*International Journal of Science, Technology and Society*
2024, Vol. 12, No. 4, pp. 133-139
https://doi.org/10.11648/j.ijsts.20241204.12

Research Article

# Surgical Planning for Pattern Strabismus in Patients with Intermittent Exotropia: Evaluating Techniques and Outcomes

**Marta Correia[1, *], Ana Margarida Ferreira[2], António Augusto Magalhães[2]**

[1]Ophthalmology Department, Local Health Unit of Lisboa Ocidental, Lisbon, Portugal
[2]Ophthalmology Department, Local Health Unit of São João, Oporto, Portugal

## Abstract

*Background or purpose*: Intermittent exotropia is the most common cause of divergent deviation. Pattern strabismus may coexist with horizontal deviations in up 35% of cases. Managing pattern strabismus concomitantly with the correction of horizontal strabismus poses a challenge due to imbalances in force vectors. This study aims to evaluate the effects of planning an intermittent exotropia surgery considering the presence of pattern strabismus and its surgical resolution. *Methods*: Observational retrospective study of patients with intermittent exotropia who underwent surgical correction at center between 2017 and 2022. Patients were categorized by the presence of pattern strabismus and furthermore by surgical technique for the correction of said incomitance (weakening of inferior oblique muscles or vertical transposition of lateral rectus muscles). Outcomes of post-surgical horizontal deviation and presence of postoperative pattern strabismus were statistical analyzed between groups using SPSS software v28.0. A p-value <0,05 was considered significant. *Results*: A total of 169 patients had surgical correction for intermittent exotropia. Pattern strabismus was observed in 35,5% of patients, primarily V-pattern (88,3%). Most were male (58, 35%) with mean age of 15,13 ±16,38 years. 41,7% patients with pattern strabismus underwent correction of the incomitance. All techniques showed significant reduction of horizontal near (p<0,001) and distance (p<0,001) deviation. However, incomitance correction favored strongly not only the collapsing of pattern strabismus (p=0,027) but also achieved better results in postoperative distance (p=0,002) and near (p=0,031) horizontal deviation. The two techniques for resolution of pattern strabismus showed comparable results in postoperative horizontal near deviation values and resolution of pattern strabismus, favoring vertical transposition in horizontal distance deviation values (p=0,015). *Conclusions*: The presence of pattern deviations should be actively persecuted in pre-operatively appointments to plan the surgery appropriately, as benefits in correcting the vertical incomitance are supported by this study findings. Both vertical transposition of lateral rectus muscles and weakening of inferior oblique muscles are effective techniques to correct vertical incomitances.

## Keywords

Strabismus, Intermittent Exotropia, Pattern Strabismus, Surgical Correction

[*]Corresponding author: marta.s.correia.95@gmail.com (Marta Correia)

**Received:** 23 June 2024; **Accepted:** 22 July 2024; **Published:** 6 August 2024

Copyright: © The Author(s), 2024. Published by Science Publishing Group. This is an **Open Access** article, distributed under the terms of the Creative Commons Attribution 4.0 License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

# 1. Introduction

Exotropia accounts for 25% of strabismus cases with intermittent exotropia (X(T)) being the most common type of divergent strabismus [1, 2]. The moment for surgical correction is still debatable but most cases of large angle of deviation, reduction of stereoacuity or deterioration of fusional control can benefit from surgical intervention [1, 3].

In up to one third of horizontal strabismus an alphabetic pattern can be found [4, 5]. The incomitance is defined as a constant defect of concomitance in one or several directions of gaze [6].

Various pathogenic mechanisms have been suggested as the cause of A and V patterns including changes in activity of horizontal muscles between up and down-gaze; abnormal torsional rotation of the plans of motion of extraocular muscles; orbital pulleys imbalances; or oblique muscles disfunction, mainly overaction [7, 8].

Management of A and V pattern strabismus can be problematic as transposing vertically horizontal muscles lead to significant changes in muscular force vectors [9]. Their primary action is reduced when the eye is gazing the direction the transposition is made, corresponding to the desired effect in reducing the pattern strabismus [9-11]. However it also creates a force vector in the direction of the transposition and a torsional vector in the same direction, which can create extraocular muscle imbalances when attempting to diminish the pattern strabismus [9]. In most clinical practice settings, fortunately, this surgical method does not cause clinical subjective significant adverse effects, and this effect is greater with transposition of vertical muscles [9, 12]. Caution should also be made when evaluating the function of oblique muscles. In exotropia patients, the presence of inferior oblique (IO) muscle overaction can result in a V pattern [5]. Therefore, planning a weakening of these muscles in addition to horizontal correction can result in both correction of horizontal and pattern deviation [5]. Some studies seem to favor that patients with pattern strabismus are also more prone to amblyopia, reduction of binocular fusion, absence or reduced stereopsis, risk of scoliosis and abnormal head posture [7, 10, 13].

The purpose of this study was to evaluate the motor outcomes of planning an X(T) surgery taking into account the concomitantly presence of pattern strabismus and its surgical resolution. Additionally, the authors investigated if there was a difference in the postoperatively results between the surgical approaches for correction of pattern strabismus: weakening of IO muscle and those submitted to vertical transposition of lateral rectus (LR) muscles.

# 2. Material and Methods

The authors conducted an observational retrospective study reviewing the medical records of all patients with X(T) that underwent surgical correction for their deviation between January 1 of 2017 and December 31 of 2022 in Centro Hospitalar Universitário de São João (CHUSJ).

Horizontal deviation was measured using prismatic cover-uncover test for both near (33 cm) and distance (6 m) targets. Exotropia patients were divided between those with pattern strabismus and those with no vertical incomitance. Incomitance was assessed in primary position and by tilting the head approximately the 25 ºup and down with the patient fixating at a distance target, mimicking straight up- and down-gazes.

Two surgical approaches were used to correct horizontal deviation: unilateral LR muscle recession with medial rectus muscle resection surgery or bilateral LR recession surgery.

Patients with pattern strabismus associated were then divided between those submitted to surgery that only considered horizontal deviation from the ones additionally submitted to vertical incomitance correction. Two surgical techniques were used in addition to the horizontal correction: weakening of IO muscle by graduated IO recession; or vertical transposition of at least 1/2 of fibers of LR muscles, corresponding to a minimum of 5 mm.

Patients were observed between 1 to 4 days after surgery, then at 1 month and 3 months postoperatively. A surgery was considered successful if in the 6-month follow-up visit a residual horizontal deviation within ±10 ΔD of orthotropia was achieved.

Statistical analysis was performed using SPPS statistical software (IBM SPSS Statistics ver. 28.0.1.0; Chicago, IL, USA). The differences in the outcomes between groups were analyzed using *t* tests and its corrections for quantitative variables and Chi-square and McNemar tests for qualitative variables. A p value <0,05 was deemed statistically significant.

The study and data collection were compliant with the principles of the Declaration of Helsinki.

# 3. Results

## 3.1. Global Characterization

In the time period of this study 169 patients where surgically intervened for X(T). The mean age at time of surgery was 16,34±16,11 years, with 53,3% (n= 90) male patients.

Mean best corrected visual acuity of the right eye was 0,12±0,13 and 0,11±0,13 of the left eye, logmar scale. The demographic and clinical characteristics are summarized in *table 1*.

***Table 1.*** *X(T) Patient demographic and clinical characteristics.*

| **Global characteristics** | **n=169** |
|---|---|
| Age (years), mean ± SD | 16,34 ± 16,11 |

| Global characteristics | n=169 |
|---|---|
| Gender, n (%) | |
| Female | 79 (46,7) |
| Male | 90 (53,3) |
| Best corrected visual acuity (logmar), mean ± SD | |
| Right eye | 0,12 ± 0,13 |
| Left eye | 0,11 ± 0,13 |
| Horizontal muscles surgical intervention, n (%) | |
| Unilateral recess resect surgery | 28 (16,6) |
| Bilateral recession of lateral rectus muscles | 141 (83,4) |
| Baseline horizontal deviation (ΔD), mean ± SD | |
| Distance | -38,62 ± 13,61 |
| Near | -37,53 ± 15,54 |
| Pattern strabismus, n (%) | 60 (35,5%)2 |
| V pattern | 53 (88,3%) |
| A pattern | 5 (8,3%) |
| Others | 2 (3,3%) |
| Pattern strabismus patients' characteristics | n=60 |
| Age (years), mean ± SD | 15,13 ± 16,38 |
| Gender, n (%) | |
| Female | 25 (41,7) |
| Male | 35 (58,3) |
| Best corrected visual acuity (logmar), mean ± SD | |
| Right eye | 0,11 ± 0,10 |
| Left eye | 0,11 ± 0,11 |
| Baseline horizontal deviation (ΔD), mean ± SD | |
| Distance | -39,90 ± 14,10 |
| Near | -38,12 ± 12,68 |
| Pattern strabismus correction surgery, n (%) | |
| Weakening of inferior oblique muscle | 13 (21,67) |
| Vertical transposition of lateral rectus muscle | 12 (20) |

X(T), intermittent exotropia; ΔD, prismatic diopters

The majority received a bilateral recession of LR muscles (83,4%, n=141) either or not with correction of pattern strabismus. IO muscle overaction was found in 11,3% (n=19) of X(T) patients.

## 3.2. Pattern Strabismus

35,5% (n=60) of X(T) patients presented with pattern strabismus, the majority of which corresponding to V pattern (88,3%, n=53), followed by A pattern (8,3%, n=5).

The majority were males (58,35%, n=35) with a mean age of 15,13 ± 16,38 years.

25 patients (41,7%) had additional incomitance surgery added to the correction of horizontal deviation.

### 3.2.1. Pre-surgical Horizontal Deviation

The mean distance deviation for patients submitted only to horizontal correction was -41,11 ± 13,59 ΔD and -38,12 ± 14,93 ΔD for patients undergoing concomitant surgery to correct the alphabetic syndrome (*table 2*). Identically, the mean values for near deviation were -39,51 ± 12,80 ΔD and -36,08 ± 13,59 ΔD for the same two groups. The p-value for both comparisons was 0,43 and 0,31, respectively, indication no statistically significant difference between the two groups.

***Table 1.*** *Patients with pattern strabismus.*

| Characteristic | Horizontal correction only patients (n=35) | Pattern Strabismus correction patients (n=25) | p value |
|---|---|---|---|
| Distance deviation (ΔD), mean ± SD | | | |
| Pre-surgery | -41,11 ± 13,59 | -38,12 ± 14,93 | p = 0,43 |
| Post-surgery | -9,91 ± 13,93 | -1,96 ± 3,61 | p = 0,002* |
| Near deviation (ΔD), mean ± SD | | | |
| Pre-surgery | -39,51 ± 12,80 | -36,08 ± 12,49 | p = 0,31 |
| Post-surgery | -7,37 ± 12,89 | -2,20 ± 3,85 | p = 0,031* |
| Pattern strabismus, n (%) | | | |

| Characteristic | Horizontal correction only patients (n=35) | Pattern Strabismus correction patients (n=25) | p value |
|---|---|---|---|
| Post-surgery | 15 (42,85) | 4 (16) | p = 0,027** |

ΔD, prismatic diopters
*Equality of variances not assumed, Welch's t-test for independent samples used
**Pearson Chi-square test

### 3.2.2. Post-Surgical Horizontal Deviation

In patients with pattern strabismus all surgical techniques showed a significant reduction of horizontal deviation: -33,19 ± 16,96 ΔD (p<0,001) for distance deviation and -32.81 ± 15,3 ΔD (p<0,001) for near deviation.

A successful result was achieved in 73,3% (n= 44) for near and in 66,7% (n=40) for distance. A significant difference was found in success of surgery for distance deviation between patients corrected only horizontally and patients undergoing incomitance correction, favoring the latter (p<0,001). No differences were found for success in the correction of near deviation between the groups (p=0,11).

After surgery, the mean near and distance deviation for patients submitted to horizontal correction only decreased to -7.37 11 ± 12,89 ΔD and -9,91 ± 13,92 ΔD.

The corresponding mean values for patients corrected for pattern strabismus was -2,20 ± 3,85 ΔD and -1,96 ± 3,61 ΔD, respectively.

When comparing both groups near and distance postoperative results, a statistically significant difference was found in these two analyses (p=0,031 and p=0,002), corresponding to a greater reduction of horizontal mean deviation in patients for which not only the horizontal deviation was corrected but also the incomitance.

### 3.2.3. Resolution of Pattern Strabismus

Finally, the authors analyzed the reduction in incidence of pattern strabismus after surgery. In patients that realized only horizontal surgery (n=35), 15 patients (42,85%) maintained some degree of pattern strabismus. Contrastingly, patients submitted to simultaneous surgery to pattern deviation (n=25), only 4 patients (16%) had some vertical incomitance. The difference was found to be statistically significant with a p-value of 0,027.

## 3.3. Surgical Techniques for Pattern Strabismus

The authors analyzed the differences between the two surgical techniques used for correction of incomitance in the pattern strabismus group. Weakening of inferior oblique muscle (group 1) was performed in 13 patients (21,7%); In 12 patients (20%) (group 2) a vertical transposition of at least half of LR muscle fibers was made. All patients (n=13, 100%) in group 1 had IO muscle overaction, the vast majority (n=12, 92,31%) presenting unilateral. Contrastingly, only 1 (8,33%) in group 2 presented unilateral IO muscle overaction.

### 3.3.1. Pre-surgical Deviation

Group 1 presented with a distance and near horizontal deviation of -33,0 ± 15,01 ΔD and +33,92 ± 14,15 ΔD, respectively. The same measures for group 2 were -44,18 ± 12,94 ΔD and -38,64 ± 10,25 ΔD. No statistically significant difference for distance deviation (p=0,07) nor near deviation (p=0,37) was found between the groups.

### 3.3.2. Post-Surgical Deviation

After surgery there was a statistically significant reduction of horizontal deviation in both groups both for distance and near measurements (p<0,001) (*table 3*). When comparing the two approaches no significant differences was for near deviation (p=0,29), but a p value of 0,015 was found for comparison of postoperative distance deviation, favoring the vertical transposition of LR muscles approach (*table 4*).

***Table 3.*** *Variations in measured outcomes of patients submitted to pattern strabismus correction.*

| Characteristic | Group 1 (n=13) | Group 2 (n=12) | p value |
|---|---|---|---|
| IO muscle overaction, n (%) | 13 (100%) | 1 (8,33%) | - |
| Distance deviation (ΔD), mean ± SD | | | |
| Pre-surgery | -33,0 ±15,01 | -44,18 ± 12,94 | p = 0,066 |
| Post-surgery | -3,62 ± 4,27 | -0,18 ±1,40 | p = 0,015* |
| Near deviation (ΔD), mean ± SD | | | |

| Characteristic | Group 1 (n=13) | Group 2 (n=12) | p value |
|---|---|---|---|
| Pre-surgery | -33,92 ± 14,15 | -38,64 ± 10,27 | p = 0,37 |
| Post-surgery | -3,00 ± 4,32 | -1,45 ± 3,36 | p = 0,29 |
| Pattern strabismus, n (%) | | | |
| Post-surgery | 2 (15,40) | 2 (16,67) | p =0,93 |

Group 1, inferior oblique muscle weakening; Group 2, vertical transposition of lateral rectus muscle; ΔD, prismatic diopters

***Table 4.*** *Patients submitted to correction of pattern strabismus.*

| Characteristic | Group 1 (n=13) | Group 2 (n=12) | p value |
|---|---|---|---|
| IO muscle overaction, n (%) | 13 (100%) | 1 (8,33%) | - |
| Distance deviation (ΔD), mean ± SD | | | |
| Pre-surgery | -33,0 ±15,01 | -44,18 ± 12,94 | p = 0,066 |
| Post-surgery | -3,62 ± 4,27 | -0,18 ±1,40 | p = 0,015* |
| Near deviation (ΔD), mean ± SD | | | |
| Pre-surgery | -33,92 ± 14,15 | -38,64 ± 10,27 | p = 0,37 |
| Post-surgery | -3,00 ± 4,32 | -1,45 ± 3,36 | p = 0,29 |
| Pattern strabismus, n (%) | | | |
| Post-surgery | 2 (15,40) | 2 (16,67) | p =0,93 |

Group 1, IO muscle weakening; Group 2, vertical transposition of lateral rectus muscle; IO, inferior oblique; ΔD, prismatic diopters
*Equality of variances not assumed, Welch's t-test for independent samples used

### 3.3.3. Resolution of Pattern Strabismus

The authors found that only 2 patients in each group remained with some degree of vertical incomitance, representing 15,40% and 16,67% of the sample for each group. This reduction was found to be statistically significant in both groups (group 1 p<0,001; group 2 p=0,002), with no significant difference between groups (p=0,93).

## 4. Discussion

In this study, the authors investigated the effects of planning surgery considering the presence of pattern strabismus compared to performing surgery for only the horizontal deviation even in the presence of vertical incomitance.

In the literature, prevalence of pattern strabismus in patients with horizontal deviations ranges from 15% to 35% [4, 5], the main differences occurring due to significantly different number of samples in the studies. Contrastingly, in one 2022 large sample study, the prevalence of pattern strabismus was revealed to be lower, at only 10% among patients with horizontal deviations [13]. Among this research X(T) patients a prevalence of vertical incomitance of 35,5% was found and it was hypothesized that this large number might be derived from a greater awareness in pre-operative assessments to actively look for this disturbance. the most common pattern found associated with X(T) was V pattern, in this study, as found in literature [13].

No differences were found in clinical characteristics between X(T) patients with pattern strabismus from those without, namely in gender, age, best corrected visual acuity, and quantification of horizontal deviation for near and distance. These findings seem to imply a greater need to perform a thorough orthoptic examination to identify patients with vertical incomitances, who otherwise can go unnoticed.

Our data, unlike previous findings, showed that the effect of IO muscle weakening and vertical transposition of LR muscles on the correction of horizontal deviation in patients with X(T) seems to be statistically superior and achieved better postoperative results both for near and distance horizontal deviation [8, 10]. In the authors knowledge, is it then of the utmost importance to actively search the presence of pattern strabismus in patients who seem to suffer only from horizontal strabismus in order to plan the surgery accordingly, aiming to obtain the best results possible.

Various surgical techniques can be used to correct vertical deviations, as described in previous studies. Meeting previous findings in the literature, our data shows that in the absence of oblique muscles overactions, the vertical transposition of horizontal muscles is an effective and successful approach, even favoring the correction of distance horizontal deviation [10, 14]. This approach avoids surgery in a third muscle lowering the intra and post operative risks and allowing for a shorter surgery time.

Given that IO muscle overaction is a well-established pathogenic mechanism contributing to vertical incomitance, this study demonstrated that weakening these muscles proved successful in resolving pattern strabismus, aligning with prior published studies [8, 15, 16]. The choice performing graduated recession of IO muscle was based on the level of IO overaction Other options might concentrate in diminish the muscle tension by myectomy or standard recession (6 mm) of IO muscle, as described in literature [16, 17].

This study has some limitations. Being a retrospective study, the sample is prone to selection bias and might be not representative of the general population. Furthermore, reviewing medical records and collecting good data is always dependent on quality of records, which was found to be satisfactory in this sample.

Another limitation of this study was the absence of sufficient data to analyze changes in patients' stereopsis and quantification of fusional potential pre- and postoperatively. It is speculated that patients with absence of stereopsis and binocular vision are more prone to pattern strabismus and if correction of vertical incomitance can improve fusional potential in these patients. Previous studies strongly indicate that in the absence of binocular function, alphabetic patterns and torsional deviations are more likely to be present [7, 13]. Reciprocally, patients who regain binocular function postoperatively seem to have a minor residual deviation of vertical incomitance, and patients that have pattern strabismus correction seem to achieve higher levels of stereopsis [7].

Finally, no data regarding appearance of torsional deviation after vertical transposition of horizontal rectus muscles was collected. According to literature, vertical transposition of horizontal muscles can result in aggravating torsional deviation and concomitant diplopia [9]. However, even if objective measures were absent from medical records, no report of subjective torsional deviation, manifesting as diplopia, was found among the patients studied, meeting the objective measures reported by previous studies [17].

Larger prospective trials would be desirable to study predictability of surgical effect according to amount of OI recession and vertical transposition performed on the horizontal muscles. Having standardized measures for transposition in proportion to the amount of vertical incomitance present would benefit postoperative outcomes, minimize over- and undercorrections and making easier comparisons between surgical techniques.

## 5. Conclusions

In conclusion, the presence of pattern deviations should be actively persecuted in pre-operatively appointments in order to plan the surgery appropriately, as benefits in correcting the vertical incomitance extend beyond correction of pattern strabismus, appearing to be advantageous in the correction of horizontal deviation. Both vertical transposition of LR muscles and weakening of IO muscles are effective techniques to correct vertical incomitances associated with horizontal strabismus.

## Abbreviations

| | |
|---|---|
| IO | Inferior Oblique |
| LR | Lateral Rectus |
| ΔD | Prismatic Diopters |

## Protection of Human and Animal Subjects

The authors declare that this study adhered to the tenets of the Declaration of Helsinki (1964), revised in 2013, of World Medical Association.

The authors declare that they have followed the protocols of their work center on the publication of data from patients.

## Author Contributions

**Marta Correia:** Data curation, Formal Analysis, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing

**Ana Margarida Ferreira:** Investigation, Project administration, Writing – original draft, Writing – review & editing

**António Augusto Magalhães:** Conceptualization, Methodology, Project administration, Resources, Supervision, Validation, Visualization

## Funding

This work has not received any contribution, grant, scholarship, or any form of external financing support.

## Conflicts of Interest

The authors declare no conflicts of interest.

## References

[1] Pang Y, Gnanaraj L, Gayleard J, Han G, Hatt SR. Interventions for intermittent exotropia. Cochrane Database Syst Rev. 2021; 2021(9). https://doi.org/10.1002/14651858.CD003737.pub4

[2] Lavrich JB. Intermittent exotropia: Continued controversies and current management. Curr Opin Ophthalmol. 2015; 26(5): 375-81. https://doi.org/10.1097/ICU.0000000000000188

[3] Elkamshoushy A, Awadein A, Arfeen SA. Pattern strabismus in consecutive esodeviation after bilateral lateral rectus muscle recession for intermittent exotropia. J AAPOS. 2020; 24(6): 342.e1-342.e7. https://doi.org/10.1016/j.jaapos.2020.07.015

[4] Dickmann A, Petroni S, Salerni A, Parrilla R, Savino G, Battendieri R, et al. Effect of vertical transposition of the medial rectus muscle on primary position alignment in infantile esotropia with A- or V-pattern strabismus. J AAPOS. 2011; 15(1): 14-6. https://doi.org/10.1016/j.jaapos.2010.11.017

[5] Galindez Iglesisas F, Navarro B, Zurdo M. Consideraciones sobre la cirugía de los síndromes alfabéticos. Acta Estrabológica. 1978; 6: 129-56.

[6] Roth A, Bumbacher M, Rossillion B. Associated Incomitance in Concomitant Strabismus. Diagnosis and Surgical treatment. Klin Monbl Augenheilkd. 2015; 232(4): 459-66. https://doi.org/10.1055/s-0035-1545785

[7] Deng H, Irsch K, Gutmark R, Phamonvaechavan P, Foo FY, Anwar DS, et al. Fusion can mask the relationships between fundus torsion, oblique muscle overaction/underaction, and A- and V-pattern strabismus. J AAPOS. 2013; 17(2): 177-83. https://doi.org/10.1016/j.jaapos.2012.10.023

[8] Wang X, Zhang W, Liu L. Effect of Isolated Oblique Muscle Weakening Procedures on Horizontal Deviation in A- and V-pattern Exotropia. Curr Eye Res. 2020; 45(2): 211-4. https://doi.org/10.1080/02713683.2019.1660795

[9] Kushner BJ. Torsion and Pattern Strabismus. JAMA Ophthalmol. 2013; 131(2): 190. https://doi.org/10.1001/2013.jamaophthalmol.199

[10] Rossel M, Bergholz R, Salchow DJ. Effect of unilateral vertical transposition of the horizontal rectus muscles on vertical strabismus. Eur J Ophthalmol. 2021; 31(3): 1333-7. https://doi.org/10.1177/1120672120934979

[11] Kekunnaya R, Mendonca T, Sachdeva V. Pattern strabismus and torsion needs special surgical attention. Eye. 2015; 29(2): 184-90. https://doi.org/10.1038/eye.2014.270

[12] Metz HS, Schwartz L. The Treatment of A and V Patterns by Monocular Surgery. Arch Ophthalmol. 1977 Feb 1; 95(2): 251-3. http://archopht.jamanetwork.com/article.aspx?articleid=632089

[13] Zhu B, Wang X, Fu L, Yan J. Pattern Strabismus in a Tertiary Hospital in Southern China: A Retrospective Review. Med. 2022; 58(8). https://doi.org/10.3390/medicina58081018

[14] Awadein A. Lateral rectus recession with/without transposition in V-pattern exotropia without inferior oblique overaction. Can J Ophthalmol. 2013; 48(6): 500-5. https://doi.org/10.1016/j.jcjo.2013.05.003

[15] Scott WE, Drummond GT, Keech R V. Vertical offsets of horizontal recti muscles in the management of A and V pattern strabismus. Aust N Z J Ophthalmol. 1989; 17(3): 281-8. https://doi.org/10.1111/j.14429071.1989.tb00534.x

[16] Anand K, Bharadwaj A, Dhiman S, Goel Y, Rastogi A, Agarwal R, et al. Comparison of conventional and Hang-back methods of inferior oblique recession in V-pattern strabismus with inferior oblique overaction. Int J Ophthalmol. 2020; 13(6): 985-90. https://doi.org/10.18240/ijo.2020.06.20

[17] Rajavi Z, Nikanfar K, Sharahi Dizabadi M, Abdi S, Kheiri B, Sheibani K, et al. Fundus torsion following inferior oblique muscle weakening. J Am Assoc Pediatr Ophthalmol Strabismus. 2024 Feb; 28(1): 103827. https://doi.org/10.1016/j.jaapos.2023.10.010