Comitant Horizontal Strabismus

3

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3.1 Introduction

Horizontal comitant strabismus forms the single largest group of strabismus we encounter routinely. In spite of their clinical abundance, varied presentation makes this subtype challenging even for an experienced observer.

Broadly speaking, a horizontal comitant deviation could be either esotropia (ET) or exotropia (XT) depending on whether either eye deviates inwards (nasally) or outwards (temporally). The literal meaning of 'committance' is to be pledged or to accompany in a subordinate way. Both the eyes (are pledged to each other and) have equal deviation in all directions of gaze for a given fixation distance. The seat of anomaly is usually the brain unlike incomitant deviations which arise out of defect in the neuro muscular complex.

Dynamic mechanisms (e.g. accommodation, fusional vergence) may be superimposed or may mask the deviation. Residents often confuse esotropia to be the opposite of exotropia; however, they should be considered as totally different entities.

A simplified classification of ET and XT is mentioned in Table 3.1.

3.2 Esotropia and Its Management

A number of anomalies may lead to esotropia (Fig. 3.1), and it is essential to elaborate the underlying pathophysiology in order to administer the appropriate treatment.

Before going into the types of ET, it would be worthwhile to talk about esophoria E and intermittent esotropia E(T), both of which are usually compensated by

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Table 3.1 Simplified classification of comitant horizontal deviations

Esodeviations
1. Accommodative
Refractive
Non-refractive
Hyperaccommodative (high AC/A)
Hypoaccommodative (reduced NPA)
Partially accommodative
2. Nonaccommodative
Essential infantile
Late onset
Basic type
Acute onset
Convergence excess
3. Sensory
4. Less frequent types
Cyclic[a]
Microtropia
NBS[a]
ET with neurological abnormalities
Exodeviations
1. X
2. X(T)
3. XT
Divergence excess
Basic
Convergence insufficiency
Simulated divergence excess
4. Sensory

ET esotropia, *XT* exotropia, *X* exophoria, *X(T)* intermittent exotropia, *AC/A* accommodative convergence/accommodation, *NPA* near point of accommodation, *NBS* nystagmus blockage syndrome
[a]Discussed in other chapters

Fig. 3.1 Esotropia left eye

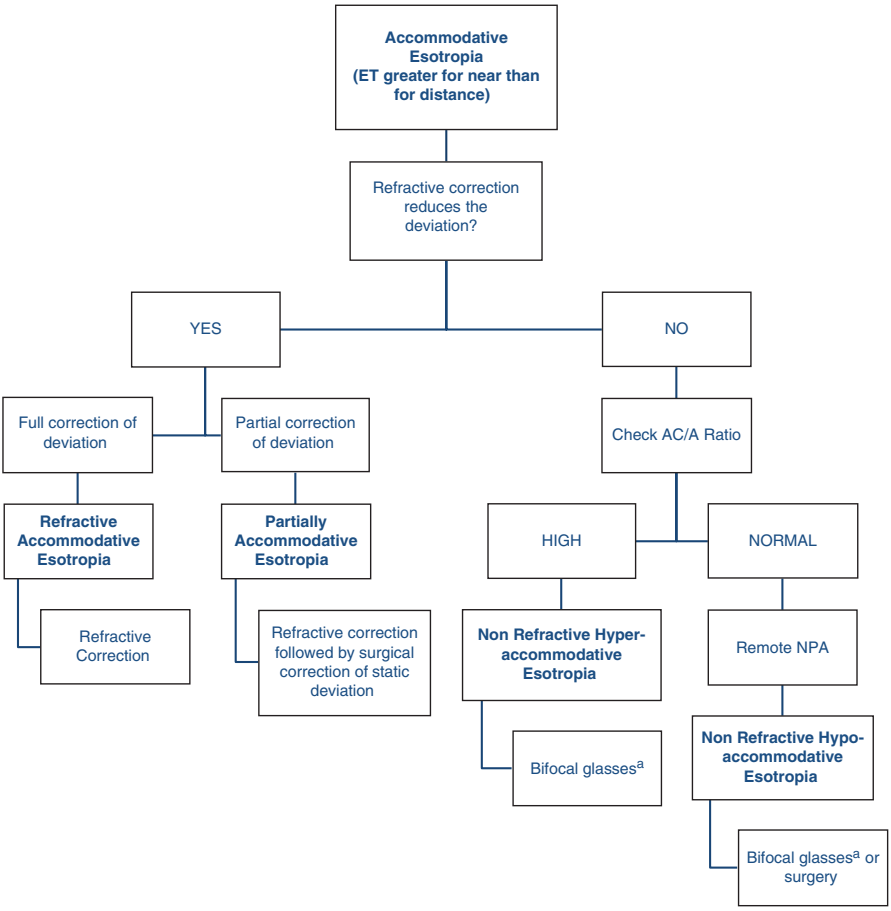
fusional reserves. Refractive correction should be done. If the asthenopia persists, the patient should be referred to a specialist to consider a trial of prisms or, in rare cases, surgery. The following discussion outlines basic characteristics and management of various subtypes of esotropia.

3.2.1 Accommodative ET

Accommodative ET is caused by increased accommodative effort or an abnormally high accommodative convergence/accommodation (AC/A) ratio. Its onset is usually between 2 and 3 years of age, and the deviation for near fixation is larger than that for distance [1]. Simplified approach to diagnosis and management of accommodative ET is represented in Table 3.2.

1. *Refractive accommodative ET* is due to uncorrected hypermetropia. ET occurs because of convergence associated with persistent accommodative effort to overcome uncorrected hypermetropia. AC/A ratio is normal, and it is fully corrected in all gazes and at all fixation distances by refractive correction.

Table 3.2 Diagnosis and management of accommodative esotropia



AC/A accommodative convergence/accommodation, *ET* esotropia, *NPA* near point of accommodation

[a]Bifocal glasses should eliminate the near deviation and have no utility if the deviation merely reduces

Fig. 3.2 Pupil bisecting executive bifocals

2. *Non-refractive hyperaccommodative ET* is caused by an abnormally high accommodative convergence/accommodation (AC/A) ratio with a normal near point of accommodation. The deviation is greater for near fixation and is unrelated to the refractive error. It is treated by prescribing straight top (executive) pupil bisecting bifocal lenses (Figs. 3.2 and 6.2) with the near addition just enough to convert ET into esophoria. Measuring the AC/A ratio has been discussed in the Text Box 3.1 [2–5].
3. Non-refractive hypoaccommodative ET presents as ET for near fixation due to increased accommodative effort to overcome a weakness of accommodation (remote near point of accommodation). This entity is seldom seen, and both bifocals and medial rectus weakening procedures are recommended for its management [6].
4. Partially accommodative ET is diagnosed when only a part of the deviation is due to accommodative factors (Fig. 3.3). The nonaccommodative component may be congenital or may develop after correction of refractive error [1]. Surgery is indicated to correct only the static deviation after refractive correction.

3.2.2 Nonaccommodative ET

The distinctive feature between accommodative and nonaccommodative esotropia is the absence of disparity in deviation while fixating upon a near or distant target. The following are the common subtypes of nonaccommodative esotropia:

Text Box 3.1: Measuring the AC/A Ratio

The AC/A ratio can be measured either by the gradient method or the heterophoria method. The gradient method gives a better estimate of the ratio [2]. The unit for AC/A ratio is prism diopter (Δ)/diopter (D). The ratio in normal subjects varies from about 1.5:1 to 5.5:1 depending on the method used for its calculation and probably also on the race [3–5].

Gradient method

$$\text{AC / A} = \frac{N - L}{3}$$

N = Deviation in Δ with proper correction at 33 cm

L = Deviation with addition of +3D lenses at 33 cm to relax accommodation

Heterophoria method

$$\text{AC / A} = \text{IPD} + \frac{N - D}{3}$$

IPD = Interpupillary distance (in cm)

N = Near deviation (33 cm) in Δ

D = Distance deviation (6 m) in Δ

Fig. 3.3 (L to R) Refractive accommodative ET, partially accommodative ET and nonaccommodative (basic type) ET

1. *Essential infantile ET* as the name suggests has an onset in the first year of life and has an unknown aetiology (Fig. 3.4). It is a commonly seen variant and is characterised by a stable, large-angle deviation with asymmetrical optokinetic nystagmus. Amblyopia, crossed fixation and other motility abnormalities like up shoot or down shoot on adduction are frequently associated. It's management is surgical alignment. Surgery should be performed as soon as a fair estimate of the

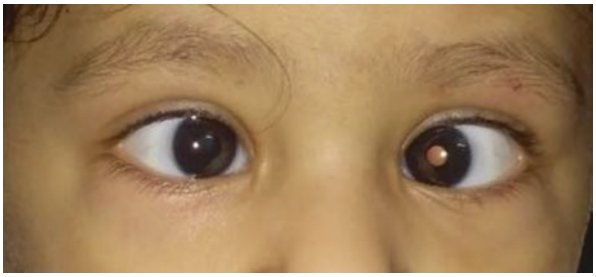


Fig. 3.4 Infantile ET

Text Box 3.2: Choice of Surgery in Infantile ET

Children below 6 years	Bimedial recession
Patients with demonstrable binocularity	Bimedial recession
Patients with no binocular functions	MR Recession + LR Resection of non-dominant eye
Children unwilling/unfit for surgery	Inj. botulinum toxin in both medial recti

amount of deviation can be made. The surgery recommended is bimedial recession in children and medial rectus recession with lateral rectus resection of the non-dominant eye in patients with poor prognosis for recovery of binocularity (Text Box 3.2). For children in whom early surgery is not possible, botulinum toxin may be considered as an alternative (Chap. 8). Frequently, multiple surgeries are required and binocular functions remain subnormal in long term. Postoperative rehabilitation should be aimed towards amblyopia management.

2. *Acquired or basic ET* has a gradual onset after infancy with no disparity between near and distance deviation. Amblyopia management should be followed by surgical alignment.
3. *Acute onset comitant ET* should be carefully differentiated from paralytic strabismus paying careful attention to motility limitation (Chap. 1). This entity should be managed by specialists.
4. *Convergence excess ET* occurs due to excessive convergence in the presence of normal accommodation. Large bilateral MR recession or posterior fixation sutures (Faden's procedure) on them may be indicated for treatment [1].

3.2.3 Sensory ET

Sensory ET occurs secondary to poor vision in one eye. Treatment consists of correcting the underlying cause of poor vision and amblyopia therapy if the cause is treatable. Alignment should be considered even for blind eyes as the psychosocial impact of cosmetic disfigurement is significant [7–9].

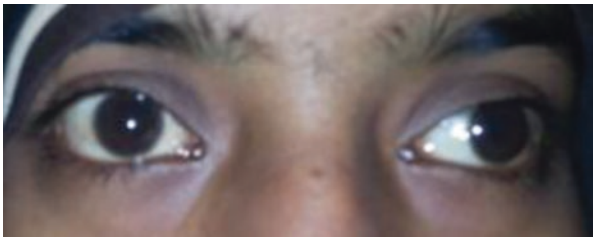


Fig. 3.5 Exotropia left eye

3.2.4 Microtropia

Microtropia is a small-angle (lesser than 5°) ET associated with abnormal retinal correspondence, amblyopia, normal peripheral fusion and defective stereopsis. It is usually diagnosed in older children and adults, in whom it does not require treatment.

3.2.5 ET with Neurological Abnormalities

Children with neurological abnormalities like cerebral palsy often have associated strabismus, most frequently ET [10]. This may present in infancy or later and may show large variability over time. Considering the variability and high risk for general anaesthesia, we manage these children by amblyopia prevention therapy and botulinum toxin initially. Surgical management has a satisfactory outcome in about 50% of children [11].

3.3 Exotropia

Unlike ET, which present as a conglomerate of discreet underlying pathologies, exodeviations are more uniform in their presentation. Exophoria X, intermittent exotropia X (T) and constant exotropia XT may usually be considered as continuum of the same spectrum with progressively worsening fusional reserves [12]. The onset is in early childhood, but usually the patients present as adults when the amplitude of accommodation and tonic convergence begin to decline. As decompensation of exophoria begins, the patient may complain of diplopia, asthenopia or photophobia (due to absence of near clues which help in control the deviation). As the deviation becomes constant, suppression develops, and patient becomes asymptomatic except for cosmetic disfigurement (Fig. 3.5).

It should be understood that many patients have variability of fusional control depending on alertness, general health, anxiety and willingness to cooperate for examination. It could vary at different time of the day and from one examination to the next. Calhounz et al. have classified XT into IV phases based on the fusional control where a patient in phase I has X at distance only, in phase II has X(T) for distance, phase III has XT for distance and X(T)′ for near, and phase IV has

constant XT. A phase I patient would be asymptomatic, and there would be a progressive worsening of binocular functions from phase II till phase IV where they would be largely absent (Text Box 3.3).

Text Box 3.3: Phenomenon of Panoramic Vision
Horizontal enlargement of the visual field during binocular viewing is sometimes seen in large angle constant XT. There is absence of any retinal correspondence and the two eyes function independently like in lower species. These individuals enjoy a large horizontal visual field up to 250° at the cost of the binocular vision.

Clinical Tip
Care should be taken to neutralise any effect of fusion mechanisms while evaluating the angle of deviation. Maximum static deviation should be assessed while planning surgical management.

3.3.1 Exotropia Classification

For management it would be also useful to classify XT into the following types

1. *Divergence excess*—when the deviation for distance fixation is at least 15$^{\Delta}$ (prism dioptres) larger than for near
2. *Convergence insufficiency*—when the deviation for near fixation is at least 15$^{\Delta}$ larger than for distance
3. *Basic*—when the near and distance deviations are equal or their difference is lesser than 15$^{\Delta}$
4. *Simulated divergence excess*—which on initial testing has a significantly larger deviation for distance fixation but on elimination of dynamic factors (by occlusion of either eye for 1 h) the near deviation becomes equal to or larger than the distance deviation. This phenomenon is called *convergence after effect*. For this reason all patients with divergence excess type of deviation should undergo an occlusion test by occluding either eye for 1 h [13]. Before removing the patch for measurements (by prism and cover test), the fellow eye should be occluded to prevent even a momentary binocular stimulation that could make the patient control the near deviation.

3.3.2 Exotropia Management

As with all types of strabismus, refractive correction should be the first step in management. Although it is believed that uncorrected myopia plays a role in development to exodeviation by constant under stimulation of convergence [14], this factor has a much lesser importance than hypermetropia in causation of esotropia [11]. Myopia should be fully or slightly overcorrected and least possible hypermetropic

correction should be titrated individually to make the patient comfortable. Contact lenses and refractive surgery are known to have a beneficial effect on ocular deviation and may be tried in suitable patients as discussed in Chap. 6 [15, 16].

As in accommodative ET, it has also been suggested to measure the deviation for near fixation through +3.0 D sphere to eliminate the need for accommodation and unmask substantially larger deviation in patients with increased AC/A ratio [17]. This exercise, however, has a very limited role in management planning of XT [11, 18]. Stereoacuity assessment for near and distance should routinely be done in patients with X(T). A progressive deterioration can be an indicator for early surgical intervention.

Role of prisms and orthoptics is limited to improving binocular vision, amblyopia treatment and treating obvious convergence insufficiency. Definite treatment of symptomatic X, X(T) and XT is surgical [11].

Surgery for constant deviations should be performed once the diagnosis is made and reliable measurements made. Surgery is not performed for deviations lesser than 15$^{\Delta}$.

Text Box 3.4: Timing of Surgery in X(T)
Surgery in intermittent exotropia [11, 15–17] should be considered when

- There is progression as evident by:
  - Increased frequency of manifest deviation (>50% of waking hours)
  - Increase in size of basic deviation
  - Evidence of deterioration of distance stereoacuity or development of suppression
- Newcastle control score (NCS) is ≥3/7

NCS is calculated by scoring home and clinic control and totalling the scores (0 being best control and 7 being worst).

Home control is scored 0, 1, 2 or 3 depending on whether the deviation is never noticed, noticed <50% of the time for distance, >50% of the time for distance or seen for both near and distance.

Clinic control is scored (*separately* for distance and near) 0, 1 or 2 depending on whether the deviation is manifest only after cover test with spontaneous control or control occurs after a blink or gets manifest spontaneously.

Timing of surgery for X(T) is decided according to information in Text Box 3.4 [11, 19–21]. Choice of surgery is summarised in the Text Box 3.5 [11]. Botulinum toxin injection has also been suggested for management in children and adults [22, 23].

Short- to medium-term results of exotropia surgery are good with majority of patients achieving reduction in static angle and developing better control of deviation. The latter can be attributed to better sensory status in most XT patients compared to ET. However, long-term prognosis is guarded as recurrences are common.

Sensory XT occurs secondary to poor vision in one eye. Alignment is recommended for cosmesis and associated psychosocial benefits [6, 7].

Text Box 3.5: Choice of Surgery in XT according to types

Divergence excess	Bilateral LR recession
Convergence insufficiency	1. Bimedial resection (if deviation present only for near)
	2. LR recession + MR resection of 1 eye
Basic type and simulated divergence excess	LR recession + MR resection of non-dominant eye
Sensory XT	LR recession + MR resection of blind eye

3.4 Summary

- Horizontal comitant strabismus forms the commonest group of strabismus and can be broadly classified into esotropia and exotropia.
- Primary anomaly is believed to lie in the higher centres. Dynamic factors may be superimposed making the management challenging.
- Prescribing appropriate refractive correction is the essential first step in management.
- Deviation should always be measured for near and distance. Any change in deviation with refractive correction must also be noted.
- Early surgery is indicated in essential infantile esotropia.
- Exotropia may be considered a clinical spectrum with exophoria and constant exotropia as the two extremes, indicating a progressive loss of fusional reserves.
- While assessing exotropia, all efforts must be made to unmask the maximum deviation before planning surgical correction.
- X(T) is common; surgical intervention may be indicated in the presence of worsening stereoacuity.
- Surgery is considered only for the static component of deviation with the aim to restore stable fusion at near and distance fixation.

3.5 Multiple Choice Questions

1. Infantile esotropia is characterised by all of the following *except*:
   (a) Large-angle deviation
   (b) Cross fixation
   (c) Inferior oblique overaction
   (d) High hypermetropia

Answer: (d) Infantile esotropia is usually not associated with significant refractive error.

2. True about management of intermittent exotropia X(T)
   (a) When the exotropia occurs during more than 50% of waking hours, surgery should be performed.
   (b) If diplopia vanishes in a patient who previously had diplopia, it is a good prognostic sign.
   (c) Near stereoacuity is more important than distant stereoacuity as it worsens earlier.
   (d) All of the above.

Answer: (a) Exotropia occurring for more than 50% of waking hours is indication of surgery. If diplopia vanishes in a patient of X(T), it is a bad sign as it signifies suppression. Distance stereoacuity deteriorates first in X(T).

3. Which of the following best defines accommodative esotropias?
   (a) Onset at 3–4 years of age with deviation equal for near and distance.
   (b) Onset at 2–3 years of age, deviation for near more than distance, may be associated with hypermetropia or high AC/A ratio.
   (c) Onset <1 year of age and high AC/A ratio.
   (d) Onset at 2–3 years of age, deviation for distance more than near.

Answer: (b) Accommodative ET is caused by increased accommodative effort (due to hypermetropia) or an abnormally high AC/A ratio. Its onset is usually between 2 and 3 years of age, and the deviation for near fixation is larger than that for distance.

4. 1 mm decentration of corneal reflex corresponds to:
   (a) 5°
   (b) 7°
   (c) 5.5°
   (d) 6°

Answer: (b) 1 mm decentration of corneal reflection corresponds to 7° of deviation in visual axis.

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