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Research Article

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Equatorial Scleral Anchor for the Weakening of the Inferior Oblique Muscle

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Abstract

Objective: The study was conducted to evaluate the mid-term effectiveness of anew surgical approach in the reduction of overaction of the inferior oblique muscle.

Methods: A new surgical treatment was developed consisting of suturing the muscle to the sclera at the Gobin's point with tendon sparing by way of a micro-incision to reduce any tissue damage during the surgical procedure and to enhance the healing process. The treatment was evaluated postoperatively in a group of 150 patients with primary or secondary inferior oblique overaction.

Results: All patients experienced a complete resolution of the elevation in adduction, no residual vertical imbalance, lateral incomitance was improved.

Conclusion: The outcome of the new equatorial scleral anchor surgical treatment has been generally accepted as favourable in our study, also if compared with the results yielded by the most frequently used anterior transposition of the inferior oblique muscle. The new surgical treatment appears to be a relatively a less invasive, safe, reversible technique, including the potential to perform the procedure with an adjustable suture.

Keywords

Equatorial scleral anchor; Inferior oblique overaction; Strabismus surgery; Hypertropia; Gobin's point; Inferior oblique weakening; Tendon sparing

Introduction

The aim of the study was to determine the efficacy of a new surgical approach called "equatorial scleral anchor" aimed at reducing overaction of the inferior oblique (IO) muscle. Horizontal strabismus may commonly develop with either primary (commonly occurring with horizontal strabismus) or secondary (usually due to ipsilateral superior oblique paresis) inferior oblique overaction. A previous report of the incidence of hypertropia in pediatric population (younger than 19 years of age) was carried out by Tollefson et al. where the higher rate of hypertropia was associated with the higher prevalence (71.4% of children) of fourth cranial nerve palsy and with primary inferior oblique overaction [1]. Hyperfunction of the IO may predict a potential consecutive exotropia postsurgical procedure for esotropia [2]. The surgical treatment consists of sewing the muscle to the sclera at the Gobin's point with tendon sparing and also performing a micro-incision to limit local tissue trauma and to induce a faster recovery [3,4].

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Methods

A total of 150 patients with overactive inferior oblique muscle were enrolled between March 2012 and March 2015 to receive randomly the Tomarchio-Sabetti procedure or surgical treatment of strabismus with the inferior oblique anterior transposition (IOAT). Patients were divided into two groups: Group I consisted of 82 patients aged 5-51 years (median age 25.6 years) whose entire body of the muscle was sutured onto the sclera in correspondence with the Gobin's point (anteroposition of the inferior oblique muscle with the bulbar insertion to the equator) using a non-absorbable 5-0 GORE-TEX suture with tendon sparing; Group II (control) of 68 patients aged 6-52 years (median age 26.3 years) (IOAT) using an absorbable 6-0 Vycril suture. Subjects underwent a comprehensive ophthalmological and orthoptic examination. Follow-ups were carried out at 1, 3, 6, 12 and 24 months postoperatively. The results we hereby present are at a 24- month follow-up are Tables 1 and 2 report the detailed description of the clinical cases and the angular deviations.

Results

Twenty-one patients (25.6 %) from Group I Vs 18 (26.4%) from Group II reported pain in ocular motility (due to suture fixation), in all cases solved in 14 days. One case of subjective intorsion from Group I was spontaneously solved after 30 days, with no angular modification in primary position. Six patients (7.3%) from Group I showed a milder hypofunction than 8 cases (11.76%) in Group II. In 11 subjects (13.4%) from Group I a mild hyperfunction was observed compared to 11 patients (16.17%) from Group II. No overcorrection and antielevation syndrome was diagnosed following surgery of patients in Group I. In contrast, a hypercorrection along with the presence of the antielevation syndrome was observed in 3 patients (4.41%) from Group II.

All patients recorded a significant reduction in the hyperfunction of inferior oblique muscle. The results in terms of correction in the deviation angle appear to be similar. The only relevant difference observed was the absence of the antielevation syndrome when using the new surgical technique. The deviation results are illustrated in Tables 3 and 4.

Discussion

Recession of the inferior oblique muscle (IO) was indicated by Parks as the most effective and longer lasting procedure for IO weakening [5]. However in the 1970s, anatomical studies introduced new tables for graded muscle recession (8–10 mm IOR corrects 9–15 prism dioptres central gaze hypertropia) [6]. Recently, Metten et al. published a new dose-response study having performed 0.5°/mm up to 1.4°/mm inferior oblique recession procedures [7]. We observed one case of subjective transient intorsion, the randomness of the observation is supported by the numerous studies underlining how the inferior oblique anterior transposition techniques do not determine a potential increase in incyclotorsion [3,5,8-10]. Several studies have been carried out in order to assess the efficacy of inferior oblique surgery in the management of patients with hypertropia [3,6,11,12]. The recession of the inferior oblique muscle showed favourable results in patients with superior oblique palsy exhibiting overelevation in

Table 1: Preoperative Group I (Tomarchio Sabetti Technique).

N. Patients	Deviation	Horizontal Deviation Mean	Vertical Deviation Mean
38	ET and vertical deviation	30.5 PD*	16.5 PD
7	XT and vertical deviation	23.35 PD	14 PD
14	V-pattern XT	29 PD in Upgaze 25.5 PD in Primary gaze	
23	Superior Oblique Palsy		14.7PD

The table shows the patients divided based on different forms of strabismus

* PD = Prism Diopters

Table 2: Preoperative Group II (control group, inferior oblique anterior transposition IOAT).

N. Patients	Deviation	Horizontal Deviation mean	Vertical Deviation Mean
30	ET and Vertical Deviation	29.8 PD	16.5 PD
8	XT and Vertical Deviation	24.15 PD	14.8 PD
12	V-pattern XT	30.5 PD in Upgaze 23.5 PD in Primary Gaze	
18	Superior Oblique Palsy		14.2 PD

Table 3: Group I at a 24-month postoperative follow-up.

N. Patients	Deviation	Horizontal Deviation mean	Vertical Deviation Mean
38	ET and Vertical Deviation	10.5 PD	4 PD
7	XT and Vertical Deviation	5.5 PD	6.2 PD
14	V-pattern XT	20.1 PD in Upgaze 6 PD in Primary Gaze	
23	Superior Oblique Palsy		4.2 PD

Table 4: Group II at a 24-month postoperative follow-up.

N. Patients	Deviation	Horizontal Deviation mean	Vertical Deviation Mean
30	ET and Vertical Deviation	10 PD	4.5 PD
8	XT and Vertical Deviation	5.8 PD	6.1 PD
12	V-pattern XT	20 PD in Upgaze 6.3 PD in Primary gaze	
18	Superior Oblique Palsy		4.4 PD

adduction [12]. Morover, Parks reported lower recurrence rates of overaction following inferior oblique muscle recession [5]. Due to its anatomical position, IO works as an extorter and elevator muscle, in order to make our recession with anterior Gobin's position procedure effective in reducing the IO overaction, it was necessary that all posterior body fibers were fully hooked. We must suture the muscle closer to the inferior rectus in order to increase the depression**.** The insertion of the IO near the lateral rectus increases the action of abduction with an effective action of depression. If the IO is wrongly transposed in a slightly more advanced position with respect to the equator and closer to the inferior rectus muscle insertion, it will start working as an intortion tonic depressor muscle with a resulting anti-elevation syndrome. Equally to further increase the capacity of the depression, it is possible to insert the non-absorbable suture in the muscle further away from the scleral insertion of the inferior oblique and to suture it at the sclera beyond the equator line, with the risk of an anti-elevation syndrome. The obtained IO muscle weakening is due to two different mechanisms: anchor at the Gobin's point (as in the recession shifted forward procedure) and reduction of the total muscle length. The IO muscle measured from the lacrimal crest of the maxillary bone at its insertion point on the inferior-lateral quadrant of the sclera into the rear hemisphere is sized 37 mm and thanks to our surgical technique the entire muscle is working actively on the Gobin's point. If we consider that the portion between the scleral point and the site of the suture insertion is approximately 11 mm long, the final muscle active portion we reached is therefore 26 mm (37mm-11mm = 26mm). On the contrary in the IOA procedure, the final muscle active portion obtained with the normal recession shifted forward treatment is the whole muscle (37 mm). In conclusion, the equatorial scleral anchor produces the same anatomical result of an 11 mm IO muscle resection but with the benefit of not having to cut the muscle and it provides also a considerably greater improvement compared with the well-known recession shifted forward procedure.

Conclusion

Whilst the technique could still be improved and refined, it offers additional benefits such as no or minimal risk of developing vorticose haemorrhage, of hooking the muscle with the lateral rectus muscle, of post-surgical adherence and no risk of anti elevation syndrome. The new technique offers the advantages of being simple, safe, reversible and modular in terms of suturing. The classic inferior oblique anterior transposition technique provides a similar outcome but with the limited risk of antielevation syndrome. The equatorial scleral anchor procedure can be also performed through micro-incision, minimizing related tissue trauma, inducing a faster recovery and reducing the risks of a postoperative adherence syndrome

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Top

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