Last Guidelines Overview of Consecutive Esotropia Management: Review Article

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ABSTRACT
Background: Consecutive esotropia (ET) is persistent esodeviation for 24 weeks afterward bilateral lateral rectus recession (BLRR) for correcting exotropia (XT) with or without diplopia. Some patients may have limited eye movement; amblyopia and loss of binocularity can result. Early postoperative overcorrection has been recommended in surgical treatment of intermittent XT due to tendency towards postoperative exotropic drift. ET with small angles (within 15 PD) vanishes naturally over time, whereas bigger angles are more likely to be present at the start. Patients who have ET that has persisted for at least 24 weeks after BLRR and has been present for more than 15 postoperative days should have surgery. **Objective:** Hallmark the updated lines of management of consecutive esotropia.
Conclusion: For the purpose of maintaining one MR muscle for a future intervention, several research have shown that ET can be performed consecutively after BLR recession by advancement of LR muscle previously recessed and MR muscle recession in the more deviating eye. Studies in recent years have sought to determine the effectiveness of the use of lateral rectus advancement in the treatment of consecutive ET.
Keywords: Consecutive esotropia, Extraocular muscles.

Anatomy of Rectus Muscles:

Origin of rectus muscles:

Rectus muscles come from an oval band of connective tissue called the annulus of Zinn, which is found in front of the optic foramen and in the medial portion of superior orbital fissure, just anterior to the optic foramen and medial section of superior orbital fissure in the periorbita (Figure 1).

The dural sheath of the optic nerve is also linked to the medial and superior rectus muscles. Once the rectus muscles have travelled anteriorly, they attach to the globe's anterior surface **(1).**

Insertions of rectus muscles:

Preceding the equator, the rectus muscles attach to the surface of the globe (Figure 2). The spiral of Tillaux is a line that connects the muscle insertions. This spiral starts at the medial rectus insertion that is closest to the limbus and proceeds to the inferior, the lateral and finally the superior rectus insertion that is farthest from the limbus **(2).** Variations were found from person to person in specific measurements, but the spiral of Tillaux was always observed. The tendons of insertion pierce Tenon's capsule and merge with scleral fibers. A sleeve of the capsule covers the tendon for a short distance, and the muscle can slide freely within this sleeve **(1)**.

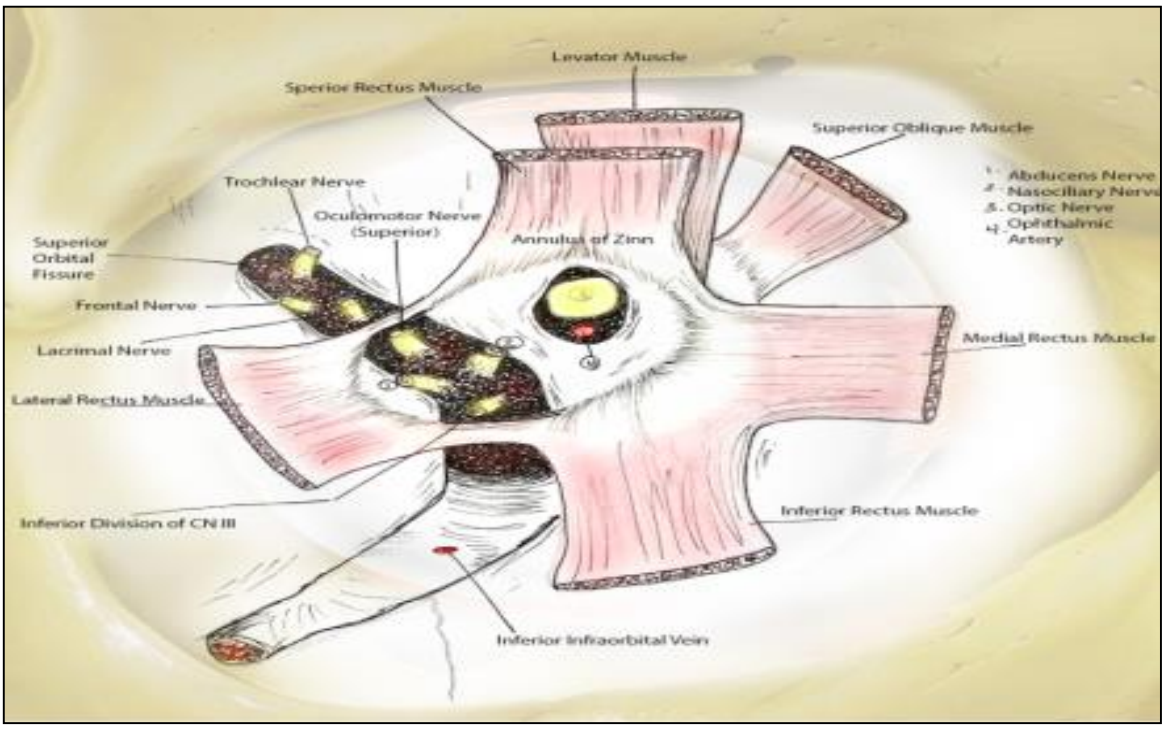

Figure (1): Origin of extra-ocular muscles **(1).**

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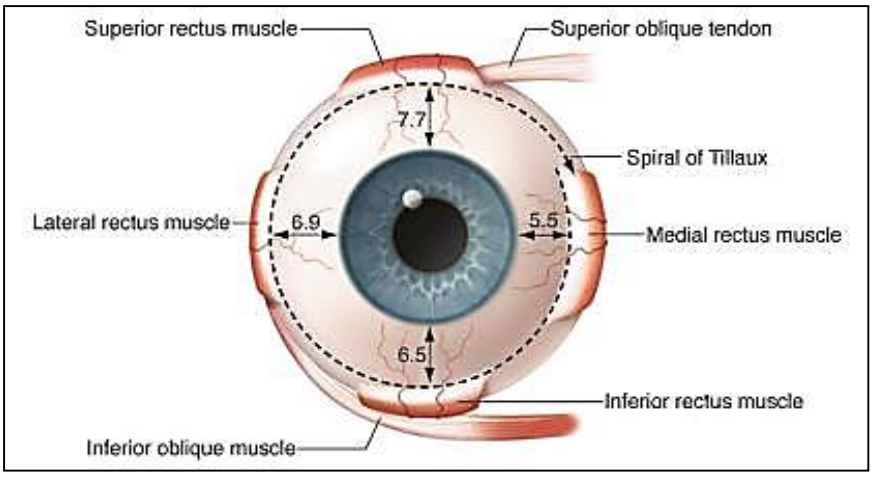

Figure (2): Insertion of extra-ocular muscles [2].

Consecutive Esotropia:

Consecutive Esotropia (ET) is persistent esodeviation for 28 weeks afterwards bilateral lateral rectus recession (BLRR) for correcting XT with or without diplopia. Some patients may have limited eye movement, also amblyopia and loss of binocularity can result. Early postoperative overcorrection has been recommended in surgical treatment of intermittent XT because of the possibility for exotropic drift after surgery [3].

An initial postoperative overcorrection that leads to small angle following intermittent exotropia surgery is typically corrected within two weeks, and the recurrence rate is minimal. A significant angle of overcorrection can lead to esodeviation, which causes suppression of visual acuity, diplopia as well as the gradual binocular vision deterioration. Esotropia recurrence following surgery for intermittent exotropia can be as high as 15% if the follow-up period is long enough and the method used to identify it is accurate [4].

According to **Kim *et al.*** [5] most patients' initial overcorrection following exotropia surgery naturally fades over time. When it comes to esotropia, which is generally present in conjunction with other conditions, treatment is a matter of monitoring and waiting. However, in younger children, esotropia can lead to a loss of sensory function if it persists for an extended period of time. It has been shown that individuals under the age of six with consecutive esotropia are at increased risk of developing amblyopia and completely losing their stereoacuity, according to **Edelman and colleagues** [6].

Evaluation of a case of consecutive esotropia:

Complete ophthalmic examinations should be performed to all patients. Also, patients' information about age, sex & occupation, any chronic disease and any information about previous operation is to be known [7].

Calculation of the deviation angle:

Angle of deviation is measured with patient wearing his fully corrective glasses at near and far by Krimsky method or Prism cover test [3].

Krimsky method:

Base out prism is used to give a more accurate measurement. To achieve symmetrical corneal light reflections, place a prism in front of the eye that is being fixed. If it is placed in front of deviating eye, it is named prism reflection test [8].

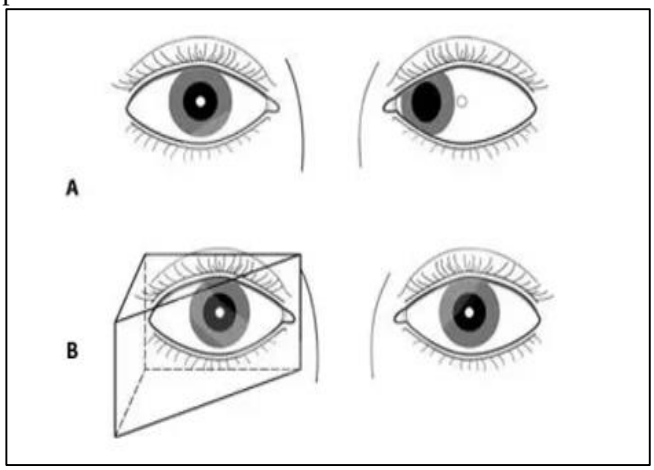

Figure (3): Krimsky method; **A:** left esodeviation in primary position. **B:** Positioning of a base out prism in front of the fixed eye [8].

Prism cover test:

Using an alternate prism cover test, the maximum deviation may be measured at a distance of 6 meters and a close distance of 30 centimeters while the patient is wearing his refractive corrections and viewing an accommodating target in the main position. One eye is covered with a base-out prism, while the other eye is concurrently covered with a second prism, with gradually increasing prism strength, until there is no movement (highest prism power that induced no movement before reversal of the deviation) [9].

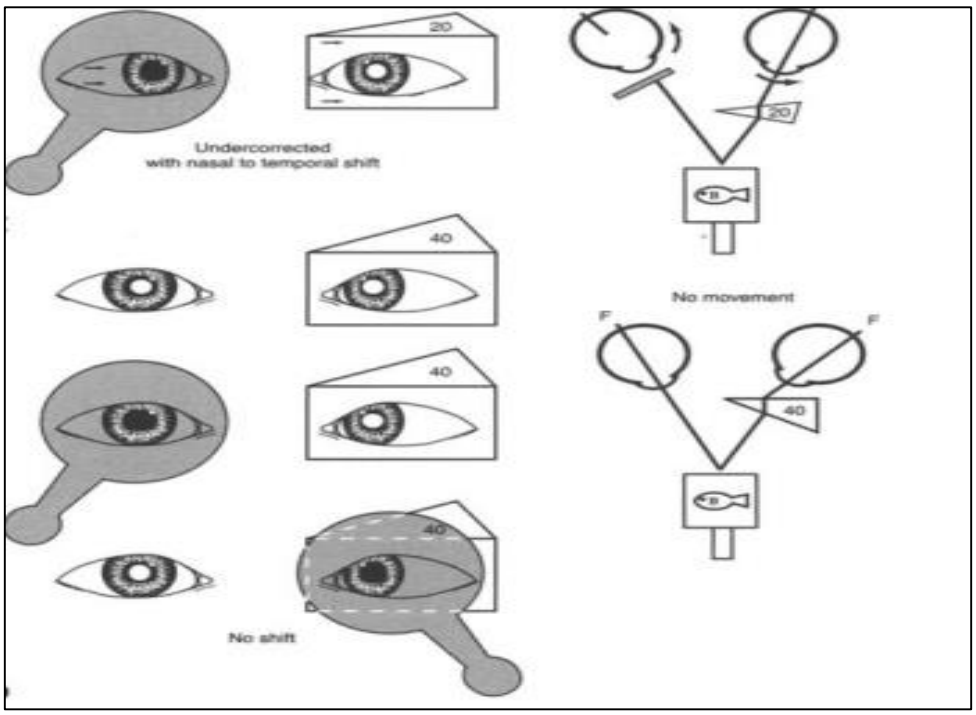

Figure (4): Alternate Prism cover test in 40 PD ET; Using 20 PD prisms beneath correcting the deviation, first covering the right eye, then the left and therefore there is a movement to the outside of the exposed eye. There is no movement in eye position since the deviation is totally countered by a larger prism 40 PD positioned in front of the left eye [(9)].

AC/A ratio measurement:

It's the amount of change in accommodation that corresponds to the change in convergence (AC/A ratio). Diagnosis and treatment of strabismus can be aided by taking an AC/A ratio measurement. If a ratio falls inside a so-called normative range of 3-5:1, it's typically regarded excessive or low heterophoria and lens gradient methods can be used to measure the AC/A ratio [(10)].

Examination of ocular movements:

The initial clinical examination of the extraocular motility (EOM) is to be done by examining the eye movement through the nine cardinal positions to exclude any limitation of movement [(10)].

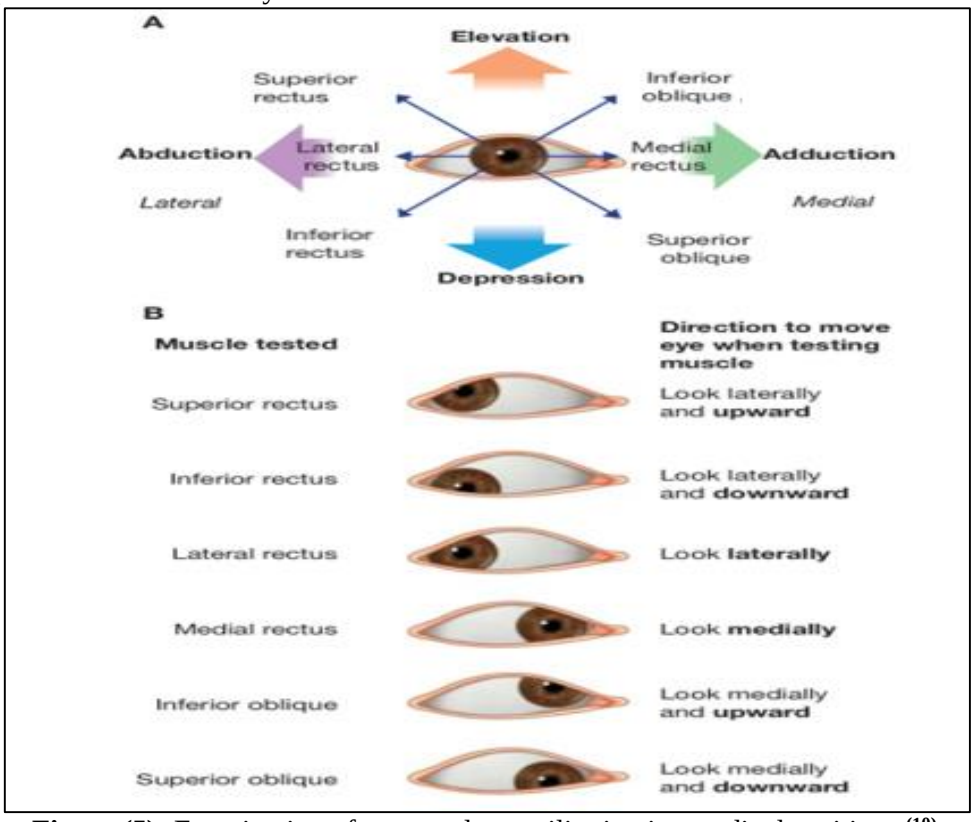

Figure (5): Examination of extraocular motility in nine cardinal positions [(10)].

Stereopsis Measurement

In the third grade of binocular vision, stereopsis, arc seconds are used as the unit of measurement. The stereopsis of patients with strabismus is impacted because of their binocular misalignment. Stereopsis cannot be performed normally if the retinal pictures are misaligned, as the brain cannot fuse them together. Amblyopia can also occur when the visual fields are different resulting in the brain suppress the damaged eye [(11)].

Two objects are polarized at 90 degrees with respect to one another and observed through polaroid filters to create the illusion of depth stereopsis, which may be quantified by the vectograph test known as the Titmus. Fly picture, which occupies half of the exam, is the most dissimilar (3000 seconds). A sequence of circles with stereo disparities ranging from 800 to 40 seconds is followed by three images of animals with several contour cues. The stereo disparities of these images vary from 400 to 100 seconds [(11)].

Fig. (6): Titmus test [(12)].

To test for suppression, the Worth four-dot (W4DT) clinical test can be utilized, which is most commonly used to examine binocular vision in patients. For the W4DT, the examiner can do it from both close (33 cm) and great distances (6m). While, using goggles with red and green tints (with one red lens over the right eye and one green lens over the left). There are four lights in the W4DT device, which is a silver box that is fixed on a wall in front of a patient's face. There are four lights in a diamond arrangement, with a red light at the top, two green lights on either side (left and right), and a white light at the bottom [(13)].

Treatment of consecutive esotropia:

Immediately following surgery for intermittent exotropia (XT), esotropia is recommended because of a predisposition for exotropic drift following surgery. Recent research, on the other hand, indicates that the long-term effects of an initial overcorrection may not be favorable. Consecutive ET can lead to aesthetic issues and difficulty with binocular vision in some patients (e.g. amblyopia, suppression, or diplopia) [(3)].

Nonsurgical treatment is possible in the early stages of recurrent emphysema (such as watchful waiting, alternate occlusion, or prism). Consider surgery if the ET continues for more than 24 weeks following nonsurgical therapy [(14)].

Non-surgical treatment of consecutive ET:

Consecutive ET disappeared mostly within 1 year after intermittent exotropia surgery, with conservative management only.

1. **Correction of refractive errors:** After cycloplegic refraction, hyperopia greater than +1.00 D should be fully corrected. Full correction in myopic should be prescribed to maintain active accommodation. Significant astigmatism and anisometropia should be corrected. Consecutive ET with high AC/A ratio should be corrected by bifocal glasses [(5)].
2. **Treatment of Amblyopia if present:** Treating amblyopic ET with patching the sound eye is essential to enhance sensory and motor fusion by eliminating the suppression scotoma, as determined [(15)]. An anti-suppression treatment called occlusion therapy is employed. Prevention or eradication of improper retinal correspondence and suppression to generate diplopia and enhance motor integration are the goals of this treatment. For this treatment, occlusion of the dominant eye, or alternating occlusion in individuals who have no preference, has been employed [(16)].
3. **Prismatic correction (Using base-out Fresnel prism):** Prism correction successfully manages persistent consecutive ET following BLRR in the majority of patients without the need for reoperation and maintains excellent sensory status and is typically linked with a very good long-term prognosis for patients [(17)].
4. **Botulinum toxin type A:** A kind of botulinum toxin known as BTXA is the most usually utilised. There are receptor sites on motor nerve terminals, and BTXA enters and prevents the release of the neurotransmitter acetylcholine. To be injected into the muscles around the eyes. To begin with, the first dosage is 1.25-2.5 U; lower doses are used for minor deviations, while bigger doses are used for greater discrepancies [(18)].

   Because the medial recti muscles have a high concentration of singly innervated muscle fibers, which are more sensitive to BTXA than muscles with multiple innervations, injection of BTXA into the medial recti muscles is considered to be successful [(19)]. Even though BTXA injections under topical anaesthetic may be administered to most adult patients, this is not frequently practicable for small children. As a bonus, there are no perforations of the scleral membrane or orbital hemorrhages in the event of exodeviation. In 12 percent of adults and 25 percent of youngsters, temporary ptosis and vertical

deviations occur (Occurs in up to 17 percent of patients). If many injections are needed, the patient may also need another strabismus operation [20].

Surgical treatment of consecutive ET:

Indications: (1) Persistence of esodeviation more than 6 months (≥15PD) after correction of exotropia. (2) Non-compliance to non-surgical treatment. (3) Limitation in extraocular movement (lateral gaze). (4) Lateral incommitancy inducing diplopia and loss of proper abduction [5].

Choice of procedure:

Esotropia can be surgically corrected using many surgical techniques, including bilateral MR retraction or LR advancement. Intermittent exotropia was studied in patients who had both bilateral LR recession for exotropia as well as those who did not (average of 24 weeks) [21]. Even though rectus advancement may be more successful in relieving post-operative esotropia, it is not known if MR recession is more beneficial. Therefore, the impact of MR regression was compared to LR advancement in a patient with subsequent esotropia following bilateral LR recession for intermittent exotropia [22].

1. **Medial rectus recession:** MR recession is preferred in consecutive ET without limited movement. There are several advantages to resurrecting a previously operated muscle. Because the anatomical structure is normal and there is no adhesion of surrounding tissues, surgery is simple and predictable. In addition, it has the disadvantage of limiting the number of muscles that may be used in future surgeries [23].
2. **Lateral rectus advancement:** There are advantages to resurrecting muscles that have already been surgically removed, such as verifying that they are connected to the planned location of the original operation with no slippage or resistance on a forced duction test and allowing for further surgery. However, it has drawbacks such as inaccuracy and the adherence of neighboring tissues [24]. Many investigations have shown that surgical advancement for subsequent esotropia is more effective than standard rectus muscle recession in terms of surgical impact [22].

Over time, the previously recessed muscles are believed to lose their flexibility. Exotropia would happen if these muscles were returned to their former position, which would constrain antagonistic muscles. Patients with successive esotropia have a tough time determining the best surgical procedure and the appropriate surgical dosage due to a lack of conventional recommendations [25].

A number of investigations have shown that the surgical impact of an advanced lateral rectus muscle for subsequent esotropia is superior to that of standard lateral rectus muscle recession. Due to the fact that the same amount of surgery would be utilized for both advancement and recession in patients with recurring esotropia, the likelihood of overcorrection is likely to rise [24].

For the purpose of maintaining one MR muscle for a future intervention, several researches have shown that ET can be performed consecutively after BLR recession by advancement of LR muscle previously recessed and MR muscle recession in the more deviating eye. Up till now, there are no standardized amounts of lateral rectus advancement in correction of consecutive ET. So, recent studies intend to evaluate efficacy of lateral rectus advancement [26].

CONCLUSION

For the purpose of maintaining one MR muscle for a future intervention, several researches have shown that ET can be performed consecutively after BLR recession by advancement of LR muscle previously recessed and MR muscle recession in the more deviating eye. Esotropia can be surgically corrected using many surgical techniques, including as bilateral MR retraction or LR advancement. MR recession is preferred in consecutive ET without limited movement.

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