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## Clinical characteristics and surgical outcome in patient with consecutive exotropia

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### Abstract

**Background:** Consecutive exotropia (XT) is a manifest exotropia that develops either spontaneously or after surgical treatment in a patient that formerly had esotropia. The aim of this work was for assessment of the clinical characteristics of consecutive exotropia and evaluation of the results of surgery.

**Methods:** This prospective cohort study was carried out on 30 patients with established diagnosis of consecutive exotropia after surgery for esotropia with deviation angle >10 PD Who met with the inclusion criteria, aged from 3 years to 25 years. Follow up of patients was done in the postoperative period for 6 months.

**Results:** There were not statistically significant regarding preoperative angle, age of surgery for esotropia, limited adduction and different types of surgical procedure used. There was statically significant relation between period between surgery of ET & consecutive XT ( $P=0.003$ ), post cyclorefraction ( $p<0.001$ ), preoperative angle and each other periods  $p\leq 0.05$  and pre- and post-operative periods regarding Improvement of adduction restriction.

**Conclusions:** Postoperative results showed that 20 patients had a successful outcome (66.7%) with post-operative angle within 10 PD. Surgical management of consecutive XT by medial rectus (MR) advancement had success rate (20%), MR advancement and resection had success rate (30%), lateral rectus (LR) recession had success rate (45%) and LR recession with MR advancement had success rate (5%), surgical treatment of consecutive XT is successful in most of the patients with numerous surgical options performed on a single eye or both eyes in a single session.

**Keywords:** Consecutive exotropia, medial rectus, lateral rectus, outcome

### Introduction

Exotropia is an outward deviation of the visual axis. Non paralytic exotropia is classified into; primary, consecutive, secondary and residual [1].

Exodeviation that develops iatrogenically after esotropia surgery is called consecutive exotropia. The incidence ranged from 4% to 27%. This surgical complication can develop immediately after surgery or many years later, risk factor include: high hyperopia, amblyopia, vertical deviation, A and V patterns, nystagmus, large medial rectus (MR) recessions, restriction of adduction, multiple surgeries, developmental delay and the failure to evaluate the patient condition preoperatively [2, 3].

The surgical treatment of this condition encloses more options on horizontal rectus muscles. All surgeon accept that the decision regarding the surgical procedure to be taken involves an assessment of the type and amount of previous surgery and the presence of limitation of adduction (sometimes to the presence of stretched scar) or convergence insufficiency [4].

It was established that large recessions, exceeding 5 mm of the medial rectus muscle (MRM) can produce consecutive exotropia associated with limitation of adduction; large resections of the lateral rectus (LR) muscle can cause in contrary a limitation of abduction [5].

Usually recession is indicated for patients with consecutive exotropia with limited adduction after bilateral MRM recession, or in cases that underwent unilateral MRM recession/ lateral rectus muscle (LRM) resection surgery [6].

For patients with divergence excess or exotropia with normal MRM function a bilateral LRM recession is indicated, but it should be avoided in patients with limitation of adduction, but one thing is actual concerning Consecutive exotropia, it requires special attention of the orthoptist and surgeons, due to the difficulties in pre-operative assessment, in planning and even performing the surgery [7, 8].

The aim of this study was assessment of the clinical characteristics of consecutive exotropia and evaluation of the results of surgery.

### Patients and Methods

This prospective interventional cohort study conducted on 30 patients diagnosed with consecutive exotropia after surgery for esotropia with deviation angle >10 PD attending at ophthalmology department, Tanta university hospital from June 2021 to July 2022. The study was done after approval from the Ethical Committee Faculty of medicine, Tanta University. An informed written consent was obtained from the patient.

Exclusion criteria were previous surgery for recurrent consecutive XT (Less than 6 months of postoperative follow-up), vertical deviation with congenital or acquired ophthalmic condition such as optic nerve disease, glaucoma media opacity, or cataract and paralytic strabismus.

All patients were subjected to history taking, clinical examination [(Refraction assessment, motility tests, measure angle of deviation (Corneal light reflex, Cover tests), detection of associated motor abnormalities, forced duction test, anterior segment examination and fundus examination, pediatric or internal medicine consultation to detect any systemic diseases, chest problems, or hematological diseases, laboratory investigations.

Surgical treatment methods consisted of: Bilateral MR resection and advancement in patient with limited adduction and equal visual acuity in both eyes with no amblyopia, LR recession in patient with good adduction, combined MR advancement with resection and LR recession in non-dominant eye in patient with anisometropia, amblyopia or deviation with small angle, MR advancement in patient with small angle of deviation.

The amount of surgery depends on the size of exodeviation at 6m with spectacle correction.

All cases were under general anaesthesia, sterilization was done to both eyes by using povidine iodine 5%.

Assessment of ocular alignment in both eyes in primary position by ocular light reflex tests and detection of ocular motility in both eyes by ductions and versions tests. Surgical success was defined as orthophoria or under-correction (residual exotropia) or esotropia within 10 PD.

Follow up: A thorough ophthalmic examination was performed on all patients at one day, one week, 1,3,6 months to detect distant angle of deviation and limitation of adduction movement if present. After 6 months, Patient-Satisfaction score and Patient were done to measure the satisfaction index and scar quality.

### Statistical analysis

Data was fed to the computer and analyzed using IBM SPSS software package version 20.0. Qualitative data were described using (number and percent). Quantitative data range (minimum and maximum), mean, standard deviation, median and interquartile range (IQR). The Shapiro-Wilk test was used to verify the normality of distribution. ANOVA with repeated measures was used to compare between more than two periods for normally distributed quantitative variables, and Post Hoc test (Bonferroni adjusted) for pairwise comparisons. Friedman test was used to compare between more than two periods or stages for not normally distributed quantitative variables, and Post Hoc Test (Dunn's) for pairwise comparisons. Cochran's test was used to compare between more than two periods for binary qualitative variables, with Post Hoc Test (Dunn's) for pairwise comparisons. Significance of the obtained results was judged at the 5% level.

### Results

The patients' characteristics are presented at (Table 1).

**Table 1:** Patients' characteristics among the study patients

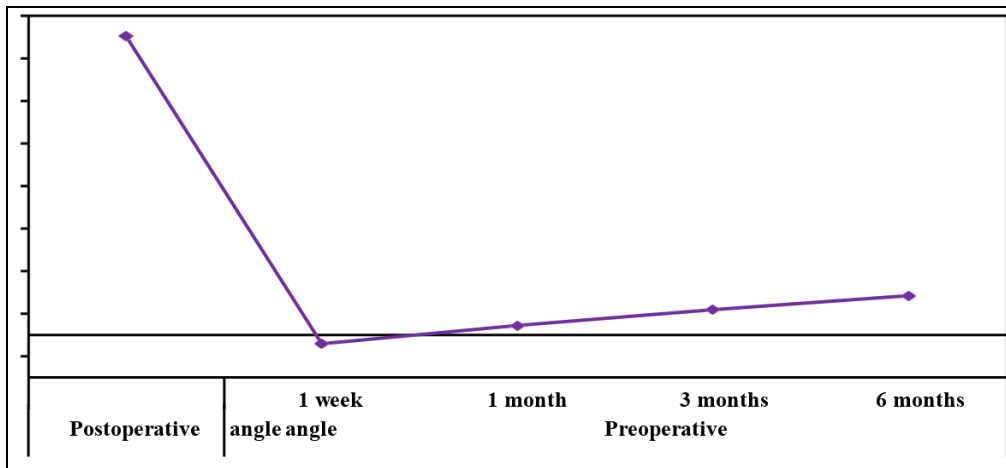
Variables		Patients (n = 30)
Age (years) (Mean± SD)		11.07± 6.26
Sex n (%)	Male	14 (53.3%)
	Female	16 (46.7%)
Age at time of surgery for consecutive exotropia Median (IQR)		11.0 (5.0 – 15.0)
Age of surgery for esotropia Median		6.0 (3.50 – 11.90)
Interval between surgery for ET & onset for Consecutive XT Median		1.0 (0.50-4.0)
Postcyclorefraction Right eye Median (IQR)		2.50 (0.0 – 3.0)
Postcyclorefraction left eye		2.25 (0.0 -3.50)
Preoperative distant angle of deviation measured by PD.		56.0± 12.21

Data are presented as mean±SD, Median (IQR) or frequency (percent). ET: esotropia, XT: Exotropia and PD: prism diopter

Six patients (20.0%) underwent Medial rectus Advancement, 8 patients (26.7%) underwent MR advancement and resection, 14 patients (46.6%) underwent LR recession, and 2 patients (6.7%) underwent LR recession and MR advancement. Postoperative results showed that 20 patients (66.7%) had a successful outcome (post-operative

angle  $\leq$  10 PD esotropia or exotropia and 10 patients (33.3%) failed with angle more than 10 PD.

There were Statistically significant difference at comparing between the studied periods and comparing between preoperative angle and each other periods  $p \leq 0.05$  (Fig 1).



**Fig 1:** The changes in distant deviation angle after surgery in the follow up visits in the 1st week, 1st month, 3rd month, 6th month.

Degree of patient satisfaction and the presence or absence limited adduction are shown in (Table 2).

**Table 2:** Distribution of the studied cases according to degree of patient satisfaction and the presence or absence limited adduction

Degree of patient satisfaction	
I am not satisfied	6 (20%)
I am moderately satisfied	4 (13.3%)
I am satisfied	8 (26.7%)
I am very satisfied	12 (40%)
Presence limited adduction	
NO	14 (46.7%)
YES	16 (53.3%)

Data are presented as frequency (percent)

There was statically significance between pre- and post-operative periods regarding Improvement of adduction restriction (Table 3).

**Table 3:** Distribution of the studied cases according to Improvement of adduction restriction.

Degree of limited adduction	Preoperative	Postoperative		P value
Min. – Max.	-3.0 – -1.0	-2.0 – 0.0 1 month	-1.0 – 0.0 6 months	
Median (IQR)	-3.0 (-3.0 – -2.0)	-1.50(-2.0 – -1.0) 1 month	-1.0 (-1.0 – 0.0) 6 months	<0.001*
Sig. bet. Periods		p <sub>1</sub> =0.001*, p <sub>2</sub> <0.001*, p <sub>3</sub> =0.034*		

p: p value for comparing between degree of limited adduction, p<sub>1</sub>: p value for comparing between degree of limited adduction preoperative and after 1 month, p<sub>2</sub>: p value for comparing between degree of limited adduction preoperative and after 6 months. p<sub>3</sub>: p value for comparing between degree of limited adduction after 1 month and 6 months.

There were not statistically significant regarding age, sex, preoperative angle, age of surgery for esotropia, limited adduction and different types of surgical procedure used.

There was statically significant relation between period between surgery of ET & consecutive XT (P=0.003), post cyclorefraction (p<0.001) (Table 4).

**Table 4:** Relation between patient factors and success rate

	Success		Test of sig.	P
	No (n= 10)	Yes (n= 20)		
Age (Mean± SD)	10± 5.98	11.60± 6.48	U=82.0	0.448
Sex	Male	7(70%)	c <sup>2</sup> =3.281	FE p=0.122
	Female	3(30%)		
Preoperative angle PD				
Mean± SD.	-57± 14.94	-55.50± 10.99	U=84.0	0.502
Median (Min. – Max.)	-65 (-70 – -40)	-60 (-70 – -40)		
Period between surgery of ET & consecutive XT				
<6 months	0 (0%)	6 (30%)	c <sup>2</sup> =9.202*	MC p=0.018*
6 months - <1 year	0 (0%)	2 (10%)		
1 year – 2 years	3 (30%)	9 (45%)		
≥3 years	7 (70%)	3 (15%)		
Median (Min. – Max.)	3.50 (1 – 20)	1 (0.08 – 20)		
Age of surgery of Esotropia	6 (2 – 8)	9.45 (2 – 15.11)	U=65.0	0.131

Median (Min. – Max.)					
Post cyclorefraction right Median (Min. – Max.)		4 (0.50 – 4.25)	1.50 (0 – 3)	U=23.0*	<0.001*
Post cyclorefraction left. Median (Min. – Max.)		4.0 (0.3 – 4.8)	1.3 (0.0 – 3.5)	U=25.0*	<0.001*
Presence of Limited adduction	No	5 (50%)	9 (45%)	$\chi^2=0.067$	$^{FE}p=1.000$
	Yes	5 (50%)	11 (55%)		
Type of surgical procedure					
Medial rectus Resection		2 (20%)	4 (20%)	$\chi^2=0.962$	$^{FE}p=1.000$
Medial rectus Resection & Advancement		2 (20%)	6 (30%)		
Lateral rectus Recession		5 (50%)	9 (45%)		
Lateral rectus Recession & MR Advancement		1 (10%)	1 (5%)		

SD: Standard deviation,  $\chi^2$ : Chi square test, FE: Fisher Exact, MC: Monte Carlo, U: Mann Whitney test, p: p value for comparison between the studied categories, \*: Statistically significant at  $p \leq 0.05$

## Discussion

Consecutive exotropia (XT) is a manifest exotropia that develops either spontaneously or after optical or surgical treatment in a patient that formerly had esotropia (ET). It has been reported in 4% to 27% of patients after surgical treatment of exotropia<sup>[9]</sup>.

Our study included 30 patients (16 females and 14 males) with established diagnosis of consecutive exotropia after surgery for esotropia with deviation angle  $\geq 10$  PD, aged from 3 to 25 years with the Mean age $\pm$ SD was 11.07 $\pm$  6.26 years .

However, the number of study subjects was higher in other studies as that conducted by Sefi *et al*<sup>[10]</sup> that included 49 patients with consecutive XT (21 females, 28 male) enrolled in the study. The mean age was 22.97 years. Also, Yurdakul *et al*<sup>[11]</sup> reported that average ages of 47 patients with consecutive exotropia (25 female and 22 male) from 1 to 41 years was 10.8 $\pm$  8.7 years.

Consecutive exotropia commonly developed months or years after MR muscle recession, and sometimes, shortly after surgery. The incidence ranged from 3% to 29%. The causes included several types of abnormal MR muscle attachments such as slipped muscle, lost muscle, stretched scar, and others without abnormal sclera attachment<sup>[12]</sup>.

Our study subjects have a period between surgery of esotropia (ET) and consecutive XT ranged between 6 months to 20 years with mean $\pm$  SD. 3.47 $\pm$  5.36 years.

In contrary to Gong, Q.*et al*<sup>[9]</sup> who reported a mean interval between the initial surgery and the XT operation was 37 (range, 1–90) months.

On the other hand, Gesite *et al*<sup>[7]</sup> reported that the mean interval between surgery for esotropia and consecutive exotropia was 14.6 $\pm$  19.3 years. Also, Spierer *et al*<sup>[13]</sup> found that the mean time between the first and the second surgery was 173.7 $\pm$  181.5 (range 5 to 538) months.

By clinical examination, we found that the preoperative angle of deviation ranged from 40 to 70 prism diopter (PD) with a mean of 56.0 $\pm$  12.21 PD. Postoperative results showed that 20 patients had a successful outcome with post-operative angle within 10 PD. It is still significantly lower than the preoperative distant angles measurement.

Contrary, Spierer *et al*<sup>[13]</sup> in their study found that the mean preoperative angle of deviation was 26.5 $\pm$  11.8 PD exotropia (range 8 PD XT to 50 PD XT) at distance and 27.4 $\pm$  14.0 PD exotropia (range 0 to 65 XT), the mean postoperative angle of deviation was 7.7 $\pm$  18.4 PD exotropia (range 40 ET to 40 XT) at distance and 10.5 $\pm$  19.3 PD exotropia (range 30 ET to 40 XT) at near. The mean postoperative angle of deviation at last follow-up was not significantly different between the success and failure groups .

While Gesite *et al*<sup>[7]</sup> reported that the mean preoperative exotropia was 28 $\Delta$  $\pm$  16 PD (range, 12–60 PD). Surgery corrected about 4( $\Delta$ ) of exotropia per mm total MR advancement. Although 95% of patients were aligned successfully immediately after surgery, averaging 2( $\Delta$ ) $\pm$  4( $\Delta$ ) esotropia, there was significant late exodrift, averaging 17( $\Delta$ ) at final follow-up.

Limitation of adduction was an important possible risk factor reported to be associated with development of consecutive exotropia. It has been argued that limitation of adduction may cause convergence impairment, which may in turn lead to instability of alignment and exotropia drift<sup>[11]</sup>.

In our study 16 patients (53.3%) had limited adduction before surgery with no slipped muscle in patients but a stretched scar was noticed in four patients, and they had advancement with or without resection of MR muscle.

This finding was similar to the results reported by Rajavi, *et al*<sup>[14]</sup> who did not diagnose any patients with typical presentations of MR slippage including the existence of transparent capsule from MR muscle fibre to its primary insertion during the surgery, even by microscope magnification.

Ceylan *et al*<sup>[15]</sup> revealed that adduction limitation was improved in 13 (87%) patients after CXT surgery, they observed stretch scar formation in two (5%) patients.

Hatt *et al*<sup>[16]</sup> had a study of patients with consecutive XT, adduction deficit ( $-0.5$  or greater) was found in 87%. This rate is comparable with that reported by Mittelman and Folk<sup>[17]</sup> who found adduction deficit present in 82% of patients with consecutive XT.

While the study of Lee, *et al*<sup>[18]</sup> included 14 patients (37.8%) with adduction limitation.

In the present study 6 patients underwent MR advancement, 8 patients underwent MR advancement and resection, 14 patients underwent LR recession, and two patients underwent LR recession and MR advancement. Based on last follow-up examination, 20 patients had successful re-operation and were satisfied with the outcome. The success rate in our study was 66.7%.

Treatment of consecutive exotropia by MR resection achieved a success rate 20%, MR advancement and resection with success rate 30%, LR recession with success rate 45% but LR recession and MR advancement with success rate 5%

Lee, *et al*<sup>[18]</sup>, had 3 types of surgery for consecutive exotropia were performed: 12 patients with LR recession, 18 patients with MR advancement, and 7 patients with LR recession combined with MR advancement. Surgical success rate 2 years postoperatively was 75.7%. Chatzistefanou *et al*<sup>[19]</sup> reported a similar success rate of

79% but both are higher than our finding.

On the other hand, several studies had lower success rate than ours such as the results of Spierer *et al* [13] who operated 20 patients, 9 patients underwent MR advancement alone and 11 underwent MR advancement with LR recession. 9 (45.0%) patients had a successful result and 11 (55.0%) failure. The success rate in the studied group was 45%.

Ceylan, *et al* [15] in their study, they reported that 50% success rate in group 1 (who had LR recession), success rate of group 2 (who had MR advancement) (65%).

Nabie *et al* [5] had Successful alignment achieved in 71.4% and 85.7% of cases in the bilateral MR advancement (BMRA) and bilateral LR recession (BLRR) groups respectively (P=0.94).

Abdalla *et al* [20] revealed that success rate of 85% was achieved in both groups' 20 patients underwent recession/plication and the other 20 patients underwent recession/resection.

A week after surgery, changing of the distant angles to the ET side was noticed, with a mean of (2.33±3.14), ranged from (0.0 – + 10.0 PD) which decreased to mean of (-2.0± 3.11) at 1st month, ranged from (-5.0 – + 5.0PD), At 3rd month postoperative, the mean distance deviation shifted more towards the exotropia side (-5.67± 3.65), ranged from (- 10.0 – 0.0PD ) The mean distant angle after 6 months (- 9.0± 4.62) ranged from (- 15.0 – -5.0 PD) with more shift towards the exotropia side, there was a statically significance in all times of follow up.

On the other hand, Spierer *et al* [13] reported that the postoperative drift between 1 and 6 weeks was 2.8± 6.0 PD exotropia in the success group and 1.1± 14.3 PD exotropia in the failure group (p=0.794). The drift between the 6 weeks and last follow-up was 0.21± 7.1 PD exotropia in the success group and 6.9± 16.7 PD exotropia in the failure group (p=0.338). The mean drift between 1 week and last follow-up was 1.9± 2.4 PD exotropia in the success group and 5.3± 25.2 PD exotropia in the failure group (p=0.667). Moreover, Lee, *et al*, 2019 (125), the amount of exodrift at distance between postoperative 1 week and 1 month was 2.4± 4.5 PD in the success group and 7.2± 6.0 PD in the recurrence group. Final exodeviation at distance was 4.5± 9.8 PD in the success group and 16.8± 7.1 PD in the recurrence group (P=0.001). Deviations at near also showed similar postoperative changes, and final exodeviation was 5.2± 9.8 PD in the success group and 16.8± 8.6 PD in the recurrence group (P=0.003).

Gesite *et al* [7] noticed that at final follow-up, 1.6 ±1.8 (range, 0.10–6.2) years after surgery, 50% of patients-maintained alignment within 10Δ of orthotropic (mean, 3Δ ±4Δ exotropia); the rest experienced recurrent exotropia of 25Δ ±8Δ.

There was not statistically significance in preoperative angle (p= 0.502), age of surgery for esotropia (p=0.313), limited adduction (p=1.000) and type of surgery in cases management (p=1.000). As well, Sefi-Yurdakul N *et al* [10] found that if the amount of deviation angle increased, the number of muscles and procedures intervened increased. No other factors such as amblyopia or anisometropia were associated with poorer prognosis and success rate as stated by Donaldson *et al* [6].

Patients, particularly with a high amount of deviation should be warned about the possibility of additional surgery. Surgical treatment for consecutive XT with limited adduction with medial rectus advancement or advancement

and resection according to angle of deviation. Surgical treatment for consecutive XT without limited adduction with lateral rectus recession or lateral rectus recession and medial rectus advancement.

## Conclusions

Postoperative results showed that 20 patients had a successful outcome (66.7%) with post-operative angle within 10 PD. Surgical management of consecutive XT by medial rectus (MR) advancement had success rate (20%), MR advancement and resection had success rate (30%), lateral rectus (LR) recession had success rate (45%) and LR recession with MR advancement had success rate (5%), surgical treatment of consecutive XT is successful in most of the patients with numerous surgical options performed on a single eye or both eyes in a single session.

## Conflict of Interest

Not available

## Financial Support

Not available

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