

**SURGICAL OUTCOME OF INTERMITTENT EXOTROPIA**Reshu Malhotra<sup>1</sup>, M. Gurudutt Kamath<sup>2</sup>, M. Manjunath Kamath<sup>3</sup>, Madhurima K. Nayak<sup>4</sup>**HOW TO CITE THIS ARTICLE:**

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**ABSTRACT: AIM:** To assess the surgical outcome of intermittent exodeviation in the form of ocular alignment and stereopsis. **MATERIALS AND METHODS:** It was a prospective comparative study conducted at a teaching hospital in South India. Preoperative angle of deviation was measured for all patients with intermittent exotropia. Binocular function was measured using worth four dot test and stereopsis was measured using Titmus fly test. They underwent bilateral recession or unilateral recession/resection and were followed up at first week, first month and third month postoperatively. **STATISTICAL ANALYSIS:** Paired t test and unpaired t test were used. **RESULTS:** A total of 20 patients were studied. 14 patients underwent unilateral recession/resection and four underwent bilateral lateral rectus resection with medial rectus recession and two underwent bilateral lateral rectus recession/resection. Successful surgical alignment was accomplished in 77.8% of patients after a mean follow-up of 3 months. 85.71% success was seen with unilateral recession/resection, whereas bilateral recession/resection and lateral rectus recession had a success rate 50%. 72.22% patients had 60 arc sec or better stereopsis at three months postoperatively. **CONCLUSIONS:** Unilateral recession/resection has better outcome compared to bilateral surgery. Surgery for intermittent exotropia can help preserve binocular vision.

**KEYWORDS:** Intermittent exotropia, Stereopsis, Binocularity in exotropia, Lateral rectus recession.

**INTRODUCTION:** Intermittent exotropia (X(T)) is the commonest form of exotropia in normal children, accounting for about 50-90% of all the exotropia, with a prevalence ranging from 9.4 to 18.7/1000 population. It is more prevalent in Asian than in Caucasian population.<sup>[1]</sup> The characteristic features of X(T) are unique: one eye deviates outward typically when viewing a distant object, during periods of inattention, in bright light or when person is tired.<sup>[2]</sup> Closure of one eye in bright light<sup>[3]</sup> and panoramic viewing are other common features of X(T).<sup>[4]</sup> The symptoms of X(T) vary, including headache, blurred vision, diplopia and eye fatigue. In some cases, an exophoria can progress to an X (T) that eventually becomes constant exotropia.

Treatment of X (T) is aimed at reducing episodes of manifest exotropia, facilitating sensory fusion and achieving constant binocular alignment and normal stereo acuity. Surgery is an effective method. In spite of disagreement regarding the best surgical approach, recession of both lateral recti muscles (BLR) and monocular recession-resection (R&R) procedures are commonly used. Monocular surgery has low incidence of overcorrections and less risk of complications; however it may cause large number of under correction. The isolated recession of the lateral recti is known to provide more stable surgical results. The success rate using R & R procedure varies from 55-82% and with BLR it varies from 52-69%.<sup>[4]</sup>

Due to the large variability of the results and with no definitive evidence regarding which procedure is best for X (T), this study was done to understand the surgical outcome of recession of BLR and the R & R procedure.

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**MATERIALS AND METHODS:** This was a prospective, comparative study in X (T) 20 patients. Assessment of the surgical outcome was the primary objective. Evaluation of binocular function and overcorrection and under correction following the surgery were the secondary objectives. The study was initiated after institutional ethics committee approval and written informed consent from the patients. The inclusion criteria were patients with X (T) and those willing to participate in the study. The minimum age of surgery was four years, and no previous history of surgery and/or associated eye diseases. Critically ill patients, patients with preoperative amblyopia, coexisting ocular disease, neurological or systemic impairment, consecutive exotropia, manifest exotropia, large vertical deviation, pattern deviation, variable measurement of deviation preoperatively on prism cover test, paralytic strabismus and poor follow up patients were excluded.

Visual acuity was measured without correction, with pin hole, and with spectacle correction. Refraction under full cycloplegia was done. Angle of deviation was measured both for >6m and for near and in case of spectacles both with and without them by Hirschberg test and prism bar cover test. Binocular function was assessed by worth four dot test. Titmus fly test (Titmus Optical company, Chicago, Illinois) was done for stereopsis (Bi fixation  $\leq 60$  sec arc and mono fixation  $> 60$  sec) and for postoperative sensory status. Dilated fundus examination was done to rule out fundus pathology.

The initial surgery consisted of unilateral lateral recession and medial rectus resection in patients with deviation  $< 60$  PD in order to avoid the use of general anesthesia in cases of bilateral surgery and to reduce the morbidity associated with it. Angle of deviation greater than 60 PD were treated with three muscle surgery. The amount of recession performed was based on the distance deviation.

Patients were followed up at first week, first month and third month postoperatively. At each visit, angle of deviation, binocular function and stereopsis were assessed. A criterion for successful surgery was orthotropia  $\pm 10$ PD and good stereo acuity assessed by Titmus stereo test and stereo test circle.

Primary end point was the percentage of patients with successful surgical outcome. Secondary end points were the visual acuity without correction, with pinhole and with spectacle correction, the refraction under full cycloplegia, the angle of deviation both for distance and near and in case of spectacles both with and without them by Hirschberg test and prism bar cover test, the binocular function by worth four dot test. Results are expressed as the number, percentages, mean  $\pm$  SD as appropriate. Nominal data were compared using chi square test. For continuous data, paired t test was used for pre and post comparison; and unpaired t test was used to compare two groups.  $p < 0.05$  was considered to be statistically significant.

**RESULTS:** Out of 20 patients, 11 were female and 9 were males. The mean age was  $25.80 \pm 14.04$  years (Range 4-58 years). In all the patients, symptoms started in childhood and it was gradual in onset. In twelve patients left eye, five patients right eye and three patients alternate eye was involved. Symptoms were transient diplopia (10%), monocular eye closure (20%) and aesthenopia (40%). 90% patients did not have any prior treatment. The angle of deviation for distance and near in PD are given in Table 1 and 2 respectively. Stereo acuity circles before surgery showed 60% bi-fixation and 40% mono-fixation. [Table 3] Distribution on the basis of age v/s stereopsis showed twelve patients with the mean age of 20.7 years had bi-fixation and eight patients of mean 33.3 years of age had mono-fixation and this was statistically significant. Eleven patients had suppression in worth four dot test before surgery. [Table 4]

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16 patients had two muscle surgeries (14 unilateral R & R and 2 BLR) and four patients had three muscle surgeries (Unilateral R & R and contralateral LR recession). 18 patients completed the study according to the protocol; two patients were lost to follow up at the third month.

The postoperative results were statistically significant in almost all the tests done at first week, first month and third month follow ups. Angle of deviation for distance was orthophoria for 45% patients at first week, 50% at first month and 50% after three months with a minimum of 30% and maximum of 80% deviation [Tables 3, 4 and 5]. Similarly, angle of deviation for near was orthophoria in 90% of the patients during all postoperative follow-ups.

Stereo test circles (In sec) showed bi-fixation in 70% patients at each follow up and mono-fixation among 30% patients. Mono-fixation is seen more predominantly in the older patients (39.5 years) than younger patients (19.9 years) postoperatively. In Worth four dot test, 16 patients showed normal in all the three follow up and four patients showed suppression.

The successful surgical alignment defined as orthophoria/esotropia is achieved by 85-91% among patients who underwent R & R, and 50% by the patients in other two surgical groups [Table 5]. 15 patients had successful surgery, with four patients showing under correction and one patient having overcorrection. The success rate of the surgery was significantly high in all the three follow ups. [Table 6]

Overall success of the surgery can be assessed by the combination of test results as orthophoria+stereo test among 50% patients, whereas esotropia<10PD+stereo test in 5% patients and exotropia+stereo test in one patient. Finally the success rate of the surgery among the 20 patients was found to be 60% [Table 7].

**DISCUSSION:** The surgical success in patient with X(T) is unpredictable. The reported success rate varies from 40% to 83%. As the main purpose of surgery is to obtain stable binocular vision, well-compensated orthophoria or exo or esophoria is considered as a surgical success. In line with established criteria,<sup>[5-9]</sup> we considered a criterion of orthotropia $\pm$ 0PD and good stereo acuity for surgical success.

Surgical success was accomplished in 77.78% of patients after a mean follow-up of 3 months. The results were in line with other published studies.<sup>[5,6,8-10]</sup> Richard and Parks<sup>[8]</sup> reported a low success rate of 56%. The success rate of surgery is depends on the skill of the surgeon and the duration of follow-up. In our study, R & R had 85.71%, 85.71% and 91.67% success rate at 1 week, 1 month and 3-month postoperative period. Similar success rate was found by Fiorelli (77%),<sup>[11]</sup> Kushner's (82%),<sup>[12]</sup> Valenzuela's (55%)<sup>[9]</sup> and Lee's (60%).<sup>[6]</sup> Success rate with BLR was 50% at all three time points which was again in the line with success rate of other studies (52%-69%).<sup>[7,9,10]</sup> Overall successful surgical alignment in our study at 1 week & 1 month was 75% and 77.8% at 3 month follow up period.

Ko and Min<sup>[13]</sup> reported that the deviation angle immediately after the BLR was an important factor influencing the surgical outcome. Rabb<sup>[14]</sup> and Scott<sup>[15]</sup> have reported that a better result could be obtained by performing surgery allowing for a 10-20PD overcorrection immediately after surgery in comparison to under correction. Lee <sup>[16]</sup> have reported that the initial deviation angle on 1 day after the surgery for X (T) could be a predictive factor influencing the surgical outcome.

Though our study was not powered, comparison of success rates of the different surgeries showed comparable results, unlike previous publications that showed R & R is a better procedure.<sup>[5,10,17,18]</sup>

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The advantages of monocular surgery include low incidence of overcorrections and less risk of complications,<sup>[19,20]</sup> however, it may cause a larger number of under corrections.<sup>[9]</sup> Some authors believe the isolated recession of the lateral recti provides more stable surgical results.<sup>[5]</sup>

70% of patients in our study demonstrated 60 arc sec or better of stereopsis at 1 week & 1 month and 72.22% at 3 months as compared to 60% preoperatively. Wu et al reported 74% patients with X(T) as having better than or equal to 60 seconds of arc after one year of follow-up.<sup>[21]</sup> Noha et al reported the long-term sensory outcomes in 90% X(T) patients. 45% patients had 60 seconds or better arc stereopsis after 10 years.<sup>[22]</sup> In our study, patients who underwent surgical correction at younger age were significantly less likely to have mono-fixation ( $P < 0.1$ ). Therefore, patients who undergo early surgery at a younger age, have superior sensory outcome. Also, successful surgery that is orthotropia  $\pm 10$ PD for surgical success and good stereo acuity (Titmus stereo test & stereo test circle) was seen in 60%, 60% and 66.6% patients at 1 week, 1 month and 3 month postoperatively and the rate of postoperative deterioration from bi-fixation to mono-fixation was 0%.

We found 20%, 20% and 22.22% under corrections and 5 %, 5 % and 0 % over correction at 1 week, 1 month and 3 months postoperative respectively. Incidences of under corrections were 32% by Valenzuela after 2 years of follow-up,<sup>[9]</sup> 37% by Lee with LR recession and 30% with R & R<sup>[9]</sup> and 22% by Fiorelli with LR recession and 20% with R & R.<sup>[11]</sup> Corresponding incidences of overcorrections were 11% (Valenzuela),<sup>[9]</sup> 6 % and 10% (Lee)<sup>[6]</sup> and 4 % and 2 % (Fiorelli).<sup>[11]</sup>

Currently, early surgery is indicated in children to prevent progressing to constant exotropia and restore the bi-fixation, whereas for most adult patients, surgery can only help to achieve normotropia, but not bi-fixation. Abrams et al.<sup>[23]</sup> and Lou et al.<sup>[24]</sup> have proposed that patients achieve superior sensory outcome with motor realignment before age 7 or <5 years of strabismus duration. Others hold that the surgery needs to be postponed for several years because X(T) patients can still keep intermittent normotropia and bi-fixation could hence be obtained; not all X(T) is progressive. In some cases, the deviation may remain stable for many years, whereas in a few cases, it may even be improved.

The concern that early surgery may threaten the sensory status of a patient with X(T) is theoretically valid. A loss of bi-fixation may result from a sustained, constant esotropia of greater than 3 month's duration that may be a consequence of the surgery.<sup>[25,26]</sup> The authors who have advised against operating on patients with X(T) at an early age raise the concern that persistent overcorrections will result in amblyopia and a loss of stereopsis in visually immature patients.<sup>[27,28]</sup> For the patient population as a whole, delaying surgery for fear of losing bi-fixation after surgery may actually increase the frequency of postoperative mono-fixation. If persistent consecutive esotropia is managed aggressively with prisms, sensory outcome is rarely compromised. Other studies have reported similar low rates of postoperative deterioration from bi-fixation to mono-fixation: 0%,<sup>[9]</sup> 3.6%,<sup>[29]</sup> 3.9%,<sup>[30]</sup> 4.5%.<sup>[8]</sup>

Several studies have suggested that a delay in surgery results in improved predictability, long-term stability, and lower reoperation rate. Some argue that even if the young patient can achieve a good surgical result, there is no harm in delaying until deterioration becomes apparent. This conservative approach would spare the patient any additional risks associated with earlier surgery.<sup>[27,31]</sup> In contrast, other investigators have noted successful outcomes in younger patients and have advocated overcorrections during the immediate postoperative period regardless of age.<sup>[14]</sup> Pratt-Johnson<sup>[32]</sup> and co-investigators concluded that surgery before the age of 4 years was the most significant factor in obtaining good alignment. Saunders and Trivedi recently reported that even

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younger children (Mean age, 17 months) responded well to surgery. Of their 12 patients, 58% were aligned within 10 PD of orthotropia after 5 years of follow-up.<sup>[33]</sup>

One case needs special mention. Postoperative diplopia was noted in 1 patient who had consecutive esotropia 5PD for distance at 1 week and 1 month postoperatively and had a symptom of diplopia at lateral gaze. Patient was lost to follow up after 2<sup>nd</sup> visit. There are some situations in which a patient without previous diplopia may predictably see double after strabismus surgery if the postoperative motor alignment is not satisfactory. Kushner,<sup>[34]</sup> concluded that intractable diplopia after strabismus surgery in adults without previous diplopia is very rare, if the desired alignment is obtained surgically and that the use of prisms prior to surgery may help in identifying patients at risk.

Prospective design with standard protocol to determine type and amount of surgery was the strength of the study. In addition, a single surgeon performed surgeries thus ruling differences in surgical preference and techniques. We also analyzed the immediate post-operative alignment. The study has a number of limitations. First, the sample size was small. Second, the shorter duration of follow up. Third, associations between early surgery and superior sensory outcomes suggest the presence of, but do not allow the establishment of, causal relationships. Fourth, a surgeon with his own surgical preferences and techniques performed surgery. Fifth, different X(T) types was not taken in to consideration while performing surgery.

More work needs to be performed to determine which type of surgery will provide the best initial and long-term success for X(T). Preoperative factors such as the age and duration of X(T), fusion and stereopsis may well play a role in outcome.

Alternatively, the answer may lie in more attention to postoperative factors such as immediate postoperative strabismus size, or promoting control/achieving stereopsis postoperatively (e.g., with fusional exercises).

The R &R is more advantageous and the surgery at an early age have better outcome by preventing the progression to constant exotropia and restore the bi-fixation.

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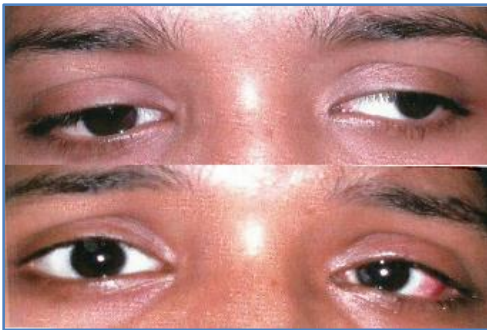
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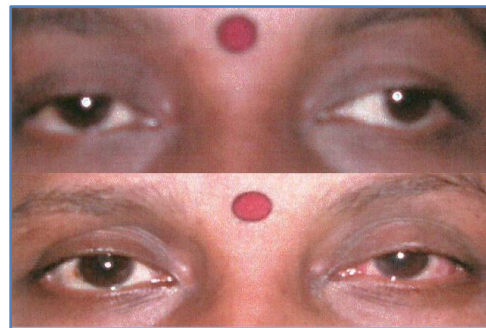
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**Fig. 1**



**Fig. 2**



**Fig. 3**



**Fig. 4**

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AOD (IN PD)	No. of Patients n (%)			
	Before Surgery	1 Week Post OP	1 Month Post Op	3 Month Post OP
ET 10-20	0(0%)	1(5 %)	1(5%)	0(0%)
ET1-9	0(0%)	2(10%)	1(5%)	1(5.56 %)
XT <10	0(0%)	9(45 %)	10(50 %)	9(50 %)
XT 10-20	0(0%)	4(20 %)	4(20 %)	4(22.22 %)
XT 21 -40	2(10 %)	2(10%)	2(10 %)	3(16.67 %)
XT 41-60	13(65%)	2(10%)	2(10 %)	1(5.56 %)
XT >60	5(25 %)	0(0%)	0(0%)	0(0%)
Total	20(100%)	20(100%)	20(100%)	18(100%)

**Table 1: Angle of deviation for distance(PD)**

ET- Esotropia; XT- Exotropia; PD- Prism diopter.

AOD (IN PD)	No. of Patients n (%)			
	Before Surgery	1 Week Post OP	1 Month Post Op	3 Month Post OP
ET 10-20	0(0 %)	0(0 %)	0(0%)	0(0 %)
ET1-9	0(0 %)	0(0%)	0(0%)	0(0%)
0	0(0 %)	9(90 %)	10(90.9%)	9(90 %)
XT <10	0(0 %)	0(0%)	0(0%)	0(0%)
XT 10-20	3(15%)	1(10 %)	1(9.09 %)	1(10 %)
XT 21 -40	11(55%)	0(0%)	0(0%)	0(0%)
XT 41-60	6(30 %)	0(0%)	0(0%)	0(0%)
Total	20(100%)	10(100%)*	11(100%)**	10(100%)***

**Table 2: Angle of deviation for Near**

ET- Esotropia; XT- Exotropia; PD- Prism diopter

\* 10 patient excluded (7 pt X (T) Distance & 3 pt ET Distance)

\*\* 9 patient excluded (7 pt X (T) Distance & 2 pt ET Distance)

\*\*\*10 patient excluded (7 pt XT Distance, 1 pt ET Distance & 2 patient lost follow-up.

AOD (IN PD)	No. of Patients n(%)			
	Before Surgery	1 Week Post OP	1 Month Post Op	3 Month Post OP
BIFIXATION≤ 60SEC	12(60.0 %)	14(70 %)	14(70%)	13(72.22 %)
MONOFIXATIO N>60SEC	8(40 %)	6(30%)	6(30 %)	5(27.78 %)
Total no of patients	20(100%)	20(100 %)	20(100%)	18(100%)*

**Table 3: Stereotest circles before and post-surgery**

\*2 patients lost follow up.



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W4 Dot Test	No. of Patients n (%)			
	Before Surgery	1 Week Post OP	1 Month Post Op	3 Month Post OP
BIFIXATION $\leq$ 60SEC	09(60.0 %)	16(70 %)	16(70%)	14(72.22 %)
MONOFIXATION $>$ 60SEC	11(40 %)	4(30%)	4(30 %)	4(27.78 %)
<b>Total no of patients</b>	<b>20(100 %)</b>	<b>20(100%)</b>	<b>20(100 %)</b>	<b>18(100%)*</b>

Table 4: Worth 4 dot test-before surgery & after surgery

\*2 patients lost follow up.

Surgery	No. of Patients n(%)			
	Before Surgery	1 Week Post OP	1 Month Post Op	3 Month Post OP
R&R	14	12(85.71%)	12(85.71%)	11(91.67%)*
BLR	2	1(50%)	1(50 %)	1(50 %)
BLR+ MR RES	4	2(50 %)	2(50 %)	2(50 %)
<b>Total</b>	<b>20</b>	<b>15(75%)</b>	<b>15(75%)</b>	<b>14(77.78 %)</b>

Table 5: Successful surgical alignment defined as Orthophoria /Esotropia or Exotropia $<$  10 pd

\*2 patients lost follow up.

Surgery	1 Week Post OP	1 Month Post Op	3 Month Post OP
Success rate	15(75%)	15(75%)	14(77.78 %)
Under correction	4(20 %)	4(20 %)	4(22.22%)
Over correction	1(5 %)	1(5 %)	0
<b>Total</b>	<b>20</b>	<b>20</b>	<b>18</b>
P value	0.025	0.025	0.018

Table 6: Successful surgeries

One sample Chi-Square test.

Surgery	No. of Patients n (%)			
	Before Surgery	1 Week Post OP	1 Month Post Op	3 Month Post OP
Orthophoria +Stereotest $<$ 60Sec	20	9(45%)	10(50%)	9(50 %)
Osotropia $<$ 10PD+Stereotest $\leq$ 60 Sec	20	2(10 %)	1(5 %)	1(5.56%)
Exotropia $<$ 10 PD+ Stereotest $\leq$ 60 Sec	20	1(5 %)	1(5 %)	2(11 %)
<b>Total</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>18</b>

Table 7: Successful surgeries

One sample Chi-Square test.

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