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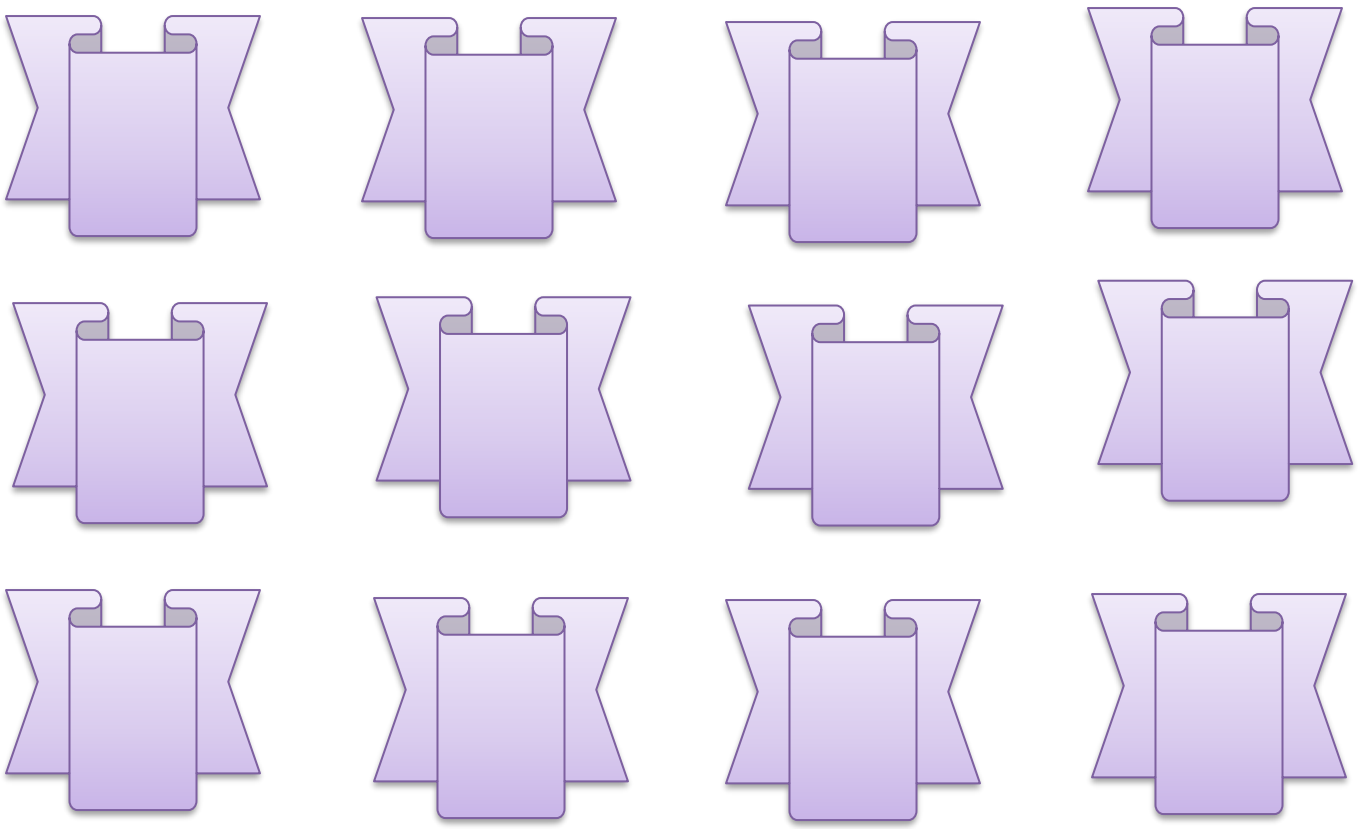

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Original Article

Comparative Study between Inferior Oblique Muscle Standard Anteriorization versus Myectomy in Primary Inferior Oblique Over Action

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ABSTRACT

Background: Surgical procedures for the treatment of intraosseous adhesions [IOOAs] have included a variety of approaches, such as disinsertion, recession, myectomy, and anterior transposition.

The Aim of the work: This study aimed to compare between inferior oblique muscle standard anteriorization versus myectomy in primary inferior oblique over action.

Patients and Methods: This prospective comparative non randomized interventional study was conducted on 40 eyes. Patients were divided into two equal groups, Group A were treated by inferior oblique standard anteriorization, and Group B were treated by inferior oblique myectomy

Results: In terms of the degree of IO overaction, at the baseline the two groups were comparable with no significant difference [P =0.7], 30% of the patients in group 1 versus 40% of the patients in group 2 were mild, 55 % of the patients in group 1 versus 45% of the patients in group 2 were moderate, and 15 % of the patients in group 1 versus 15 % of the patients in group 2 were severe. At 1-week post-operative the IO overaction was disappeared in all patients except one patient in group 2 was +1 IO. At 1, 3, 6 months postoperative, The IO disappeared in 90% of patients in both groups, 5% of the patients in group 1 versus 10% of the patients in group 2 were +1 IO, and only 5% of the patients in group 1 were +2 IO.

Conclusion: We have found both standard anteriorization and distal myomectomies of the inferior oblique muscle to be equally successful in weakening the inferior oblique muscle overaction but in severe cases [+4 IOOA].

Keywords: Standard Anteriorization; Inferior Oblique Over Action; Myectomy.

INTRODUCTION

Inferior oblique muscle over action [IOOA] is a common ocular motility disorder. IOOA manifests by overelevation of the eye in adduction and is frequently associated with horizontal deviations [1]. The initial and secondary forms of IOOA are different. The etiology of the primary type is often unknown and affects both sides of the body, whereas the secondary type affects only one side and is brought on by either the ipsilateral or contralateral superior rectus palsy [2].

The surgical correction of IOOA involves the weakening of the inferior oblique [IO] muscle. Various techniques have been employed for the surgical treatment of inferior oblique overaction [IOOA] since Duane's initial description of a transcutaneous tenotomy [myotomy] at the origin of the muscle. These techniques include disinsertion, recession, myectomy, anterior transposition, and extirpation and denervation of the inferior oblique muscle. Nevertheless, there is ongoing debate regarding the optimal approach to weakening IO [3].

Anterior transposition of the inferior oblique muscle is a highly effective method for treating inferior oblique overaction [IOOA], particularly in cases of severe IOOA and/or concurrent dissociated vertical deviation [DVD] [4]. However, if the surgery is done on only one eye, it may be complicated by a restriction in the upward movement of the eye in its normal position, a condition called primary position hypotropia. When the surgery is done on both eyes, it may lead to a limitation in the upward movement of the eyes when looking to the side, causing a Y- or V-shaped pattern, which is known as anti-elevation syndrome. It can also have an impact on torsion [5].

Inferior oblique myectomy is commonly employed to weaken the inferior oblique muscle due to its ease, convenience, and lower likelihood of surgical complications during the operation, as it does not necessitate the reattachment of the muscle to the sclera. Nevertheless, numerous surgeons are hesitant to endorse it due to the potential for muscle reattachment and subsequent recurrence of overaction. Furthermore, it can lead to postoperative reduced function and opposite-side inward turning of the eye in situations where there is unilateral inward turning of the eye. Ultimately, it could be further complicated by adherence syndrome [6].

This study aimed to compare between inferior oblique muscle standard anteriorization versus myectomy in primary inferior oblique over action.

PATIENTS AND METHODS

Forty eyes with possible horizontal strabismus [esodeviation, exodeviation] and primary inferior oblique over action were included in this prospective comparative non-randomized interventional study. Two equal groups of patients were treated: one with inferior oblique standard anteriorization [Group A] and another with inferior oblique myectomy [Group B]. The research took place at the Damietta branch of Al-Azhar University Hospital. Informed written consent was obtained from every participant or their legal guardians a. The study protocol was approved by the Ethics Board of Al-Azhar University and followed the principles of the Declaration of Helsinki.

The Exclusion criteria were: [1] Patient refuse to participate in the study, [2] Grade 1 IOOA, [3] Secondary inferior oblique over action, [4] Inferior oblique over action with dissociated vertical deviation [DVD], and [5] Recurrent or residual inferior oblique over action.

Data collection: All included patients underwent the following; 1] complete medical history taking. 2] Assessment of vision with and without correction by methods appropriate for the patient's age. 3] Ductions and versions which were evaluated in the 6 cardinal directions of gaze. 4] Measurement of the angle of deviation for distant and near fixation with and without correction using both krimsky method and alternate prism cover test, angle of horizontal deviation was measured in the primary, chin up, and chin down positions. If there is vertical deviation [hypertropia] it was measured with prisms base down, also angle of hypertropia was measured in adduction whenever possible. V pattern is considered significant when the angle of horizontal deviation in chin up is more of about > 15 than the angle in chin down. 5] Fundus examination, Cycloplegic refraction, and Treatment of amblyopia were done before the operation. 6] Searching for DVD in all cases by noting slow depression of the affected eye after removal of cover over it with no associated corrective hypotropic movement in the other eye. Associated inferior oblique overaction with DVD was diagnosed by allowing the DVD to become fully manifest behind cover without

removing cover observe for more elevation as the eye is adducted.

Surgical techniques

Group I [patients underwent inferior oblique Standard anteriorization]

Traction conjunctival suture at the lower temporal limbus. To maintain the eye in a position of maximum adduction and elevation [Figure 1A]. Creating an inferotemporal incision of conjunctiva and Tenon's capsule. The conjunctiva is incised 8 mm from the limbus parallel to the lid margin, Tenon's capsule is then incised perpendicular to the conjunctival incision [Figure 1B]. Inferior oblique muscle is exposed by placing hooks into the wound one along the inferior border of the lateral rectus and one just temporal to the inferior rectus. The hooks are lifted away from the sclera and towards the orbital rim [Figure 1C]. The inferior oblique muscle is thus, visualized together with the inferotemporal vortex vein which exist from the sclera and passes just posterior to the inferior oblique muscle as it enters Tenon's capsule. Identification of the inferotemporal vortex vein is important to avoid damaging it [Figure 1D]. A muscle hook is inserted posteriorly, parallel to the sclera and its tip is rotated 90° to clearly engage the posterior border of the inferior oblique [Figure 1E]. The muscle is elevated into the wound on the hook, along with adjacent Tenon's capsule and intermuscular septum. This additional tissue is gently "off-loaded" with toothed forceps [Figure 1F].

Once all Tenon's capsule and intermusclar septum have been removed from the hook and the posterior border of the muscle is clearly visible as pink/white junction at the tip of the steven's hook. The intermuscular septum is incised with Westcott scissors. In addition, a small hook is placed along the inferior border of the lateral rectus muscle to isolate the intermuscular septum that connects the inferior oblique and the lateral rectus. The insertion is then carefully cleaned of intermuscular septum with blunt Westcott scissors. At the completion of this step, the entire insertion is inspected and should be clearly visible without fascial attachments. The insertion is clamped on a hemostat and excised from the sclera prior to further surgical manipulation. When the entire muscle insertion has been transected, the inferior oblique insertion is lifted out from the wound to be secured with 6-0 vicryl double armed suture [Figure 2A]. The muscle insertion site is re-inspected to make sure that no residual fibers of the inferior oblique were left behind which can result in persistence of inferior oblique overaction. The inferior recuts muscle is then secured through the wound with a hook and the sclera is exposed just posterior and temporal to the inferior rectus insertion with a hook. The new insertion is located just temporal to inferior rectus muscle by double or med spatulated ¼ circle [Vicryl 6- 0] [Figure 2B]. Closure of Tenon's capsule and conjunctiva in separate layers with 6-0 vicryl sutures [Figure 2C].

Group II [patients underwent distal myectomy of the inferior oblique]

The Surgical steps are similar to a recession until the inferior oblique is isolated under direct visualization. A buttonhole in Tenon's capsule at the posterior edge of the inferior oblique muscle is made with scissors. Another muscle hook is then placed under the inferior oblique through the button hole in Tenon's capsule and both hooks are moved along the inferior oblique muscle in opposite directions to lift up the part of the muscle between the inferior rectus and lateral rectus [Figure 3A]. A 'hemostat is used to clamp the muscle as far towards the inferior rectus as possible and another hemostat is used to clamp the muscle as far towards the lateral rectus as possible [Figure 3A]. The part of the inferior oblique muscle between the two clamps is excised. The cut edges are cauterized. Tuking of inferior oblique proximal stump into Tenon's capsule was done to prevent reinsertion of muscle on sclera. Closure of the conjunctiva with 6-0 vicryl sutures [Figure 3C].

Post-operative follows up: Patients were followed up for first day, first week, first month and third month, follow up examination included: Taking photographs, Ductions and versions, Alignment in primary position, chin up, chin down were evaluated either by alternate prism and cover or by krimsky method in infants, Searching for DVD, and Searching in other eye IO overaction in unilateral cases. Cases were considered successful if: 1] Inferior oblique overaction was normalized [elevation in adduction]. 2] V pattern was corrected it was present. 3] Hypertropia in primary position was corrected [not more than 4 prism diopters].

Statistical analysis: Data entry and statistical analyses was performed using SPSS [statistical package of social sciences] version

26 [SPSS Inc., Chicago, IL, USA]. The statistical information for quantitative data was presented as mean ±SD [standard deviation]. When comparing customarily distributed data between two arms, the independent sample T-test [t] was employed. Paired data were analyzed using the paired t test. Qualitative data were analyzed using the chi-square test and were presented as numbers and percentages.

RESULTS

Our study included 24 patients divided into two groups. The two groups were matched for age and gender [P value > 0.05 for both] [Table 1].

As regards the type of ET, 58.3% of the patients in group 1 and 72.1% of the patients in group 2 were congenital ET, 41.6% of the patients in group 1 and 27.2% of the patients in group 2 were acquired ET, with no statistically significant difference between the two groups [P = 0.4]. According to the Type of error of refraction, all patients were hypermetropic except 1 patient in group 2 was myope [Table 2].

In terms of the degree of IO overaction, at the baseline the two groups were comparable with no significant difference [P =0.7], 30% of the patients in group 1 versus 40% of the patients in group 2 were mild, 55 % of the patients in group 1 versus 45% of the patients in group 2 were moderate, and 15 % of the patients in group 1 versus 15 % of the patients in group 2 were severe. At 1-week post-operative the IO overaction was disappeared in all patients except one patient in group 2 was +1 IO. At 1, 3, 6 months postoperative, The IO disappeared in 90% of patients in both groups, 5% of the patients in group 1 versus 10% of the patients in group 2 were +1 IO, and only 5% of the patients in group 1 were +2 IO [Table 3].

As regards the V pattern, at the baseline, it was absent in 50% of the patients in group 1 versus 40 % of the patients in group 2. It was 10 D in 10 % of the patients in group 1 versus 15% of the patients in group 2, 15 D in 15% of both groups, 20 D in 15% of both groups, 25D in 5 % of the patients in group 1 versus 10% of the patients in group 2, AND 30D in 5% of both groups. The difference between the two groups regarding the preoperative V pattern was not significant statistically [P = 0.9]. Postoperatively [at 1 week, 1 month, 3 months and 6 months], the V pattern disappeared in 95% of the patients in group 1 versus 90% of the patients in group 2 [P value > 0.05 for both] [Table 4].

According to the VD pattern, preoperatively, it was present by a degree of 3D, 4D, 5D in 5% of the patients in group 1 versus 0% of the patients in group 2, 5% of the patients in group 1 versus 10% of the patients in group 2, and 10% of the patients in group 1 versus 10% of the patients in group 2 respectively, with no statistically significant difference between the two groups [P value = 0.7]. At all postoperative periods, it was disappeared in 95% of the patients in group 1 versus 90% of the patients in group 2 [P value > 0.05 for all] [Table 5].

As regards the HD, it was decreased from 41.5 ± 14.5 in group 1, and 44.2 ±15.2 ingroup 2 preoperatively to 0 postoperatively [P =0.001] [Table 6].

The success rate of the patients in both groups was 90%, with 10 % of the patients in group 1 and 5% of the patients in group 2 with residual over activity. Only 1 patient in group 2 was reported as IO under action [Table 7].

Table [1]: Demographic data of the studied patients

	Variables	Total [n = 24]	Group 1 [n= 12 patients]	Group 2 [n= 12 patients]	P value
Age [years]	**Median [IQR]**	4 [3 – 6]	4 [3 – 6]	4.25 [3.25 – 6.75]	0.9[a]
	Range	2.5 – 16	2.5 – 15	2.5 – 16	
Gender, No. [%]	**Male**	14 [58.3%]	7 [58.3%]	7 [58.3%]	1[b]
	Female	10 [41.7%]	5 [41.7%]	5 [41.7%]	

a: independent t test. **b:** Chi square test. Percentage per column. IQR: Inter quartile range

Table [2]: Comparison between the 2 study groups regarding the type of esotropia and Errors of refraction

	Variables	Group 1 [n= 12 patients]	Group 2 [n= 12 patients]	P value [a]
Type of ET, N [%]	Congenital	7 [58.3%]	8 [66.6%]	0.4
	Acquired	5 [41.6%]	3 [25%]	
Error of refraction, N [%]	Hypermetropia	8 [66.6%]	6 [50%]	0.7
	Myopia	0 [0%]	1 [8.3%]	

a: Fisher exact test. Percentage per column

Table [3]: Comparison between the 2 study groups regarding the degree of IO overaction

Variables. N [%]		Group 1 [n= 20 eyes]	Group 2 [n= 20 eyes]	P value
Preoperative	Mild [+2]	6 [30%]	8 [40%]	0.7 [a]
	Moderate [+3]	11 [55%]	9 [45%]	
	Severe [+4]	3 [15%]	3 [15%]	
1 week postoperative	Absent	20 [100%]	19 [95%]	1 [b]
	[+1]	0 [0%]	1 [5%]	
1 month postoperative	Absent	18 [90%]	18 [90%]	
	[+1]	1 [5%]	2 [10%]	
	[+2]	1 [5%]	0 [0%]	0.5 [a]
3 months postoperative	Absent	18 [90%]	18 [90%]	
	[+1]	1 [5%]	2 [10%]	
	[+2]	1 [5%]	0 [0%]	0.5 [a]
6 months postoperative	Absent	18 [90%]	18 [90%]	0.5 [a]
	[+1]	1 [5%]	2 [10%]	
	[+2]	1 [5%]	0 [0%]	

a: Chi square test. b: Fisher exact test. Percentage per column

Table [4]: Comparison between the 2 study groups regarding the V pattern

Variables. N [%]		Group 1 [N= 20 eyes]	Group 2 [N= 20 eyes]	P value [a]
Preoperative	Absent	10 [50%]	8 [40%]	
	10 D	2 [10%]	3 [15%]	
	15 D	3 [15%]	3 [15%]	0.9
	20 D	3 [15%]	3 [15%]	
	25 D	1 [5%]	2 [10%]	
	30 D	1 [5%]	1 [5%]	
1 week postoperative	Absent	19 [95%]	18 [90%]	
	4 D	0 [0%]	1 [5%]	0.5
	5 D	1 [5%]	1 [5%]	
1 month postoperative	Absent	19 [95%]	18 [90%]	
	4 D	0 [0%]	1 [5%]	0.6
	5 D	1 [5%]	1 [5%]	
3 months postoperative	Absent	19 [95%]	18 [90%]	
	4 D	0 [0%]	1 [5%]	0.6
	5 D	1 [5%]	1 [5%]	
6 months postoperative	Absent	19 [95%]	18 [90%]	
	4 D	0 [0%]	1 [5%]	0.6
	5 D	1 [5%]	1 [5%]	

a: Chi square test

Table [5]: Comparison between the 2 study groups regarding the VD pattern

Variables. N [%]		Group 1 [N= 20 eyes]	Group 2 [N= 20 eyes]	P value [a]
Preoperative	Absent	16 [80%]	16 [80%]	0.7
	3 D	1 [5%]	0 [0%]	
	4 D	1 [5%]	2 [10%]	
	5 D	2 [10%]	2 [10%]	
1 week postoperative	Absent	19 [95%]	18 [90%]	0.6
	4 D	0 [0%]	1 [5%]	
	5 D	1 [5%]	1 [5%]	
1 month postoperative	Absent	19 [95%]	18 [90%]	0.6
	4 D	0 [0%]	1 [5%]	
	5 D	1 [5%]	1 [5%]	
3 months postoperative	Absent	19 [95%]	18 [90%]	0.6
	4 D	0 [0%]	1 [5%]	
	5 D	1 [5%]	1 [5%]	
6 months postoperative	Absent	19 [95%]	18 [90%]	0.6
	4 D	0 [0%]	1 [5%]	
	5 D	1 [5%]	1 [5%]	

a: Chi square test

Table [6]: Comparison between the 2 groups regarding HD

HD	Group 1 [N= 20 eyes]	Group 2 [N= 20 eyes]	P value [a]
Preoperative	41.5 ± 14.5	44.2 ±15.2	0.56
Postoperative	0	0	-
P value [b]	0.001*	0.001*	

a: Independent sample t test. b: Paired sample t test

Table [7]: Comparison between the 2 groups regarding the success rate and postoperative complications

Variables	Group 1 [N= 20 eyes]	Group 2 [N= 20 eyes]	P value
Success rate	18 [90%]	18 [90%]	1
Residual over activity	2 [10%]	1 [5%]	0.51
IO under action	0 [0%]	1 [5%]	0.31

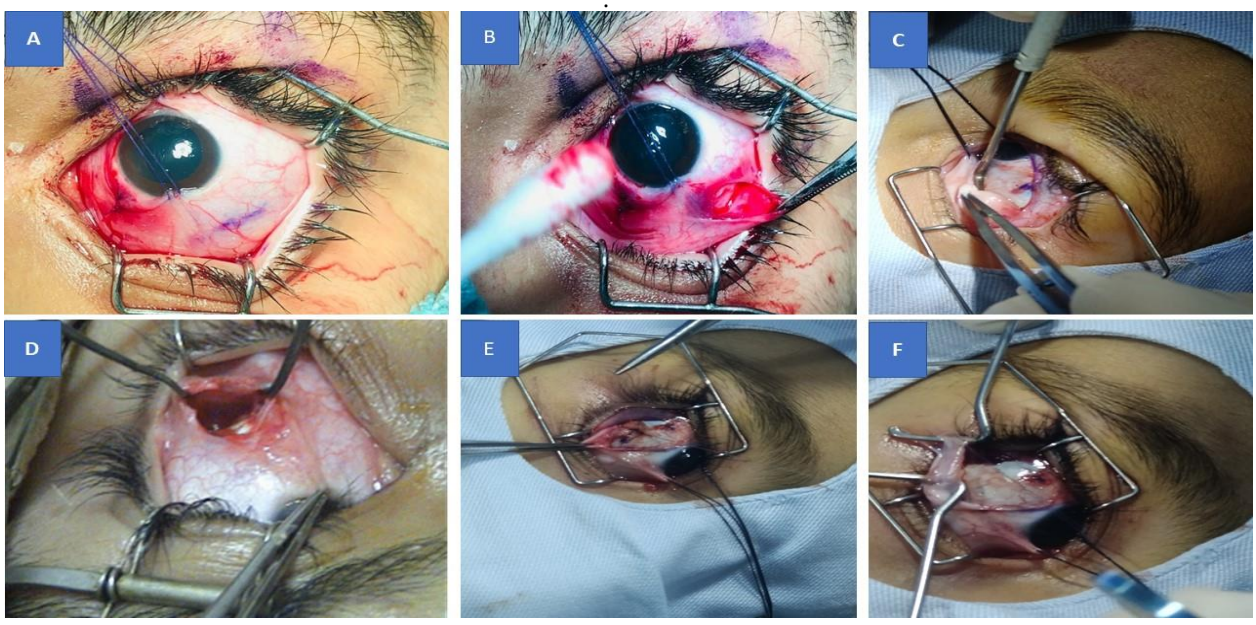

Figure [1]: A] Marking of conjunctiva. B] The conjunctiva is incised 8mm from the limbus parallel to the lid margin. C] Inferior oblique muscle is exposure. D] The inferior oblique muscle visualization together with the inferotemporal vortex vein. E] Muscle hook insertion posteriorly, parallel to the sclera. F] Stretching of the muscle by 2 strabismus hooks.

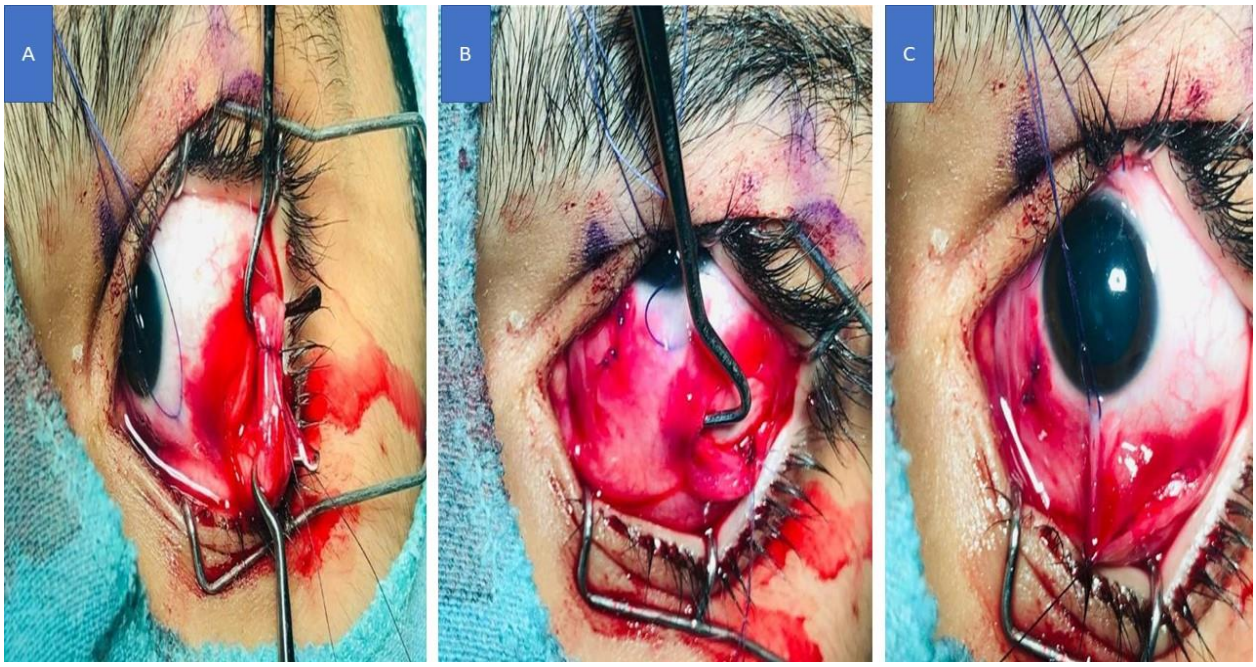

Figure [2]: A] Suturing of the muscle as far as possible by vicryl double armed spatulated [6 – 0]. B]. B] Suturing of the muscle lateral to temporal to IR armed. C] Closure of the conjunctiva.

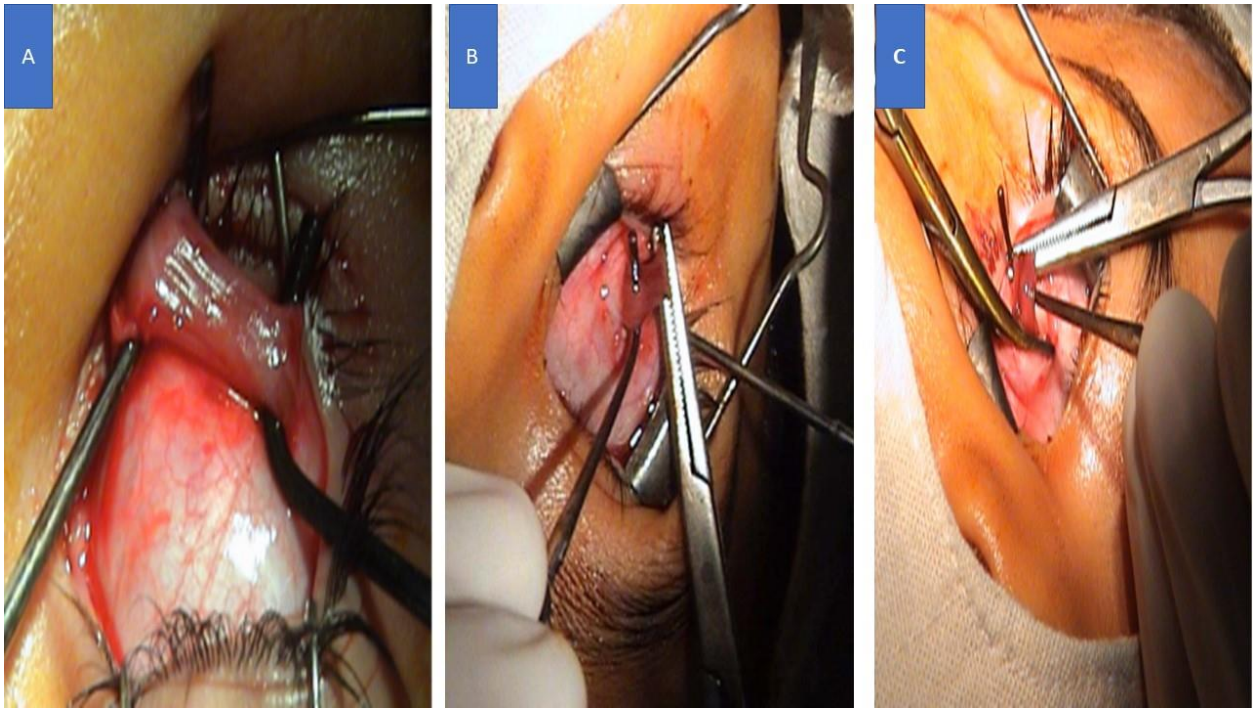

Figure [3]: A] Hoking of the muscle. B] Insertion of 2 hemostatic clamp. C] Cutting of segment in between.

DISCUSSION

The effectiveness of inferior oblique myectomy and anterior transposition in reducing the strength of the inferior oblique muscle was found to be comparable in this study. The success rate in both groups was 90%, while the residual overactivity was 10% in group 1 and 5% in group 2. There was no statistically significant difference observed between the two groups [P value = 0.5].

A study done by **Nabie *et al.*** [7], discovered that both surgical techniques effectively reduce the strength of IOOA. However, the myectomy procedure exhibited a higher rate of weakening during follow-up visits and yielded superior outcomes, which contradicts our own findings. Another study done by **Rajavi *et al.*** [8] demonstrated a significant improvement in IOOA, with 61.9% of eyes in the myectomy group and 67.5% of eyes in the classic recession group achieving a grade of 0 or +1.

Sanjari *et al.* [9] also reported the same effectiveness of myectomy and anterior transposition on IOOA correction, however, their success rates were higher than ours. In **Ghazawy *et al.*** [10], both surgical procedures [inferior oblique myectomy and anterior transposition] were effective in correcting IOOA. In contrast, **Min *et al.*** [11] reported a success rate of 25% for the myectomy method, and 75% of the cases operated with this method showed significant residual overaction.

This difference between the reported studies and our results may be explained by the different sample sizes of each study, and the definition of successful operations, in some studies post-operative overaction grade of +2 or less is the standard for success, while in other studies, the slandered for success was less than + 1.

In terms of the V pattern, it was present in 50% of the patients with Myomectomy, and 60% of the patients with anterior transposition preoperatively. These percentages were decreased to 5% in myomectomy and 10% in anterior transposition postoperatively with no statistically significant difference between the 2 groups. This result comes in line with **Rajavi *et al.*** [12], who found no significant difference between the 2 groups neither preoperatively nor postoperatively regarding the presence of the V pattern. However, the percentages of patients with V pattern in myomectomy and anterior transposition groups in **Rajavi *et al.*** [12]'s study at the baseline were higher than our percentages [67.9% and 71.4% vs. 50% and 60% respectively]. Postoperatively, the improvement regarding the V pattern in our study was higher in both groups of our study than [95% and 90% vs. 85.5% and 89.3%].

Another study done by **Yang *et al.*** [13] found that Myomectomy improves the V pattern in 90% of the cases with IOOA which is in line with our finding. **Kasem *et al.*** [14] studied 40 primary IOOA of all grades of patients with esotropia or exotropia who underwent IO retro-equatorial myopexy and myectomy. They found that myomectomy had a greater impact on collapsing the V-pattern associated with IOOA compared to eliminating IOOA.

In terms of the postoperative complications, we reported that 10% of the myomectomy and 5% of the anterior transposition had residual overactivity, and only 5% of the anterior transposition had postoperative inferior oblique overaction. These results were comparable to **Rajavi *et al.*** [8], who reported residual overactivity in 12.8% of the myomectomy group and 5.8% in the anterior transposition group. Also, **Yang *et al.*** [13] reported a 12.8% incidence of residual overactivity in patients undergoing myomectomy. Unlike **Min *et al.*** [11] who reported that 75% of the myomectomy patients in their study developed residual overactivity. Another study was done by **Ozsoy *et al.*** [1], who included 94 patients [134 eyes] with IOOA divided into 2 groups [myomectomy and recession], they reported residual overactivity in 2.5% of the myomectomy group and 3.1% of the recession group which is lower than our results. The difference between the studies in the percentage of residual activity may be due to the difference in the preoperative degree of overaction or the difference in the definition of the overaction and underaction or missing all or part of the posterior leaf of the muscle or anatomic variations of the inferior oblique muscle or scarring of the cut ends of the muscle to the sclera.

According to the Vertical Deviation of the patients in the 2 groups, we found that 100% of the patients in each group had VD pre-operatively. However, this percentage was decreased to 5% in myomectomy and 10 % in anterior transposition which is in agreement with **Sefi-Yurdakul and Gucyetmez** [15].

In comparing the two surgical procedures from the technical point of view, myectomy was found to be easier to perform because it did not entail severing the muscle at its insertion, which practically overlies the macula. It was also found to be a shorter procedure because it did not involve taking sutures in the inferior oblique insertion and securing the muscle to a new position related to the inferior rectus muscle. In the myectomy procedure, meticulous cauterization of the cut edges is, however, needed. Otherwise, significant bleeding from the muscle edges is liable to occur intraoperatively. A substantial subconjunctival hematoma may result postoperatively. In both procedures careful dissection to avoid opening the fat pad related to the inferior oblique is needed. Identification of the inferior temporal vortex vein should be done in every case to avoid damaging it during the procedure. Subconjunctival hemorrhage and lower lid edema were early post-operative complications encountered in 2 cases in the myectomy group immediately postoperatively and resolved completely at the end of the 3rd week [16].

Although the high quality of our study, it is not free of limitations, which include, a small sample size, and short follow-up periods.

Conclusion: We have found both standard anteriorization and distal myomectomies of the inferior oblique muscle to be equally successful in weakening the inferior oblique muscle overaction but in severe cases [+4 IOOA]. Complications of both procedures were avoided in this study by careful dissection of the muscle to avoid fat adherence syndrome and adequate cauterization of the cut muscle edges to avoid postoperative hemorrhage.

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