

# Adjustable muscle plication: a new surgical technique for strabismic patients with high risk for anterior segment ischemia

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## INTRODUCTION

Anterior ciliary arteries provide 70% of the vascular supply of the anterior segment. A significant interruption of the vascular flow of these arteries increases the risk for anterior ischemia. Although the frequency of this special condition is low after strabismus surgery (1:13 000)<sup>[1]</sup>, its effects may involve substantial visual problems<sup>[2]</sup>. We report the successful outcome of a new surgical approach for strabismus management in a case of high risk for anterior ischemia. Specifically, we show the correction of the horizontal ocular deviation by means of an adjustable muscle plication technique based on the Wright method in a patient with a history of III cranial nerve palsy combined with a thyroid myopathy and multiple previous strabismus surgical procedures.

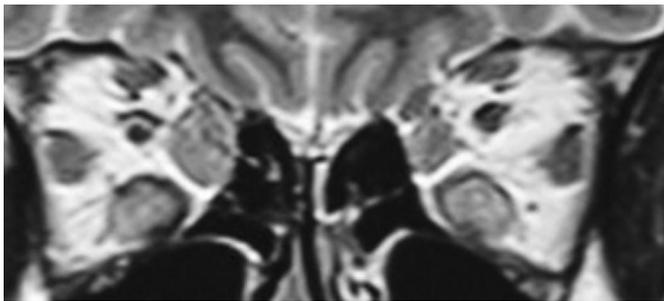
## CASE REPORT

**Preoperative Examination** A woman of 57 years old attended to our clinic seeking for a solution to her provided the results of the neurologic evaluation performed then. This evaluation revealed the presence of stenosis of the left carotid artery (66%), the middle cerebral artery and the posterior cerebral artery, with ischemia of both semioval centers and without evidence of macroscopic muscle alterations using

magnetic resonance imaging (MRI). At 1y after this episode, the patient developed a thyroid-associated orbitopathy with euthyroidism and significant muscle hypertrophy of the medial and inferior rectus muscles of both eyes (Figure 1). After the failure of the medical treatment of this condition, a thyroidectomy was performed.

As ophthalmological antecedents, the patient underwent several surgical interventions for the treatment of her strabismus. The first operation had been performed 5y before and consisted of a recession of 4 mm of the right eye (RE) inferior rectus and a recession of 6 mm of the left eye (LE) superior rectus. A second surgical intervention was performed 2y after this initial procedure and consisted of a recession of 8 mm of the LE medial rectus with reinsertion of the LE superior rectus to the original position. After this, an injection of 10 international units (IU) of botulinum toxin in LE medial and inferior rectus muscles was performed, obtaining a very limited effect. The fourth surgical intervention consisted of a tenectomy of 2/3 of the LE medial rectus and a recession of 6 mm of the LE inferior rectus with an associated tenectomy of a half of this same muscle. Finally, after all these procedures, a LE esotropia of 40 prism diopters with hypotropia of 12 prism diopters remained, with some limitation in the abduction of this eye (grade I).

On our examination, the patient presented a visual acuity of 20/20 in RE with refraction of -1.50 sphere and -1.00×70° cylinder and of 20/30 in LE with refraction of -1.50 sphere and -1.50×150° cylinder. The biomicroscopic exam revealed the presence of a more significant level of phacosclerosis in the LE, without alteration of the intraocular pressure (IOP) and posterior segment. The MRI study at the moment of our examination and also 3y after thyroidectomy did not show relevant signs of thyroid myopathy. The motor study showed RE dominance, LE suppression, and LE esotropia and hypotropia of 40 and 12 prism diopters, respectively. There was also a limitation of the abduction and supra-duction (grade II) in the LE (Figure 2). The passive forced duction test was positive for supra and abduction in the LE, with the same result intraoperatively. The patient suffered some systemic circulatory problems since 2y ago and for this reason she was taking an anticoagulant treatment.



**Figure 1** MRI showing bilateral inferior and medial muscle thickening due to thyroopathy.

**Surgical Technique** Considering the high risk of ischemia of the anterior segment due to the multiple previous interventions and the compromise of the circulatory system of this patient, a new surgical approach was planned. It consisted of a plication of 13 mm of the LE external rectus following the Wright<sup>[3]</sup> technique, but modified using an intraoperative adjustable bow tie-shaped suture that respected the anterior ciliary arteries. This muscle plication was done by using a non-resorbable double-armed suture (Dacron 5-0) and a spatulated needle. The suture was passed at 13 mm of the insertion from the center of the muscle with the help of a Jameson® hook to pull the muscle away from the ocular globe. Likewise, the suture was placed the most distant as possible from the muscle insertion with the help of a Wright<sup>[3]</sup> hook, going through the half thickness of the muscle to its inferior edge (Figure 3). No central knot was performed as there was no risk of muscle loss (Figure 3). The needle was then passed again through the entire muscle thickness as well as through the center of the loop in order to ensure the strength of the suture. After this, the same procedure was performed at the other edge of the muscle with another needle. Following this, the two needles were passed before the insertion using the "crossed-swords" technique and a tunnel of 2 mm was created to have a secure anchorage supporting the traction. Traction of both sutures was then done to achieve the plication of the muscle, and after this a downwards traction was performed to place the knot at the scleral level. Finally, a double loop was performed and held with the surgical needle holder to prevent the slippage of the muscle. After this, a simple turn reverse without undoing the loop was done. Thus, a bow-tie allowing the muscle adjustment was created (Figure 3).

**Postoperative Outcome** After the patient woke up from the sedation, the surgical result was evaluated, not only examining the primary position but also the level of adduction. A micro-exotropia with adduction limitation grade I that did not require adjustment was observed. Then, the loop of the bow-tie was cut and the suture was completed with several turns over the original knot. If an adjustment would have been necessary due to an excess of plication, the

bow-tie could have been undone and the plication reduced until achieving the desired result. In such a case, a double loop would be obtained that should be held with care by means of a needle holder to avoid its slipping (Figure 4). This part of the intervention would not require sedation of the patient and could be done with local anesthesia as the surgical handling does not require the performance of large tractions.

In our case, all the surgical procedure was concluded with the conjunctival closure and the resection of the conjunctival surplus to avoid adding excessive tissue to that produced by the plication without resection. At 1wk postoperatively, the patient has a LE hyoptropia of 8 prism diopters without manifest horizontal deviation (Figure 5A) which was maintained without changes during the two postoperative months (Figure 5B). Likewise, no limitations in the lateral ductions were evidenced postoperatively. At the level of the insertion of the lateral rectus muscle, a bulge was observed initially that was not annoying for the patient and decreased during the first few weeks by regular treatment with corticosteroids and topical antibiotics. The level of cosmetic acceptance by patient was high.

## DISCUSSION

Our patient presented severe circulatory problems that caused a paralysis of the III cranial pair of the RE. She also presented a thyroid ocular myopathy inducing strabismus that was not resolved satisfactorily after multiple interventions. Considering the complexity of the case and that the patient did not authorize the performance of a surgical intervention in the dominant eye, the main risk associated to another surgical intervention in the LE was the induction of an anterior segment ischemia (ASI). According to previous studies<sup>[1,4-6]</sup>, the main risk factors for ASI are advanced age, surgery of the rectus muscles and antecedents of vasculopathy. All these factors were present in our patient.

Considering that some previous surgeries were performed on the vertical rectus muscles, the recession of the medial rectus may have been the most appropriate option from a theoretical point of view. However, this intervention would have increased significantly the risk of ischemia because the medial rectus would have been the fourth muscle surgically handled in this patient with severe circulatory problems. For this reason, a technique of muscle plication was thought to be a potentially useful option in this case as the anterior ciliary arteries would be respected. Another option would have been the performance of a muscle resection respecting the ciliary arteries, but in this case, despite the risk of ASI being minor, would still be present.

As the patient had undergone multiple previous surgical interventions and considering the anxiety expressed by patient, the option of topical anesthesia was discarded. For this reason, a technique of an adjustable muscle plication,



Figure 2 Preoperative status.

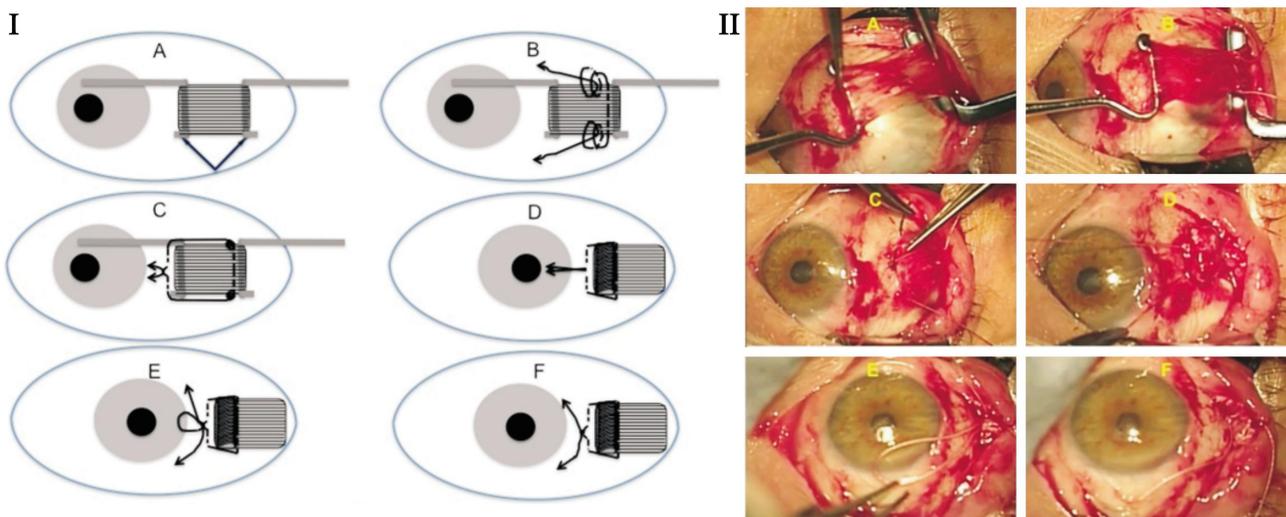


Figure 3 I Surgical technique of the “adjustable” muscle plication (diagram) A: Measurement of the plication; B: Continuous suture in both edges of the muscle; C: Anchorage before the insertion with the “crossed swords” technique; D: Muscle traction and plication with double loop; E: Adjustable bow-tie; F: Cut of the bow-tie and knot over it to ensure the suture.

Figure 3 II Surgical technique of the muscle plication (surgeon view) A: Measurement of the plication; B: Continuous suture at a distal level; C: Anchorage before the insertion with the "crossed swords" technique; D: Muscle plication; E: Bow-tie knot; F: Cut of the bow-tie for a definitive knot.

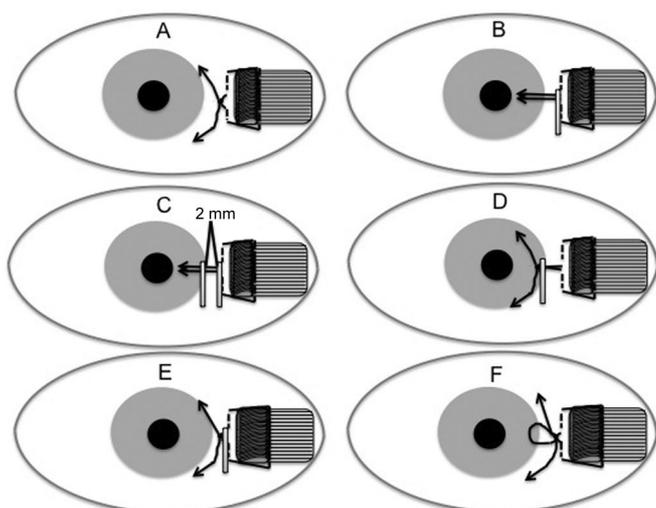


Figure 4 Procedure of adjustment of the muscle plication (diagram) A: The bow-tie is undone, maintaining the initial double loop of the suture; B: Holding with the needle holder; C: Measurement of the distance with a second needle holder; D: Release of the first needle holder; E: Glide of the suture decreasing the plication; F: Performance of an adjustable bow-tie.

avoiding the vascular cauterization and under basal deep sedation was performed. If necessary, an additional adjustment would have been done using topical anesthesia. A bow-tie system was selected for the adjustable procedure and not the slipknot technique [7,8]. Our aim was to use a system avoiding a possible glide of the suture and therefore the weakening of the muscle plication. Initially, a maximal level of muscle plication was planned (13 mm) based on a 40 prism diopters esotropia. This finding was not associated to changes in the refractive status or to intraocular anatomical changes evidenced with imaging techniques, as in other cases reported [9]. Secondary alterations associated to the previous thyroid oculopathy of our patient that generated a certain component of myositis may also have accounted for this correction of the muscle trajectory with its plication. This myositis with chronicity may have degenerated into atrophy leading to fibrosis and loss of elasticity of the external rectus<sup>[10,11]</sup>.

The technique of muscle plication of Wright modified by means of an adjustable system may be an alternative in those



**Figure 5** Postoperative status at 1wk (A) and at 2mo (B).

cases combining a risk for ASI and a potential unpredictability of the surgical outcomes due to parietic antecedents, loss of muscle elasticity secondary to thyroid myopathy and alteration of the muscle axes. This type of surgery must be very meticulous to avoid increasing the risks for ischemia associated to unnoticed vascular damage, but it should only be considered in complex and selected cases. Future studies are required with more patients to define the most appropriate dosage and the results in the long term.

#### ACKNOWLEDGEMENTS

**Conflicts of Interest:** Laria C, None; Piñero DP, None.

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