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*International Journal of Current Research*
*Vol. 10, Issue, 02, pp.65939-65942, February, 2018*

**INTERNATIONAL JOURNAL OF CURRENT RESEARCH**

**ISSN: 0975-833X**

## RESEARCH ARTICLE

# OUTCOME OF MANAGEMENT OF INFERIOR OBLIQUE INCLUSION SYNDROME ASSOCIATED WITH RECURRENT STRABISMUS

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**ARTICLE INFO**

***Article History:***
Received 21st November, 2017
Received in revised form
10th December, 2017
Accepted 25th January, 2018
Published online 28th February, 2018

***Key words:***
Inferior oblique inclusion syndrome,
Lateral rectus surgery,
Inferior oblique surgery.

**ABSTRACT**

**Purpose:** To evaluate outcome and describe the management of inferior oblique inclusion associated with recurrent strabismus.

**Methods:** Twenty two patients reoperated upon lateral rectus muscles for correction of horizontal deviation (residual or recurrent exotropia or esotropia) with abnormal vertical deviation (hypotropia or hypertropia) that suspect inferior oblique inclusion or diagnosed during reoperation. Each patient was managed with release of inferior oblique along with appropriate horizontal muscle surgery.

**Results:** After release of the inferior oblique muscle the vertical deviation reduced in primary positions from 15±7.3 PD to 7.5 ±4.3 ($P<0.001$) in patients with hypotropia and from 16±6.3PD to 8.5 ±3.6 ($P<0.001$) in patients with hypertropia, with stability of ocular alignment for a minimum of 6 months. Inferior oblique muscle was released only without recession or anteriorization in 8 patients (36.2%) and recessed from1mm to 4mm in 7patients (31.8%) and anteriorization was done in 7 patients (31.8%).

**Conclusion:** Release of inferior oblique from lateral rectus had good favorable outcome was achieved only in cases with partial inclusion with low scores of fibrosis. Limitation of vertical movement could not be completely resolved in cases with total inclusion with marked fibrosis. Inferior oblique inclusion is preventable complication if taken in consideration during surgery on the lateral rectus muscle.



**Citation: Mahmoud A Saleh and Nour Elden A Abdelhalim, 2018.** "Outcome of management of inferior oblique inclusion syndrome associated with recurrent strabismus", *International Journal of Current Research*, 10, (02), 65939-65942.

## INTRODUCTION

After operation for horizontal strabismus a vertical deviation or deficiencies of vertical rotation are significant predictors of inferior oblique inclusion into the lateral rectus insertion. (Eugene and Helveston, 2005) In more than one-third of lateral rectus muscles that re operated after previous lateral rectus recession or resection, the inferior oblique is found attached to the inferior insertion of the lateral rectus. Patients with this complication may have a hyperdeviation or hypodeviation of that eye in the primary position but usually have limited elevation and sometimes depression. There may also be limitation of adduction. (Davis and Biglan, 2002) The inferior oblique muscle is inserted beneath the inferior border of the lateral rectus muscle, approximately 12 mm from the insertion of the lateral rectus. Operative dissections show that a definite and constant fascial septum exists between the sheaths of the inferior oblique and the lateral and inferior recti. (Helveston *et al*., 1988; Moen and Marsh, 1998; Cline *et al*., 2005) When a muscle hook is placed under the lateral rectus muscle it may snag the septum and kink the inferior oblique and cause its inclusion. Re-operation to free the inferior oblique fibers often fails to reduce the vertical deviation, and hence there is a need for careful dissection of the inferior oblique during the primary surgery. (Coats, 2010) The aim of this study is to evaluate outcome and describe management of the inferior oblique inclusion during reoperation.

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### Patients and Methods

This prospective uncontrolled study was approved by the ethics committee of Al-Azhar University Faculty of Medicine, Written informed consent was obtained from all the patients. This study includes patients with inferior oblique inclusion syndrome after corrections of horizontal deviation (esotropia 10 cases and exotropia 12 cases) were included in this study. Inclusion criteria include patients with horizontal comitant strabismus which operated before on lateral rectus muscle with abnormal vertical deviation that suspect inferior oblique inclusion or diagnosed during reoperation. Patients with previous inferior oblique surgery were excluded. All patients were subjected to complete ophthalmologic examination. Visual acuity was examined using a Snellen acuity chart.

Cycloplegic refraction, fundus examination, ocular motility, duction, and version movements were examined. Hypertropia or hypotropia was measured with vertical prism.

**Surgical procedure**

General anesthesia was used for all patients, with use of the surgical microscope. Forced duction test was done and scored according to Dadeya *et al*. (2002) (Score 0 for No restriction Score 1 for Minimal restriction terminally Score 2 for Eyeball could move past midline Score 3 for Eyeball could not be moved past midline. Score 4 for Eyeball could not be moved) then lateral rectus muscle was exposed throw limbal incision. A hook was passed into the incision and rotated so that it can be slide underneath the muscle insertion with the tip of the hook held tangential to the globe. When the muscle is secured with the hook the inferior edge of the lateral rectus muscle are evaluated for inferior oblique inclusion which may be partially or totally included. Intraoperative data include results of score of adhesion as described by Dadeya *et al*. (2002) (score 0 for No adhesion score 1 for Filmy adhesions easily separable with blunt dissection score 2 for Mild to moderate adhesions with freely dissectible plan score 3 for Moderate to dense adhesions with difficult dissection). Other rectus muscles surgical treatment for correction of horizontal deviation was recorded. Postoperative motility assessment at one month, 3 months and 6months was recorded and evaluated.

## RESULTS

Mean follow-up was 6.1±2.5 months for all patients. Male to female ratio was 1:3. The mean age at the time of surgery was 12±4.07 years (range, 7–20). Preoperatively 10 patients were esotropic (7 residual and 3 consecutive) measuring between 15 and 40PD (mean, 25±5.5PD), and 12patients had exotropia (6 residual, 4 recurrent and 2 consecutive), deviations that measured between 15 and50PD (mean, 26.5±7.5 PD). Before reoperation 20 patients (90%) had a vertical deviation (Fig. 1). Thirteen patients had hypotropia; the range of hypotropia was between 5 and 25PD with a mean of 15±7.3PD. And 9 patients had a hypertropia in the primary position. The range of preoperative hypertropia was between 5 and 25PD with a mean of 16±6.3PD. Preoperatively 14 patients had deficient elevation, greater in adduction. Eight patients had deficient adduction.

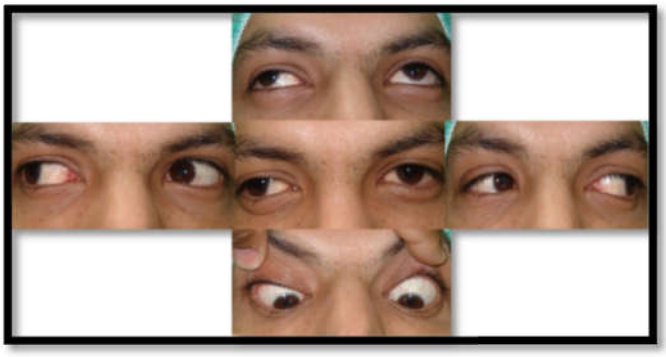

**Fig. 1. RT recurrent exotropia with hypotropia and limited elevation due to inferior oblique inclusion**

Intraoperatively, forced duction test was 1 in 3 patients (13.5%); 3 patients (100%) were favorable after 6 months. Score of forced duction test was 2 in 5 patients (22.5%); 4 patients (80%) was favorable after 6 months. Score of forced duction test was 3 in 8 patients (13.5%); 3 patient (37.5%) was favorable after 6 months. Score of forced duction test was 4 in 6 patients (27%); no favorable outcome (0%) after 6 months. There was significant difference inpercentage of outcome in different scores. Higher scores (3-4) were associated with less favorable outcome Table (1). The incidence of inferior oblique inclusion was as following: 12 patients represent 54.5% was encountered with partial inclusion (the anterior fibers of inferior oblique included with lateral rectus and 10 patients represent 45.5% was encountered with total inclusion (the belly of inferior oblique included with lateral rectus). Fifteen cases (68%) were the result of a previous lateral rectus resection, while 7 (32%) were the result of a previous lateral rectus recession. Intraoperatively, score of fibrosis was 1 in 4 patients(18.1%); 4 patients (100%) were favorable after 6 months.score of fibrosis was 2 in 5 patients (22.5%); 5 patients (100%) was favorable after 6 months.score of fibrosis was 3 in 13 patients (59%); 5 patient (38.4%) was favorable after 6 months. There was significant difference inpercentage of outcome in different scores of fibrosis. Higher scores (2-3) were associated with less favorable outcome. Table (2) represents the score of adhesion of the study patients and their outcome. In each case the lateral rectus was carefully dissected from the inferior oblique, freeing all attachments Fig (2). In all cases, forced duction were found to be free at the end of operation in all but three patients demonstrated some persistence of restriction of vertical deviation at the end of operation.

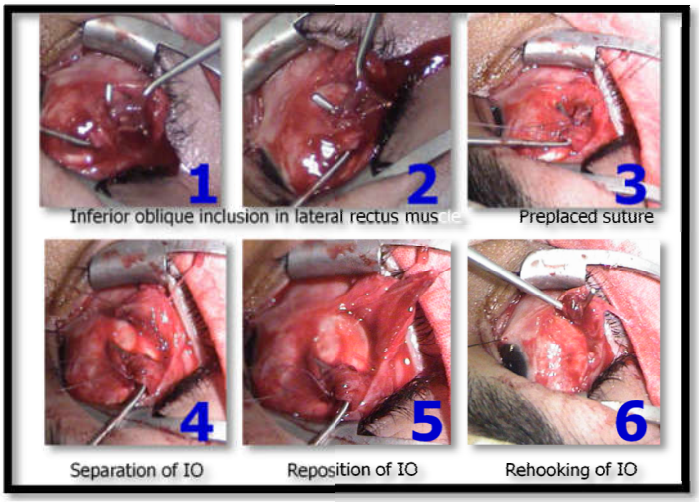


**Fig. 2. LT IO Inclusion management**

After release of the inferior oblique muscle the vertical deviation reduced in primary positions from 15±7.3 PD to 7.5 ±4.3 ($P$<0.001) in cases of hypotropia and from 16±6.3PD to 8.5 ±3.6 ($P$<0.001) in patients with hypertropia, with stability of alignment for a minimum of 6months **Fig (3)**. Esotropic patients underwent IO release combined with medial rectus rerecessions were used in 5 patients (22.7%) and lateral rectus resections (new muscles in other eye) were used in 3 patients (13.5%). Lateral rectus advancement was used in 2 patients (9.0%). Inferior oblique anteriorization combined with surgery on other rectus muscles were used in 3 patients (13.5%) with hypertropia more than 10PD. Exotropic cases underwent IO release combined bilateral lateral rectus rerecessions were used in 3 patients (13.5%) and bilateral medial rectus resections (new muscles) were used in 4 patients (18.1%).

**Table 1. Scoring of forced duction test**

| Score | Definition | No. (%) Patients | Favorable outcome | Percentage of outcome |
|---|---|---|---|---|
| 0 | No restriction. | 0 (0%) | (0%) | (0%) |
| 1 | Minimal restriction terminally. | 3 (13.5%) | 3 (13.5%) | 100% |
| 2 | Eyeball could move past midline. | 5 (22.5%) | 4 (18.8%) | 80% |
| 3 | Eyeball could not be moved past midline. | 8 (36.3%) | 3(13.5%) | 37.5% |
| 4 | Eyeball could not be moved. | 6(27%) | 0% | 0% |

**Table 2. Scoring of adhesion**

| Score | Definition | No. (%) Patients | Favorable outcome | Percentage of outcome |
|---|---|---|---|---|
| 0 | No adhesion. | 0(0%) | 0(0%) | 0% |
| 1 | Filmy adhesions easily separable with blunt dissection. | 4(18.1%) | 4(18.1%) | 100% |
| 2 | Mild to moderate adhesions with freely dissectible plane. | 5(22.5%) | 5(22.5%) | 100% |
| 3 | Moderate to dense adhesions with difficult dissection | 13(59.0 %) | 5(22.5 %) | 38.4% |

Reecession-of lateral rectusof the other eye was used in 3 patients (13.5%) and lateral rectus rerecession with resection of medial rectus (3 muscles surgery on both eyes) was used in 2 patients (9.0%). Inferior oblique anteriorization combined with surgery on other rectus muscles were used in 4 patients (18.1%) with hypertropia more than 10PD. postoperartivly horizontal deviation reduced in esotropic patients from 25±5.5PD to 10.5 ±5.4 ($P$<0.001) in exotropic cases reduced from 26.5±7.5 PD to12±6.3PD ($P$<0.001) with stability of alignment for a minimum of 6months. Inferior oblique muscle was released only and reposted (without recession or anteriorization) in 8 patients (36.2%) and recessed from1mm to 4mm in 7patients (31.8%) and anteriorization was done in 7(31.8%) patients Fig (4).

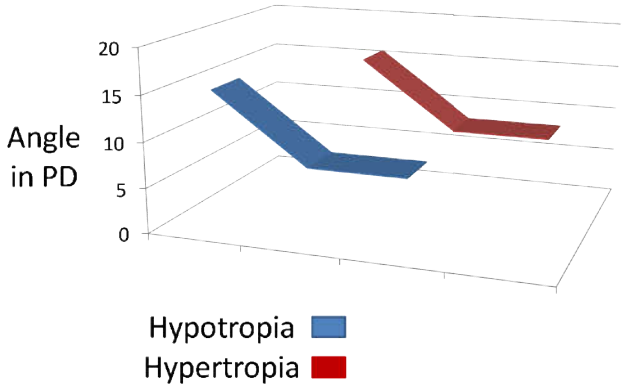


**Fig.3. Reduction of vertical deviation (hypotropia and hypertropia) in PD**

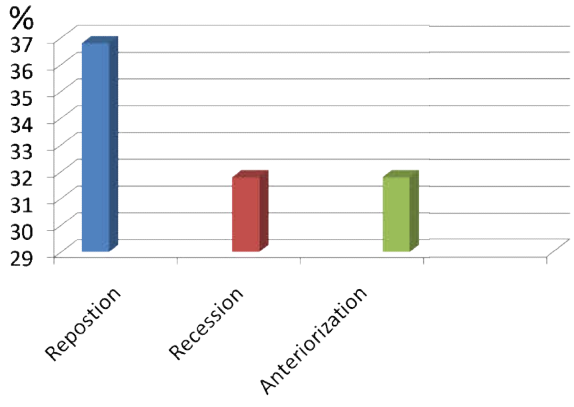


**Fig. 4. Inferior oblique procedure in study patients**

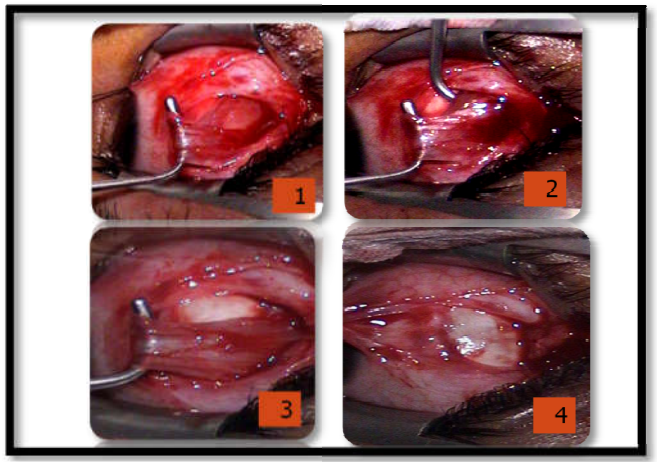


**Fig. 5. 1-Partial inclusion of IO with lateral rectus 2- hook under belly of IO3-Rehooking of lateral rectus with release of IO 4- lateral rectus was recessed back safely**

In one patient when operated on a new lateral rectus inferior oblique was included with lateral rectus. The inclusion was detected and managed by removal of the hook and rehooking of the lateral rectus just behind the location of the muscle insertion and separation of facial attachment between lateral rectus and inferior oblique muscle the lateral rectus was recessed back safely as seen in Fig (5).

## DISCUSSION

It is concluded that the simple release of the IO muscle fibers included in the attachment of the lateral rectus muscle will have a significant impact on reducing the vertical deviation and may avoid the need for additional vertical muscle surgery (Davis and Biglan, 2002). Inadvertent inclusion of the inferior oblique can occur in three ways. First, the inferior oblique muscle may be included with the lateral rectus muscle as the lateral rectus muscle is initially engaged on the muscle hook. This occurs particularly if the muscle hook is thrust deeply into the subtenon's space during an attempt to engage the lateral rectus muscle. Second, a resection clamp or suture placed on the lateral rectus muscle prior to resection may include the inferior oblique muscle and bring it forward at the time of reattachment of the lateral rectus muscle. Third, the inferior oblique muscle may be included with the lateral rectus muscle if heavy fascial attachments between these two muscles persist and if these fascial attachments have not been appropriately severed. (Cline *et al*., 2005) There are other situations following inferior oblique surgery causing limitation of elevation, such as the inferior oblique adherence syndrome and the anti elevation syndrome. (Cho *et al*., 2006; Aberkane *et al*., 1992; Stager,

2001) So patients with previous inferior oblique surgery was excluded from this study. With release of inferior oblique along with appropriate reposition, recession or anteriorization vertical deviation reduced in primary positions from 15±7.3 PD to 7.5 ±4.3 ($P$<0.001) in cases of hypotropia and from 16±6.3PD to 8.5 ±3.6 ($P$<0.001) in patients with hypertropia. The average reduction of vertical deviation in the study of Cline *et al*. (2005) was 3.5PD in hypotropia and 5.8PD in hypertropia due to the average vertical deviation was less than current study. Partial inclusion was found in 12 patients (54.5%) the anterior fibers of inferior oblique included with lateral rectus and 10 patients (45.5%) was encountered with total inclusion the belly of inferior oblique included with lateral rectus. Postoperatively outcome of vertical and horizontal deviation was clinically significant in patients with partial inclusion and low score of adhesion (fibrosis) and forced duction test.

The incidence of inferior oblique inclusion with previous lateral rectus resection was found in tow third of cases (68%) the other one third (32%) were the result of a previous lateral rectus recession. Eugene and Helveston (2005) found the inclusion of the inferior oblique muscle in the lateral rectus after resection was common than after recession of the lateral rectus muscle. As described by Cline *et al*. (2005) including the inferior oblique with the lateral rectus in a resection resulted in the anterior border of the inferior oblique being drawn superiorly and anteriorly. Including the inferior oblique with the lateral rectus during a recession resulted in it being drawn superiorly. Intraoperatively patients with previous resection of lateral rectus has high incidence of fibrosis, adhesion and high score of forced duction test. This factors fibrosis, adhesions and high score of forced duction test associated with less favorable outcome. Improvement of horizontal deviation in comparison to other studies (Wang Tand Wang, 2014; Morrison *et al*., 2011; Yazdian and Ghiassi, 2006; Chun and Rah, 2008) which deal with outcome of management of recurrent or residual strabismus without inferior oblique inclusion results is less favorable in current study as regard the mean reduction of angle in PD. In the study of Helveston *et al*. (1988), the improvement in the horizontal deviation was less than is generally achieved in patients undergoing reoperation but without inadvertent inferior oblique inclusion. Anterior transposition of the inferior oblique muscle (Anteriorization) was done in 7 patients (31.8%) with hypertropia more than 10PD, favorable outcome was obtained in 4 patients (57%) with hypertropia between 10-20PD. Anteriorization was Less effective in 3 patients with larger amounts of hypertropia more than 20PD which need for inferior rectus resection. In one patient when operated on a new lateral rectus inferior oblique was included with lateral rectus. The inclusion was detected and managed as described by Mostafa (1997) by removal of the hook and rehooking of the lateral rectus just behind the location of the muscle insertion and separation of facial attachment between lateral rectus and inferior oblique muscle the lateral rectus was recessed back safely. Eugene and Helveston (2005) advised that when carrying out any surgery on the lateral rectus muscle, the surgeon can reduce the likelihood of inclusion of the inferior oblique by observing the following: (a) insert the muscle hook immediately posterior to the lateral rectus insertion, (b) after the lateral rectus is detached inspect the undersurface of the lateral rectus muscle, (c) lift the detached lateral rectus away from the scleral surface and identify the insertion of the inferior oblique muscle, (d) cut any facial attachments between the lateral rectus and the inferior oblique muscles, (e) place a resection clamp or suture across the lateral rectus so that it is entirely free of the inferior oblique. It has been stated that any patient who is presented for reoperation, after having had a surgical procedure on the lateral rectus muscle, should be considered a suspect for inferior oblique inclusion. This is especially true if the patient demonstrates a vertical deviation in the operative eye or if duction are restricted in this eye. (Helveston *et al*., 1988)

**Conclusion**

In the management of inferior oblique inclusion syndrome, an inferior oblique release from lateral rectus has good favorable outcome been only achieved in cases with partial inclusion with low scores of fibrosis. Limitation of vertical movement could not be completely resolved in cases with total inclusion with marked fibrosis. Inferior oblique inclusion is preventable complication if taken in consideration during hooking of the lateral rectus muscle.

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