Modified transposition using silicone band for multiple rectus muscle palsies

Arash Mirmohammadsadeghi, Mohammad Reza Akbari, Abolfazl Kasaee, Motahhareh Sadeghi

Farabi Eye Hospital, Tehran University of Medical Sciences, Tehran, Iran

ARTICLE INFO
Keywords:
Silicone band transposition
Rectus muscle palsy
Multiple rectus muscle palsy
Transposition procedure

ABSTRACT
Purpose: To report the results of partial vertical rectus muscle transposition using a silicone band.
Observations: We retrospectively gathered data on two patients with multiple vertical and horizontal extraocular muscle paresis and diplopia who had been treated with vertical rectus muscle transposition with the aid of a silicone band. Both patients had acceptable results on follow-up.
Conclusion: Using the silicone band, we tried to effectively transpose the target muscles to obtain acceptable results.

1. Introduction

Transposition procedures are quite popular in cases of isolated extraocular muscle palsy. The common examples are the various vertical rectus transposition procedures for lateral rectus or medial rectus palsy, and the Knapp procedure for monocular elevation deficiency. However, if multiple muscle paresis is present, using the paretic muscles for transposition might be of no help, since they have no function themselves, and therefore, the management of the strabismus caused by this multiple muscle palsy will be more complicated. Here we provide a method of transposition which was previously reported in the management of 6th cranial nerve palsy,

2. Findings

2.1. Case 1

The first case was a 47-year-old man with a complaint of ptosis and diplopia from 18 months ago. He was diagnosed with an intracranial occipital mass 1 year after initiation of symptoms and underwent craniotomy 6 months before presenting to the strabismus clinic. Best-corrected visual acuity was 20/20 in the right eye and 20/30 in the left eye. Moderate ptosis was obvious in the left eye. The left eye had hypotropia of 20 prism diopters (PD). The left eye was nearly fixed in adduction with limitation in elevation of −4, and limitation in depression of −4 (Fig. 1). The force generation test showed absent force for lateral and superior rectus muscles and a weak force for inferior rectus muscle. The rest of the ocular examination was otherwise normal except for mild optic nerve pallor in the left eye. The diagnosis of concomitant third and sixth cranial nerve palsy was established. In the operating room after general anesthesia, the forced duction test for medial rectus muscle was performed. In addition, a modified partial vertical rectus transposition using a silicone band was performed (Fig. 2). After a 180° limbal conjunctival peritomy, the superior, inferior, and lateral rectus muscles were dissected from the surrounding tissues. The superior and inferior rectus muscles were split into 2 parts, one-third lateral and two-thirds medial, from the insertion to approximately 12 mm posteriorly along the muscle belly, without disturbing the nasal ciliary artery. A circling silicone band, style 240, with a width of 2.5 mm (DORC, Zuidland, Netherland) was placed around the temporal one-thirds of superior and inferior rectus muscles, passing underneath the lateral rectus muscle. The band was tightened manually to draw the temporal halves of the vertical rectus muscle toward the lateral rectus muscle until

Abbreviations: PD, Prism Diopter.
* Corresponding author. Farabi Eye Hospital, Tehran University of Medical Sciences, Qazvin square, Zip code 1336616351, Tehran, Iran
E-mail address: mt.sadeghi@gmail.com (M. Sadeghi).

https://doi.org/10.1016/j.ajo.2022.101720
Received 11 July 2022; Received in revised form 7 September 2022; Accepted 2 October 2022
Available online 9 October 2022
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the globe was held in the primary position. Then, the two ends of the band were fixed to each other using a non-absorbable suture. The band was also fixed to each vertical muscle 8 mm from the insertion, and to the sclera 16 mm from the limbus in superotemporal and inferotemporal quadrants, all using 5/0 non-absorbable sutures (Mersilene, Ethicon, Somerville, NJ), to stay posteriorly at the pulley region to be as effective as possible, and also to prevent anterior migration and exposure. No sleeve was used for band fixation to reduce manipulation during surgery.

Four months after the surgery, the patient had 5 PD left hypotropia with no horizontal deviation in the primary position without diplopia (Fig. 1). The force generation test demonstrated an improved, but weak, abduction force.

2.2. Case 2

A 48-year-old woman was referred to the strabismus clinic with

![Figure 1](image1.png)

**Fig. 1.** Case 1, Up, preoperative photographs in primary position and gazes. Down: postoperative photographs showing improvement in primary position deviation and abduction.

![Figure 2](image2.png)

**Fig. 2.** Schematic figure of modified partial vertical rectus transposition without tenotomy, using a silicone band.
abnormal head posture and diplopia. She had been diagnosed with cerebellar mass 2 years ago and she developed diplopia after cranial surgery for mass removal. The best-corrected visual acuity was 20/20 for the right eye and 20/40 for the left eye. She had a left face turn, due to left gaze palsy, with abduction limitation of –5 in the left eye and adduction limitation of –4 in the right eye. In addition, a limitation in elevation of –4 was observed in both eyes (Fig. 3). The alternate prism-cover test demonstrated 40 PD left Esotropia and 10 PD left hypertropia in the primary position. The force generation test showed absent force for lateral and superior rectus muscles. The forced duction test for the left medial rectus was also moderately positive in this case, so a 7 mm recession was performed for the left medial rectus muscle, combined with a partial transposition of vertical rectus muscles without tenotomy, using a silicone band, in the same manner as the previous case. Two weeks after surgery the abnormal head posture was resolved and the patient had 5 PD hypertropia with no horizontal deviation in the primary position without diplopia (Fig. 3). The results remained stable during four months of follow-up examination.

3. Discussion

Partial and complete rectus muscle transpositions have been used successfully for decades.\cite{2,3} Various modifications have been presented to avoid complications. Adjustable transpositions to prevent induced vertical deviations\cite{4,5} and transposition without tenotomy as in Jensen procedure\cite{6} and Nishida procedures\cite{7} to avoid anterior segment ischemia are some of the examples.

Partial vertical rectus transposition with a silicone band in extraocular muscle palsy was reported in the treatment of lateral rectus palsy.\cite{1} In this modification, without tenotomy of the vertical muscles, the tight horizontal rectus muscle can be recessed simultaneously, hopefully without increasing the risk of anterior segment ischemia. Furthermore, the procedure is theoretically reversible and the band can be removed in cases with overcorrection. In addition, the band circle size can be adjusted intra-operatively to balance vertical and horizontal forces and can be fixated posteriorly to the sclera, to act in the muscle pulley region, to increase the chances of getting more effect from the transposition procedure.

After approval by the Institutional Review Board, we retrospectively...
reviewed the files of two patients with both vertical and horizontal muscle palsy who underwent this modified transposition. Case 1 showed absent force for the superior and lateral rectus and weak force for the inferior rectus muscle. Case 2 showed absent force for superior and lateral rectus muscles. We believe this procedure has made use of vertical muscle tension and the mechanical effect of pulling muscles into the defective field, rather than the force and function of vertical muscles, to bring the eye into the primary position. In both cases, we could not evaluate whether there was any remaining lateral rectus function before surgery, due to a large amount of deviation and the tight medial rectus muscle. But the very small abduction apparent at the postoperative evaluation might demonstrate a very small remaining lateral rectus function which might have been masked by the tight medial rectus.

4. Conclusion

This procedure can be done in cases with combined sixth and third nerve palsy. In contrast to the initial report, no sleeve was used in our cases to fixate the band. So, optimal results can be obtained without the use of a sleeve in this technique. The results of surgery in these two cases were stable in short-term four months follow-up.

Patient consent

Written consent to publish this case has not been obtained. This report does not contain any personal identifying information.

Funding

No funding or grant support.

Authorship

All authors attest that they meet the current ICMJE criteria for

Declaration of competing interest

The authors have no conflicts of interest to declare.

Acknowledgments

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajoc.2022.101720.

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