The Egyptian Journal of Hospital Medicine (October 2021) Vol. 85 (2), Page 4013-4017

An Overview for Concomitant Exotropia Management: Review Article

Ahmed Gamal Mahmoud El-Kial, Mohamed Ahmed EL-Marakby,
Yasser Mohamed EL-Sayed, Sahar Hemeda Elsayed
Ophthalmology Department, Faculty of Medicine, Zagazig University, Egypt
Corresponding Author: Ahmed Gamal Mahmoud El-Kial, **Email:** ahmedgamalkial@gmail.com

ABSTRACT

Background: A common type of strabismus known as concomitant exotropia (XT) occurs when mismatched eyes deviate outward and the angle of deviation is the same regardless of which eye is fixed. Among ophthalmologists, there is no agreement on non-surgical treatment options for XT. For those who suffer from strabismus, surgery is an option for correcting their visual axis and restoring their ability to see in both eyes simultaneously. Instead, then severing the muscle, muscle plication involves folding the muscle around itself and stitching it in place, essentially shortening and tightening the muscle. Muscle plication has been found to reduce the risk of anterior segment ischemia by protecting the anterior ciliary arteries.

Objective: To hallmark the new guidelines options of concomitant exotropia management.

Conclusion: Muscle-tightening techniques such as excision, plication, advancement, and transposition have been documented in the literature. Technical simplicity, the ability to reverse it, shorter operating times, reduced surgical trauma, and the preservation of anterior ciliary arteries are only a few of the many advantages of plication.

Keyword: Concomitant Exotropia, Strabismus.

INTRODUCTION

As the visual axes of the eyes deviate outward, the condition known as exotropia occurs, which may manifest constantly or intermittently. It may be acquired or congenital, most often its etiology is unknown (primary forms of exotropia) but may be secondary to other underlying causes**.** Only 1% of people have it, with intermittent exotropia being the most common form [(1)]. The risk of strabismus is increased in families with a history of strabismus, in women, astigmatism, myopia, and anisometropia, and in children with a mother who uses drugs or smokes during pregnancy [(2)].

Exotropia types:

A- Primary exotropia:

1- **Intermittent exotropia:** At distance fixation, non-constant exotropia is more prevalent than at close fixation. It accounts for nearly half of all children's exotropia [(1)].

2. Infantile exotropia:

It is very rare condition among the different types [(3)]**.**

B-Secondary XT: Oculomotor palsy, Duane's syndrome, craniofacial disorders, internuclear ophthalmoplegia (INO) [(4)].

C-consecutive XT: It occurs after surgery for esotropia or it even develops spontaneously in patients who had infantile esotropia [(4)].

D-Sensory Exotropia:

It is common for the eye to become exotropic in older children aged from two to 4 years and adults with a blindness or poor vision [(4)].

The aim of the review was to hallmark the new guidelines options of concomitant exotropia management.

Treatment of Concomitant Exotropia:

A-Non-surgical treatment:

Among ophthalmologists, there is no agreement on non-surgical treatment options for XT [(5)]**.**

1-Correction of refractive error:

Corrective lenses should be provided in the case of a clinically severe refractive defect that causes impaired vision in one or both eyes. Exophoria compensation in myopia or absolute hypermetropia can be achieved with the help of refractive correction. Maintaining active accommodation necessitates prescribing full correction for myopia. Avoid correcting mild to moderate degrees of hyperopia to keep the accommodative convergence that controls the exodeviation in check [(6)]**.**

2-Overcorrecting minus lens therapy (−2.00 to −4.00 D over the habitual distance prescription):

By promoting accommodative convergence, it can help minimize an exodeformation. Patients with a high accommodative-convergence/accommodation (AC/A) ratio benefit from this treatment. It can be utilised in a variety of ways, including enhancing myopia correction in myopes, reducing hyperopia correction in hyperopes, or prescribing corrective action of myopia in ametropes [(7)]. However, when this treatment is withdrawn, the occasional exotropia returns to its prior level of control. If there is an increase in the frequency of deviations with lower power, the amount of the lens diopters is again raised. Two successive visits without an improvement in six months led to the termination of overminus therapy [(5)].

3-Treatment of amblyopia: Patching improves the sensory and motor fusion by an elimination of the suppression scotoma. Intermittent exotropia is rare, but if a patient's vision is impaired without an obvious cause (such as anisometropia or an ocular anatomical defect), it should prompt an ophthalmologist to look into the

Received: 18/8/2021
Accepted: 3/10/2021

possibility of minor optic nerve or retina abnormalities [1].

4- Occlusion therapy (2 to 6 hours daily): By treating suppression and amblyopia, a phoria can be converted from an intermittent exotropia. A gradual reduction in the angle of deviation necessitates that the occlusion be maintained until no more change occurs. It is cancelled if there is no improvement after four months. However, it has a short-lived effect on extremely young children (3 to 10 years old). With equal preference for fixation, alternate occlusion can be applied [8].

5-Prism therapy: There are two types:-

A-Base-in prism (conventional prism): By enhancing sensory fusion when reading, it may be integrated into spectacles [9].

B-Base-out (inverse) prism: Convergence insufficiency exotropia can be treated by changing the picture in the eye's field of vision to where the eye is intended to be looking, which causes diplopia and stimulates fusion [10].

6-Orthoptic treatment: Fusional training activities and other techniques that use monocular targets or stereograms can be used with a major amblyoscope [11].

7-Botulinum toxin therapy: With an injection of just 2.5 international units (IU) into each of the bilateral recti, the angle drops from 30 prism diopters (PD) to a range of 6–10 in children, making it easier for them to see. Between 40% and 70% of trials are successful after six months. Injecting into the lateral rectus (LR), inferior oblique (IO), and superior rectus (SR) muscles can cause upper lid ptosis and subsequent esotropia [12].

B- Surgical treatment:

Indications for surgery: 1-Increasing frequency of strabismus (manifest 50% of the time or more). 2-Decreasing binocularity (e.g., stereopsis). 3-Decompensation from intermittent to constant exotropia. 4-Squinting and rubbing of the eyes, asthenopia, and accommodative spasms are becoming more common. 5-Friends, teachers, and even strangers have noticed the child's strabismus. If there is a clear and evident manifestation of a defect, it is considered cosmetic [4]. Patients with angles of deviation less than 20 to 25 prism diopter (PD) should not undergo surgery unless the fusion has deteriorated significantly; instead, they should be closely monitored [13].

Signs of progression:

The frequency with which exodeviation manifests itself has increased, Stereoacuity is reduced, The absence of diplopia during the manifest phase indicates the development of suppression, The basic deviation grows in size, Convergence instability secondary to primary instability [13].

Time of surgical intervention:

The timing of surgical intervention for XT remains a matter of debate. The best opportunity for a complete cure is elimination of the exotropia angle prior to the development of a suppression scotoma and abnormal retinal correspondence [14].

In order to prevent overcorrection in visually immature newborns, **Jampolsky** [15] advocated delaying surgery until the child was 4 years old. **Baker and Davies** [16] found that patients who underwent surgery after the age of four had superior functional outcomes. While, **Knapp** [17] urged early surgical intervention. **Johnson *et al.*** [18] noted that good results with early intervention, others noted good results with intervention between 4 and 5 years [19].

Choice of operation:

Exotropia can be treated surgically in a variety of ways [4].

Lateral rectus recession:

For patients with real divergence excess, this is the chosen surgical procedure. The non-dominant eye may benefit from significant unilateral lateral rectus recessions in patients with mild aberrations up to 16 diopters. Muscle slack is created when the muscle insertion is moved closer to the origin. Recession of the rectus muscle has the largest impact on the muscle's functional area [20].

There are two types of muscle recession:

Fixed recession muscle is stitched to the cornea where it will be advanced. A suture is used to hang back the muscle from the scleral insertions. Suture can be easily threaded through the sclera's thick front sclera [20].

Recession-resection or recession-plication procedure:

Basic exodeviation is more likely to succeed with this method. Unilateral amblyopia frequently necessitates surgery on only one eye, thus the surgeon prefers to avoid surgery on the eye with adequate vision. In most cases, bilateral lateral rectus recessions and one or more medial rectus muscle excisions are necessary to treat large-angle exotropia with more than 2 prism diopters of exotropia. The basic or pseudo-divergence excess form of exotropia responds well to recession and resection, while the real divergence excess type responds better to bilateral LR recession [21].

Medial rectus resection:

The improved effect of bilateral medial rectus resections at close term on treating intermittent exotropia of the convergence insufficiency type [20].

Lateral incomitance:

A difference in the magnitude of lateral gaze deviance is seen. Some surgeons have proposed limiting the amount of recession in patients with preoperative lateral incomitance, as they are more prone to be overcorrected. The best treatment for concomitant strabismus is symmetrical bilateral surgery [20]. The question whether unilateral or bilateral surgery yields better results has not been settled [4].

Table (1) : Bilateral vs Unilateral Surgery in Exotropia [(4)]

Type of surgery	Advantage	Disadvantage
Bilateral surgery (recession of both lateral recti or resection/plication of both medial recti)	-Does not create lid fissure anomalies on side-gaze. -Recessions do not sacrifice muscle tissue do not alter refractive error.	-Bilateral surgery may be difficult to explain to patients. -Monocular surgery itself more readily to local anesthesia techniques.
Unilateral surgery (recession of one lateral rectus and resection/plication of one medial rectus)	-Preferred if one eye deeply amblyopic -Preferred if patient demands surgery on one eye -Monocular surgery itself more easily to local anesthetic techniques.	-Resections/plications involve disposal of muscle tissue -Often leads to subtle lid tissue anomalies on side-gaze (wider in abduction than adduction).

Medial rectus muscle strengthening procedures:

1- Resection: (Figure 1)

Total removal of the part of the muscle and reattach it to the sclera**.** Because the anterior ciliary arteries are permanently disrupted, this may increase the risk of anterior segment ischemia in the patient Strengthening or tightening the muscles of the rectus extraocular is the most common procedure [(22)].

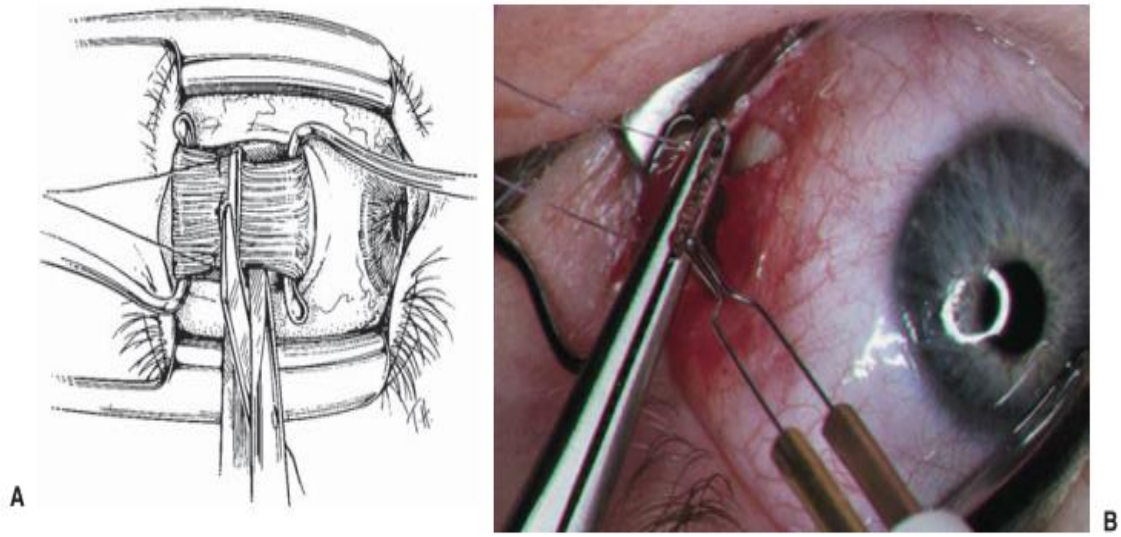

Figure (1): (A) 5-0 Vicryl suture is used to bind the muscle, with locking bites placed on both sides of the muscle and a central security knot. To finish the procedure, a Hartman clamp is used to cross-clamp the muscle anterior to the sutures. In order to remove the muscle, it is first cut in front of the Hartman clamp, such that it is flushed with the clamp's surface **(B)** In this image, a muscle stump is being cauterized [(20)]**.**

2-Plication: (Figure 2)

Shortening and tightening of the muscle can be achieved by folding the muscle on itself and sewing it to the skin at its insertion point. Reducing the danger of anterior segment ischemia by manipulating the muscles of the anterior ciliary vessels has been found to allow simultaneous operations on numerous rectus muscles. The reversibility in the early postoperative phase is a major advantage [(23)]**.** Plication was proposed as a surgical therapy for strabismus due to these reasons [(24)].

Doubts about the plication procedure's efficacy in comparison to muscle resection may be an obstacle to its increased acceptability [(22)]. There was no statistically significant difference between the surgical outcomes of the two methods of treating exotropia/esotropia according to **Chaudhuri and Demer's**[(24)] retrospective comparison of surgical outcomes.

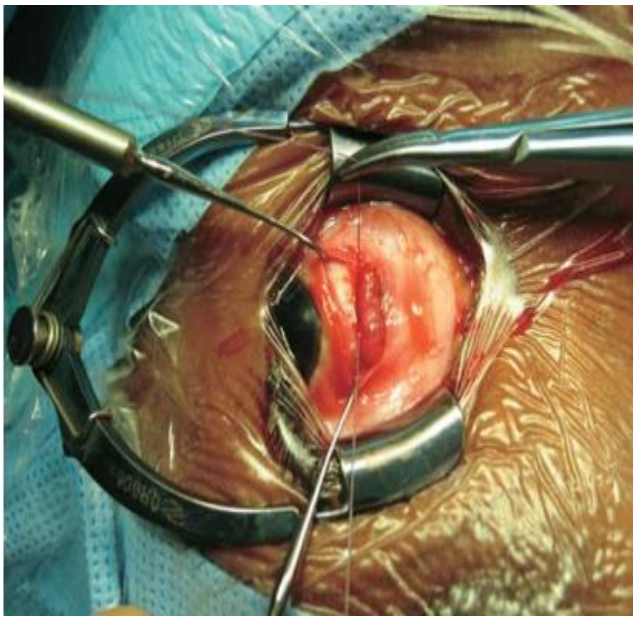

Figure (2): By yanking on the sutures, the muscle was plicated [20]

Surgical aim and prognosis:

Short-term overcorrection (4 to 10 PD) is required for long-term effectiveness because eyes tend to drift out over time. Fusional vergences and postoperative alignment are both aided by postoperative diplopia. Amblyopia and loss of binocularity can result from repeated esotropias in a visually immature neonate. On the first postoperative day, orthotropia is common in adults who have intermittent exotropia. This is not a purposeful overcorrection. The diplopia of adults with long-standing intermittent aberrations can be tolerated by undercorrection, while overcorrection can cause symptoms in those adults [25].

Surgical dosage:

Table (2): Surgical dosage values for bilateral lateral rectus recession, bilateral medial rectus resection and monocular recession-resection [20]

Deviation (prism diopter)	LR recession OU(mm)	MR resection OU (mm)	Monocular exotropia surgery	
			LR recession (mm)	MR resection (mm)
15	4.0	3.0	4.0	3.0
20	5.0	4.0	5.0	4.0
25	6.0	5.0	6.0	4.5
30	7.0	5.5	6.5	5
35	7.5	6.0	7	5.5
40	8.0	6.5	7.5	6
50	9.0		8.5	6.5

The amount of deduction following two-muscle surgery is still a matter of debate, and the reference tables are primarily developed for this purpose. Some surgeons conduct bilateral LR recession of 9 mm for 50 PD and 1 mm of unilateral MR resection for every 5 PD residual angle greater than 50 PD for exotropia greater than 60 PD [26].

Strabismus surgery outcomes are impacted by a number of factors prior to the procedure. Variables such as the commencement of deviation, the age at surgery, the time gap between the onset of deviation and surgery, and the AC/A ratio were all examined by **Bateman *et al.*** [27] in their study.

Kushner [28] reported evidence that response to strabismus surgery should correlate with axial length. **Kushner** [28] reported significant negative correlation between axial length (AxL) and response for patients with esotropia and poor correlation for patients with exotropia. In both esotropia and exotropia groups, **Ghali** [29] found a negative connection between AxL and the effect of recession. Longer AxL should have their recession increased. Mean dose response (MDR) =4.28 – (0.11×AxL) + (0.019×preoperative angle).

CONCLUSION

Muscle-tightening techniques such as excision, plication, advancement, and transposition have been documented in the literature. Technical simplicity, the ability to reverse it, shorter operating times, reduced surgical trauma, and the preservation of anterior ciliary arteries are only a few of the many advantages of plication.

Financial support and sponsorship: Nil.
Conflict of interest: Nil.

REFERENCES

1. **Mohney B, Huffaker R (2003):** Common forms of childhood exotropia. Ophthalmology, 110(11): 2093–2096.
2. **Cotter S, Varma R, Tarczy-Hornoch K *et al.* (2011):** Risk factors associated with childhood strabismus: the multi-ethnic pediatric eye disease and Baltimore pediatric eye disease studies. Ophthalmology, 118(11): 2251–2261.
3. **Archer S, Sondhi N, Helveston E (1989):** Strabismus in infancy. Ophthalmology, 96(1): 133–137.
4. **Yanoff M, Duker J, Augsburger J (2019):** Pediatric and Adult strabismus. Ophthalmology. Fifth ed. Edinburgh: Elsevier/Saunders, Pp. 1217- 1219. https://www.scielo.br/j/abo/a/7sCCbDbqpSRZCDd6CQS8M3K/?lang=en
5. **Bayramlar H, Gurturk A, Sari U *et al.* (2017):** Overcorrecting minus lens therapy in patients with intermittent exotropia: Should it be the first therapeutic choice? International Ophthalmology, 37(2): 385–390.
6. **Iacobucci I, Archer S, Giles C (1993):** Children with exotropia responsive to spectacle correction of hyperopia. American Journal of Ophthalmology, 116(1): 79–83.
7. **Chen A, Holmes J, Chandler D *et al.* (2016):** A randomized trial evaluating short-term effectiveness of overminus lenses in children 3 to 6 years of age with intermittent exotropia. Ophthalmology, 123(10): 2127–2136.

8. **Berg P, Isenberg S (1991):** Treatment of unilateral exotropia by part-time occlusion. American Orthoptic Journal, 41(1): 72–76.
9. **El Gendy NMS, Abdel Nabi E (2019):** Is inverse prism therapy comparable to conventional prism therapy for improving Newcastle scores in patients with basic intermittent exotropia? Seminars in Ophthalmology, 34(7–8): 497–503.
10. **Scheiman M, Cotter S, Rouse M *et al.* (2005):** Randomised clinical trial of the effectiveness of base-in References 105 prism reading glasses versus placebo reading glasses for symptomatic convergence insufficiency in children. British Journal of Ophthalmology, 89(10): 1318–1323.
11. **Pejic Z, Wong W, Husain R *et al.* (2006):** Fusion exercises for treatment of intermittent exotropia and phoria. American Orthoptic Journal, 56(1): 138–146.
12. **Etezad Razavi M, Sharifi M, Armanfar F (2014):** Efficacy of botulinum toxin in the treatment of intermittent exotropia. Strabismus, 22(4): 176–181.
13. **von Noorden G, Campos E (2002):** "Amblyopia." Binocular vision and ocular motility-theory and management of strabismus. 6th ed. London, Mosby Publishers. Pp. 246-248. https://www.aao.org/assets/0c711d7f-503f-4cd9-b4ac-
14. **Edelman P, Brown M, Murphree A *et al.* (1988):** Consecutive esodeviation… then what? American Orthoptic Journal, 38(1): 111–116.
15. **Jampolsky A (1958):** Surgical management of exotropia. American Journal of References 99 Ophthalmology, 46(5): 646–648**.**
16. **Baker J, Davies G (1979):** Monofixational intermittent exotropia. Archives of Ophthalmology, 97(1): 93–95.
17. **Knapp P (1953):** Intermittent exotropia: evaluation and therapy. American Orthoptic Journal, 3(1): 27–33.
18. **Johnson M, Christiansen S, Rath P *et al.* (2009):** Anterior ciliary circulation from the horizontal rectus muscles. Strabismus, 17(1): 45–48.
19. **Kelkar J, Gopal S, Shah R *et al.* (2015):** Intermittent exotropia: Surgical treatment strategies. Indian Journal of Ophthalmology, 63(7): 566–569.
20. **Wright K, Strube Y (2015):** Color atlas of strabismus surgery. In color atlas of strabismus surgery. Springer New York. Pp. 161-170. https://link.springer.com/book/10.1007%2F978-1-4939-1480-7
21. **Lee Y, Choi D (2017):** Comparison of outcomes of unilateral recession-resection as primary surgery and reoperation for intermittent Exotropia. BMC Ophthalmology, 17(1): 1-4.
22. **Huston P, Hoover D (2018):** Surgical outcomes following rectus muscle plication versus resection combined with antagonist muscle recession for basic horizontal strabismus. Journal of AAPOS., 22(1): 7–11.
23. **Sukhija J, Kaur S (2018):** Comparison of plication and resection in large-angle exotropia. Journal of AAPOS., 22(5): 348–351**.**
24. **Chaudhuri Z, Demer J (2014):** Surgical outcomes following rectus muscle plication: a potentially reversible, vessel-sparing alternative to resection. JAMA Ophthalmology, 132(5): 579–585.
25. **Raab E, Parks M (1969):** Recession of the lateral recti: early and late postoperative alignments. Archives of Ophthalmology, 82(2): 203–208.
26. **Lau F, Fan D, Yip W *et al.* (2010):** Surgical outcome of single-staged three horizontal muscles squint surgery for extra-large angle exotropia. Eye, 24(7): 1171–1176.
27. **Bateman J, Parks M, Wheeler N (1983):** Discriminant analysis of acquired esotropia surgery: predictor variables for short-and long-term outcomes. Ophthalmology, 90(10): 1154–1159.
28. **Kushner B (1988):** Exotropic deviations: a functional classification and approach to treatment. American Orthoptic Journal, 38(1): 81–93.
29. **Ghali, M (2017):** Correlation between the axial length and the effect of recession of horizontal rectus muscles. Journal of the Egyptian Ophthalmological Society, 110(3): 89-93.