent serious undercorrection without the necessity of a secondary procedure on the ipsilateral medial rectus muscle. One or two full-thickness locking bites were placed at the edge of the muscle halves (1- or 2-point fixation). We used non-absorbable 6–0 polyester sutures (Dacron; Ethicon Inc, Somerville, NJ) to secure the muscle. The muscle halves were disinserted, and the sutures on the muscle halves were passed through the hole of the Gass hook (Katena, Denville, NJ). Then, the upper half of the muscle was passed under the only superior rectus muscle with the help of the Gass hook and the inferior half of the muscle was passed only under the inferior rectus muscle.

The operation continues like the original technique: the two parts of the lateral rectus muscle were pushed far posteriorly so that they could be transposed closer to the insertion of the medial rectus muscle. In this intraoperative maneuver, we rotated the globe medially by grasping the lateral rectus insertional stump (where a small tendon remained) with two locked teeth forceps to facilitate reinsertion of the lateral muscle halves in their new position. These two parts were advanced anteriorly to the medial rectus muscle insertion. This maneuver was performed to ensure suture tightening and to prevent the tearing of the scleral bite area from the tension. The lower half of the lateral rectus muscle was reattached 1 mm posterior to the inferior border of the medial rectus insertion, and the upper was reattached 1 mm posterior to the superior border of the medial rectus insertion. The postoperative muscle positions above and below the globe are shown in Fig. 1.

Statistical analysis

The statistical analysis was performed with the Statistical Package for the Social Sciences (SPSS) 20 (SPSS Inc. Chicago, IL, EUA). Results were expressed as mean ± standard deviation and paired samples *t*-test and Wilcoxon matched pairs test was used together to evaluate the level of significance. p value of 0.05 or less was considered significant.

Results

In the two-year period, modification of the medial transposition of split lateral rectus surgeries was performed in our hospital and 8 patients were enrolled in the study. The clinical characteristics of the total CN 3 palsy patients are summarized in Table 1. In this study, there were five men and three women who ranged in age from 7 to 56 years (average 39.4 years). The postoperative follow-up period ranged from 6 to 20 months (mean 11.8 ± 5.8 months).

The mean preoperative deviation was − 42.5 ± 2.7 PD, which decreased to − 1.7 ± 2.6 PD after the operation; this decrease was statistically significant ($p = 0.026$).

Preoperative Botox^{R} injection was performed in all patients. Five patients had histories of stroke, five had ptosis, and one patient had congenital oculomotor nerve palsy. Two cases had previously underwent lateral rectus recession, medial rectus resection, and superior oblique nasal transposition.

The preoperative limitation of ductions in the adduction was − 4.7 ± 0.5 in the patients. The Hess screen test showed a limitation of eye movements in adduction. The forced duction test was positive in three very old cases for preoperative adduction. Postoperative evaluation using the Hess screen test showed improvements to ocular motility (Fig. 2). In the postoperative term, the limitation of adduction was − 3.3 ± 0.8; there was no significant difference in the adduction values before and after the surgery ($p = 0.066$).

The surgery achieved orthotropia or slight esodeviation or exodeviation (less than 14 PD) in the primary position.

At the latest examination, patients had no diplopia in the primary position and were diplopia-free with prismatic glass in the reading gaze. There were no other postoperative complications.

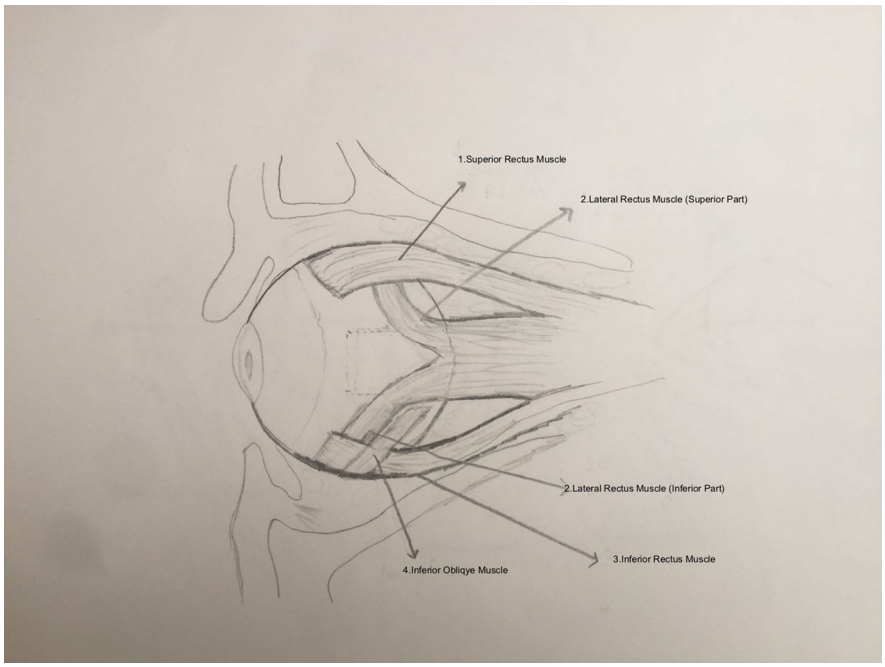

Fig. 1 Schematic presentation of muscle positions

Table 1 Summary of patient demographic data

No	Sex	Age	Eye	History	Preop deviation (PD)	Adduction deficit	Force duction	Postop deviation (PD)	Follow-up time (mount)
1	M	46	R/L	Stroke	40	− 5	Neg	+ 3 ET	6
2	F	46	L	Stroke	45	− 5	Neg	0	12
3	M	37	L	No	40	− 4	Neg	0	20
4	M	56	R/L	Stroke	45	− 5	Neg	0	6
5	F	36	L	Stroke	45	− 4	Neg	0	12
6	F	42	L	No	40	− 5	Neg	0	20
7	M	7	R	Kongenital	50	− 4	+	+ 5 ET	12
8	M	45	R	Stroke	40	− 4	Neg	0	6

Discussion

Cranial nerve palsies are commonly encountered in ophthalmologic and neuro-ophthalmologic practice. In complete CN 3 palsy, the function of four of the six extraocular muscles is compromised, leaving the lateral rectus and superior oblique muscles unopposed. As a result, in the primary position, the affected eye is aligned in an abducted position with slight depression and intorsion. In many cases, concurrent paralysis of the levator palpebra causes ptosis in the same eye [2–4].

In such cases, existing therapeutic options are limited. There are many surgical alternatives, such as large recession and resection, Knapp procedure, muscle transpositions, and orbital fixation. The many techniques for managing CN 3 palsy have been described by various researchers, such as Scott, Helveston, Maruo, and Kaufmann. [5].

Several potential complications happen in the other surgical alternatives for CN 3 palsy, such as under-correction, overcorrection, diplopia, mild anterior ischemic syndrome, and excessive congestion and chemosis over the nasal conjunctiva.

Khaier et al. [6] suggested that using traction sutures combined with a large recess–resect of the horizontal rectus muscles is a safe and effective approach to treat long-standing strabismus in

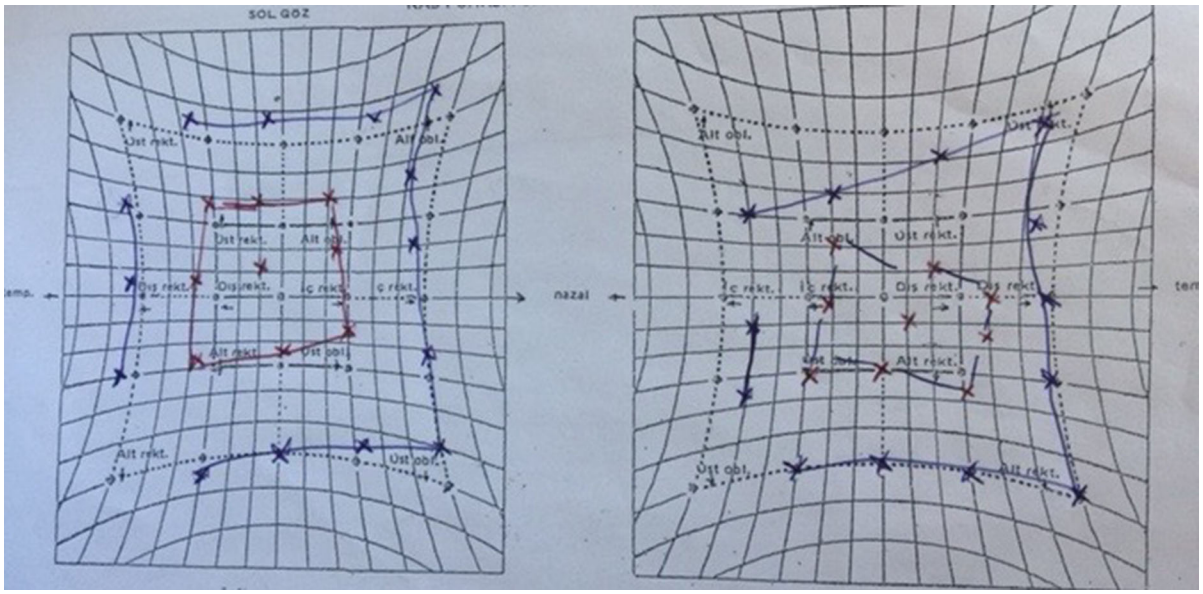

Fig. 2 Hess screen test showed improvements to ocular motility

oculomotor palsy patients. In their study, suture infection, conjunctival hypertrophy, and suture granuloma sometimes developed after the surgery. Morad et al. [7] performed lateral rectus muscle disinsertion and reattachment to the orbital wall, which could result in the reduction of eye movement. Sinskey et al. [8] reported complete lateral rectus muscle excision patients with nystagmus, but their surgery was very invasive.

The latest approach in these cases is Gokyigit's technique, defined by Saxena in 2009 as a modification of the medial transposition of split lateral rectus technique in which the transposition is augmented with the application of an equatorial fixation suture [9]. In Gokyigit's technique, the upper half of the split lateral rectus muscle is passed under the superior rectus–superior oblique complex and the lower half is passed under the inferior rectus and inferior oblique muscles. The split ends are reattached 1 mm posterior to the superior and inferior borders of the medial rectus muscle insertion [2]. Perhaps because of this very close relationship with the lateral rectus muscle arms and vortex veins, choroidal circulation problems can occur with this technique; although we have never encountered this complication, it is seen in the literature.

The limitations of the present study include a small sample size, a retrospective design, and a lack of a controlled study group. Further large series studies should therefore be performed to confirm our conclusions.

The outcomes of the different management options for CN 3 palsy vary. Our aim in this study was to simplify Gokyigit's technique in order to prevent effusion complications, for which this new simplification was successful.

References

1. von Noorden GK, Campos EC (2002) Paralitic strabismus. Binocular vision and ocular motility, 6th edn. Mosby, St Louis, pp 414–457
2. Gokyigit B, Akar S, Satana B, Demirok A, Yilmaz OF (2013) Medial transposition of a split lateral rectus muscle for complete oculomotor nerve palsy. JAAPOS 17(4):402–410
3. Franzco JM (2004) An adjustable medial orbital wall suture for third nerve palsy. Clin Exp Ophthalmol 32:460–461
4. Taylor JN (1989) Surgical management of oculomotor nerve palsy with lateral rectus transplantation to the medial side of the globe. Aust NZ J Ophthalmol 17:27–31
5. Kaufmann H (1991) Lateralis splitting' in total oculomotor nerve paralysis with trochlear nerve paralysis. Fortschr Ophthalmol 88:314–316
6. Khaier A, Dawson E, Lee J (2008) Traction sutures in the management of long-standing third nerve palsy. Strabismus 16(2):77–83

7. Morad Y, Kowal L, Scott AB (2005) Lateral rectus muscle disinsertion and reattachment to the lateral orbital wall. Br J Ophthalmol 89(8):983–985
8. Sinskey RM, Eshete A (2002) Maximal subtotal extirpation of the horizontal rectus extraocular muscles for the treatment of nystagmus with no null point. Binocul Vis Strabismus Q 17:297–303
9. Saxena R, Sinha A, Sharma P, Phuljhele S, Menon V (2009) Precaruncular approach for medial orbital wall periosteal anchoring of the globe in oculomotor nerve palsy. J AAPOS 13(6):578–582