



Complications of Strabismus Surgery

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10.1 Introduction

Over the years, the strabismus surgery has undergone improvement in terms of both efficacy and safety. Although serious complications are fortunately rare, no surgery is devoid of risk. It is important for surgeons to be aware of the incidence of complications and various factors that may increase the risk. The complications range from preoperative glitches like wrong surgery to postoperative complications like undesired correction and infection.

10.2 Preoperative Complication

10.2.1 Error in Patient Identity or Surgical Plan

Even though it may appear unrealistic, mistake in the identity of the patient is a possibility in a busy operation theatre. There can be no greater misfortune for the operating team than to perform surgery on the incorrect patient, eye or muscle. The patient particulars and the surgical plan must be reconfirmed by the surgeon himself immediately prior to starting the surgery. These errors are commoner when the surgeon moves between multiple operating rooms and the muscles to be operated have not been marked preoperatively [1]. It should be kept in mind that these errors are considered as negligence (and not complication) legally.

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10.3 Per-Operative Complications

10.3.1 Identification of the Muscle

Sometimes if the surgical exposure is inadequate or due to globe rotation, an inexperienced surgeon may pick up a wrong muscle for surgery. The confusion occurs most commonly between the lateral rectus and inferior oblique. The best way to confirm the identity of the muscle is to give the muscle a gentle tug and observe the effect on the eye. It is advisable to increase the size of incision and identify the muscle under direct visualization. Placing fixation sutures (Chap. 8) also helps by providing an axis guide and preventing undue rotation of the globe which may happen during surgery.

10.3.2 Haemorrhage

Per-operative haemorrhage compromises surgical field visibility and increases the chances of postoperative scarring. Common cause of bleeding is disruption of the muscle sheath and injury to the muscle during dissection. Blind dissection in the area where the muscle insertion is expected should not be done (Chap. 8). Other causes of bleeding are inadvertent injury to vortex veins and scarring from previous surgery. Topical vasoconstrictors, bipolar cautery and careful dissection help decrease the incidence of bleeding [2].

Text Box 10.1: Causes of Lost and Slipped Muscle

- Passing sutures only through muscle sheath without including the muscle fibres
- Inadvertently cutting sutures while disinserting muscle
- Tearing of tight muscle due to extensive tension—Pulled-in-two syndrome (PITS)
- Superficial bites while passing sutures through sclera
- Risk factors like advanced age, restrictive strabismus, prior radiation or surgery

10.3.3 Lost/Slipped/Severed Muscle and PITS

A *lost muscle* is characterized by the absence of any attachment of the muscle tendon or its sheath to the sclera [3, 4]. The muscle along with its sheath recoils posteriorly through the Tenon's capsule. In *slipped muscle* the tendon retracts posteriorly within the muscle sheath. The sheath remains empty and attached to the sclera at the chosen insertion site [5]. Common causes of lost and slipped muscle are listed in the Text Box 10.1 [6–8].

Sometimes when the muscle is too tight or fibrosed, it may retract uncontrollably after tenotomy or inadvertent myotomy/myectomy during dissection resulting in a *severed muscle*. The muscle may also get torn at the muscle-tendon junction as a result of excessive tension or pull on the muscle. This is termed as *pulled-in-two*

syndrome (PITS) [6]. The medial rectus is the commonest muscle to retract posteriorly and difficult to recover thereafter as it has minimal attachments with surrounding muscles and a shorter arc of contact [4, 9].

A slipped muscle when discovered intraoperatively is easier to retrieve and secured to the sclera with full-thickness bites through the muscle. One should avoid pulling the Tenon's capsule or rotating the globe on the opposite side to get more exposure as this would cause the muscle to retract further back. In fact, the globe should be compressed or retro placed and then the posterior Tenon's capsule should be gently opened. The dissection should be directed towards the orbital apex and muscle should be explored. Similarly, a severed muscle is managed by careful identification, dissection from surrounding tissues and resuturing to the desired site [3].

In cases of PITS, the posterior detached part of the muscle is explored as described above. If found it can be sutured to the anterior part of the muscle that remains attached to the sclera or can be directly sutured to the sclera in a recessed position [10, 11].

If the exploration and retrieval fail, a delayed transposition surgery may be required in order to achieve alignment and ocular motility.

Clinical Tip: Before passing sutures through the muscle, it must be ensured that the entire width of the muscle is in the muscle hook and both borders are well visualized.

10.3.4 Globe Perforation

Scleral perforation is one of the most severe and potentially devastating complications of strabismus surgery. The perforation typically occurs while passing the sutures through the sclera during reattaching the muscle. In case the perforation has occurred, one can still go ahead with rest of the surgery provided there is no vitreous loss and excessive manipulation is not needed. However intraoperative or postoperative dilated fundus examination is mandatory to look for any retinal tear. Retinopexy either with cryo or laser may be required to prevent further complications.

Dilated pupil indirect ophthalmoscopy performed after strabismus surgery has reported incidence of scleral perforation between 0.4% and 1.8% [12]. Its risk factors are thin sclera, high myopia, inexperienced surgeons and re-surgeries.

10.3.5 Oculocardiac Reflex

Oculocardiac reflex is characterized by sinus bradycardia, ectopic beats or sinus arrest during manipulation of extraocular muscles, specially the medial rectus. Prompt diagnosis should be followed by immediate release of the muscle. If it persists, intravenous atropine (0.15 mg/kg) is given. In recalcitrant cases, retrobulbar lignocaine is recommended to block the afferent loop.

For this reason a monitor should always be connected and an anaesthetist be present while performing strabismus surgery, even under local anaesthesia.

10.4 Postoperative Complications

10.4.1 Ocular Surface Complications

10.4.1.1 Corneal Dellen

Corneal dellen formation occurs when the tear film regularity is disturbed due to conjunctival swelling or its unsatisfactory approximation at limbus. It is commoner after medial rectus re-surgery or transposition procedures and responds well to aggressive lubrication [13].

10.4.1.2 Inclusion Cyst

Edge-to-edge conjunctival closure not only enhances postoperative cosmetic outcome; it also reduces the incidence of inclusion cyst formation. Inclusion cyst is usually non-tender, translucent and arises from inadvertent burying of conjunctiva while approximating the edges (Fig. 10.4). The risk factors include younger age and muscle recession procedures [14].

Treatment is not always indicated; cysts those are small and asymptomatic may be observed. However, cysts that form early in the postoperative period may become infected, necessitating antibiotic therapy and surgical excision [15, 16].

10.4.1.3 Prolapsed Tenon's Capsule

Exposed or prolapsed Tenon's tissue caused by improper apposition of the conjunctival edges results in unsightly scar. It can be managed by surgical excision of the prolapsed tissue (Fig. 10.1). Meticulous surgical dissection and paying attention to approximation of Tenon's capsule during incision closure may reduce its occurrence.

10.4.2 Lost or Slipped Muscle

Lost or slipped muscle may also present in the early postoperative period. The clinical manifestations of a lost muscle are more severe and appear earlier than those of a slipped muscle. Along with gross motility limitation, there is protrusion of the globe as patient attempts to move the eye in the direction of action of the lost muscle. This is due to a relaxation of the antagonist and the lack of pull of the lost muscle [11]. Magnetic resonance imaging (MRI) is preferred for localization of the muscle and determining presence or absence of its attachments to the globe [17–19]. When the

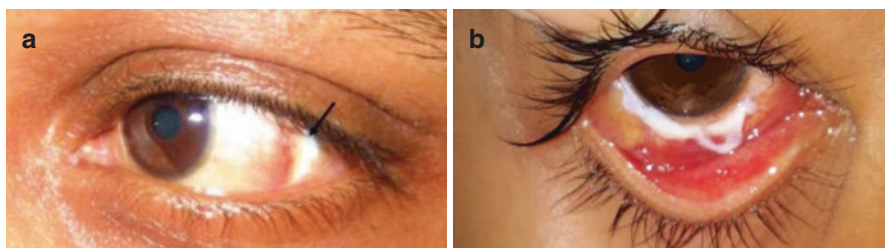


Fig. 10.1 (a) Wound gape and prolapsed Tenon's capsule (arrow) from fornix incision. (b) Prolapse of Tenon's capsule from limbal incision

diagnosis of slipped or lost muscle is suspected, surgical exploration is indicated. It has been recommended that the surgical exploration should not be delayed for more than 2 weeks to avoid contracture of the ipsilateral antagonist [17]. Tracing the path of the capsule posteriorly until the muscle body is found can usually retrieve the slipped muscle. To identify an empty muscle capsule in case of slipped muscle, a strabismus hook is passed under the attached tissue; if the muscle has slipped, a thin translucent sheath will allow the hook to be clearly visible. The empty capsule is followed posteriorly until the muscle fibres are found. The tendon fibres and overlying capsule are then secured with sutures to the desired site. The surgeon should also be prepared with a second plan in the form of transposition surgery, should the retrieval fail.

10.4.3 Overcorrection (Consecutive Strabismus)/Undercorrection (Residual Strabismus)

Unsatisfactory ocular alignment after surgery is a common postoperative complication. Inherent unpredictability of the procedure, incorrect preoperative evaluation or surgical dosage calculation, overlooking oblique muscle dysfunctions or other dynamic factors and improper surgical technique are frequent causes for early postoperative malalignment (Fig. 10.2). Each of these factors has been discussed in earlier chapters.

Unless the diagnosis of slipped or lost muscle is suspected, immediate corrective measures are not necessary. The patient needs to be reassured and re-evaluated later to determine if the outcome is unacceptable and requires re-surgery. Text Box 10.2 summarizes such unacceptable motor outcomes in common types of strabismus [20–22]. Botulinum toxin and prisms may be used in the interim in selected cases. Adjustable sutures enhance satisfactory outcomes as has been discussed in earlier chapters.

Text Box 10.2: Unacceptable Motor Outcomes [20–22]

Infantile ET	>20Δ ET or XT
XT	>15Δ ET
	Residual XT
Sensory strabismus	>10Δ XT
Incomitant strabismus	>10Δ deviation in primary or down gaze

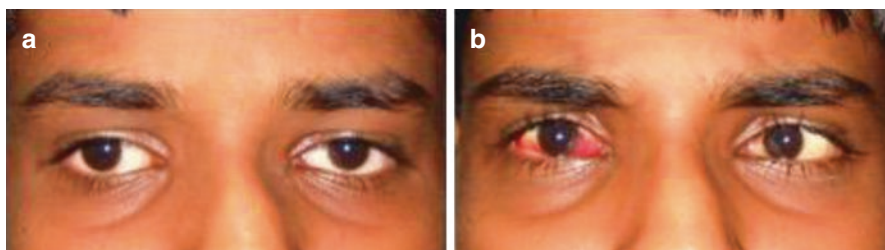


Fig. 10.2 (a) Fourteen-year-old boy with right eye exotropia, (b) following surgery (LR recession and MR resection) developed consecutive esotropia with diplopia

Late postoperative ocular malalignment of eyes that were aligned in the early postoperative period can usually be attributed to the type/cause of strabismus. Exodrift in X(T), reactivation of thyroid ophthalmopathy and progressive myopathy are few examples. Sometimes fibrosis of conjunctival scar may be a cause of late motility limitation.

10.4.4 Postoperative Diplopia

Early postoperative diplopia after strabismus surgery is distressing for the patient but is often not an unwelcome sign for the surgeon. In conditions like X(T), it may be acceptable, and in long-standing deviations, it may be a welcome sign with a potential of binocular recovery. Patient should be reassured and given time to fuse, suppress or ignore the second image. Frequently the patients are able to overcome the diplopia in a few days. Prisms should be considered only after few weeks.

Surgical realignment may be required after a few weeks if troublesome diplopia and deviation persist in primary and downgazes. Abnormal retinal correspondence may cause transient paradoxical diplopia in presence of orthotropia.

Surgeon should be aware of the possibility of postoperative diplopia in different types of strabismus like X(T), paralytic deviations, etc. and warn these patients prior to surgery. It is even better to make the patients experience diplopia by correcting or nearly correcting the deviation with prisms prior to surgery. This ensures that it does not come as a surprise and patients don't see it as a complication.

10.4.5 Change in Visual Acuity and Refractive Error

An observant patient may notice a change in visual acuity after strabismus surgery. This can be attributed to development of astigmatism due to alteration in corneal curvature as response to the reduction in tension of the recessed extraocular muscle transmitted via the sclera to the cornea [23, 24]. This phenomenon is commoner in restrictive strabismus and is usually transient [23, 25]. Change of glasses should be done only after 3 months of surgery [26].

10.4.6 Change in Palpebral Aperture

Horizontal muscle strabismus surgery is known to cause palpebral aperture (PA) changes [27, 28]. Recession of a horizontal rectus muscle causes widening of the PA while resection decreases its height. The amount change in PA may be related to the amount surgery done on rectus muscle (Fig. 10.3). Changes in PA also occur after surgery on vertical recti if attachments between the muscles and lid retractors are not severed [29]. Recession of vertical recti may cause widening of the aperture while resection may cause its narrowing.

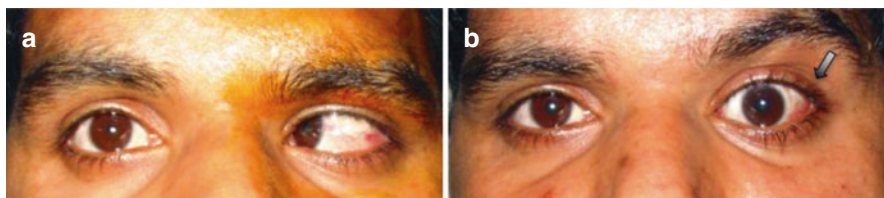


Fig. 10.3 (a) Case of left lateral rectus palsy underwent MR recession with half width transposition of vertical recti to LR, (b) postoperative satisfactory alignment in primary position with widening palpebral aperture

10.4.7 Retinal Detachment

Intraoperative scleral perforation during muscle reattachment may cause postoperative retinal detachment depending of the depth of the needle pass. All suspected perforations should be managed as discussed above in globe perforation. The incidence of detachment is reported to be 1.9% in presence of retinal tear [30].

10.4.8 Anterior Segment Ischaemia

The risk of anterior segment ischaemia is influenced by both patient susceptibility and the extent of the strabismus surgery. The most important patient risk factor is older age [31]. Other reported risk factors include atherosclerosis, blood dyscrasias, hyperviscosity syndromes, carotid artery ligation and Graves ophthalmopathy [32].

Anterior segment ischaemia may occur after transposition procedures, surgeries involving more than two recti simultaneously and vertical recti surgery on patients who have previously undergone horizontal surgery [33].

Vessel sparing surgery may prevent anterior segment ischaemia, but does not eliminate the risk entirely [34]. Muscle plication, an alternative to resection, has also been utilized in an effort to preserve ciliary vasculature.

Clinical features include severe ocular pain, corneal oedema, anterior segment flare and hypotony. It is managed by short course of systemic steroids and intensive application of topical steroids. Most patients recover iris circulation by 12 weeks with increased blood flow through the long posterior ciliary arteries.

10.4.9 Postoperative Infections

10.4.9.1 Suture Abscess and Granuloma

Suture abscess is usually seen within a week of surgery and is caused by contaminated suture. It presents as yellowish nodule with swelling and erythema over the suture site [35]. It usually needs to be drained followed by topical antibiotics. Granulomas on the other hand occur between 2 and 4 weeks of surgery due to foreign body reaction to suture material, cotton fibres, glove powder or a buried eye

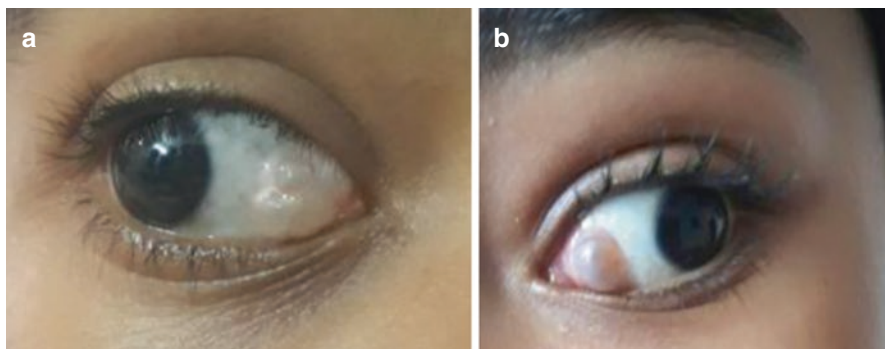


Fig. 10.4 Suture-related complications (a) Inclusion cyst (b) Suture granuloma

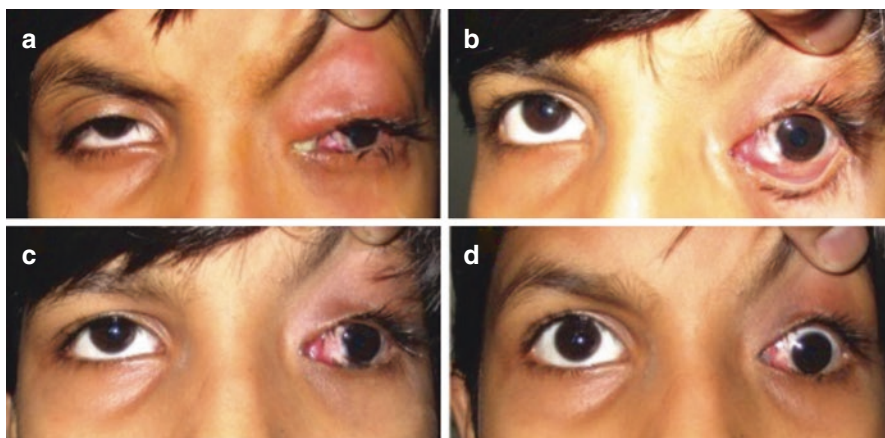


Fig. 10.5 Twelve-year old developed orbital cellulitis (a, b) after strabismus surgery for complete third nerve palsy which responded to systemic antibiotics (c, d)

lash [35] (Fig. 10.4). Majority of granulomas resolve with topical corticosteroids and surgical excision is seldom needed.

10.4.9.2 Orbital Cellulites and Endophthalmitis

Orbital cellulitis and endophthalmitis are rare but unfortunate complications of strabismus surgery (Fig. 10.5). Endophthalmitis is more common in presence of scleral perforation. Treatment involves aggressive topical, intravitreal and systemic antibiotics; vitrectomy may be required for nonresponsive endophthalmitis. CT scan is indicated in orbital cellulitis to identify any abscess which may need drainage [35].

10.5 Summary

- With evolution in surgical technique and instrumentation, the complications related to strabismus surgery have declined over time.
- Error in identification of extraocular muscle and per-operative haemorrhage following injury to muscle sheath are common with beginners.
- Muscle loss or slippage may occur per-operatively or in early postoperative period. Medial rectus muscle is more prone due to straighter orbital course and minimal surrounding attachments.
- Globe perforation, retinal detachment and anterior segment ischaemia are rare but sight threatening.
- Under- and overcorrections are common. Inherent unpredictability of the procedure, incorrect surgical planning or its execution are common causes of unexpected surgical outcome.

10.6 Multiple Choice Questions

1. Which of the following statement is *incorrect* regarding preoperative evaluation for strabismus surgery?
 - (a) Prism adaptation test is avoidable in patients with no demonstrable binocularity.
 - (b) Prism testing and evaluation of sensory status are useful to determine post-operative fusion ability and presence of ARC.
 - (c) Assessment of deviation is incomplete without measuring associated features like presence of any A-V patterns, presence of accommodative component and near-distance disparity.
 - (d) Objective measurement tests are superior to subjective tests in determining the deviation that should be corrected.

Answer: (a) Prism adaptation test should be performed even in absence of binocularity as these patients often demonstrate binocular functions after ocular alignment. Angle measured by objective tests should be the target angle for correction.

2. *Incorrect* statement regarding lost/slipped/severed/PITS muscle?
 - (a) Partial thickness suture placement through the muscle can lead to these complications.
 - (b) Muscle that is too tight or fibrosed may get torn at the muscle-tendon junction resulting in 'pulled-in-two syndrome' (PITS).
 - (c) The globe can be slightly enophthalmic and the palpebral fissure decreased as patients attempt to move the eye in the direction of the lost muscle.

- (d) Imaging is helpful in localization of the muscle as well as identifying absence or presence of its attachments to the globe.

Answer: (c) The globe can be slightly proptotic and the palpebral fissure widened with limitation of movement in the direction of action of lost muscle.

3. *False* statement regarding strabismus surgery?

- (a) Late-onset consecutive strabismus occurs due to remodelling of scar tissue.
- (b) Scleral perforation and penetration usually occur during muscle disinsertion or muscle reattachment.
- (c) Risk of perforation is higher in recession than in other strabismus procedure.
- (d) Recession results in dellen formation more frequently than resection.

Answer: (d) Resection results in more frequent dellen formation, as resection involves more tissue crowding near limbus than recession.

4. Which of the following statement is *correct* regarding anterior segment ischaemia following strabismus surgery?

- (a) Fornix incisions have a lower incidence compared to limbal incisions.
- (b) Vessel sparing surgery does not reduce its risk.
- (c) Its incidence is irrespective of type of procedure.
- (d) It is more commonly seen in young patients.

Answer: (a) Fornix incisions spare anterior ciliary vessels reducing its incidence. Vessel sparing surgery reduces the risk but does not eliminate it. It is commoner in multiple muscle surgeries and transposition procedures. It is commoner in elderly and debilitated patients.

5. Causes of overcorrection/undercorrection are all *except*?

- (a) Lateral gaze incomitance
- (b) Amblyopia
- (c) Eccentric fixation
- (d) Good binocularity

Answer: (d) Good binocularity reduces the unsatisfactory motor outcome. All other options listed above increase it.

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