ARTICLE ORIGINAL

Indications and results of exotropia surgical management

Les indications et les résultats de la prise en charge chirurgicale des exotropies

Lamia El Fekih[1], Houda Lajmi[2] , Achraf Ben Yakhlef[2]

1-Hôpital Mongi Slim La Marsa / Faculté de médecine de Tunis
2-Hôpital des FSI La Marsa / Faculté de médecine de Tunis

RÉSUMÉ

Objectif : Etudier les particularités cliniques et la prise en charge chirurgicale des différentes formes d'exotropie, et d'analyser les facteurs pronostiques influençant le résultat chirurgical.

Méthodes : Il s'agissait de 132 cas d'exotropie pris en charge dans le service d'ophtalmologie de l'hôpital des forces de sécurité intérieure de la Marsa entre 1995 et 2015. Tous nos patients ont bénéficié d'un examen ophtalmologique et d'un bilan sensori-moteur complets. Ils ont été opérés par le même chirurgien.

Résultats : Il s'agissait de 57 cas d'exotropie intermittente, 22 cas d'exotropie précoce, 43 cas d'exotropie sensorielle et 10 cas d'exotropie consécutive. L'âge moyen d'apparition de l'exotropie était de 6,8 ans +/- 8. L'amblyopie a été notée dans 36,4% des cas d'exotropie précoce. L'angle de déviation moyen était de 36,5 DP dans l'exotropie intermittente, 39,6 DP dans l'exotropie précoce et 44,5 DP dans l'exotropie sensorielle. Un syndrome vertical a été fréquemment retrouvé chez les patients d'exotropie précoce. Le recul bilatéral du droit latéral était le plus pratiqué. Le taux de réussite global après une seule intervention chirurgicale était de 72%. Les facteurs de bon pronostic étaient l'absence d'amblyopie, la forme intermittente du strabisme, un faible angle de déviation préopératoire et l'alignement oculaire le premier jour postopératoire.

Conclusions : L'exotropie intermittente est la forme la plus courante. La chirurgie a abouti à un alignement réussi dans la plupart des cas. Une prise en charge précoce et une analyse rigoureuse de l'état sensori-moteur des patients sont les meilleurs garants d'une réussite à long terme

Mots clés: exotropie; chirurgie; la prise en charge

SUMMARY

Aim: To study the clinical particularities and the surgical management of the different forms of exotropia, and to analyze the prognostic factors influencing the surgical result.

Methods: Medical records of 132 patients who underwent exotropia surgery from 1995 to 2015, were retrospectively reviewed. Ophthalmological examination and a complete sensorimotor assessment were performed for each patient. All surgeries were performed by the same surgeon.

Results: We had 57 cases of intermittent exotropia (IE), 22 cases of infantile exotropia (IfE), 43 cases of sensory exotropia (SE) and 10 cases of concecutive exotropia (CE). The average age of onset of exotropia was 6.8 years +/- 8 SD. Amblyopia was noted in 36.4% of cases of IfE. The mean deviation angle was 36.5 DP in (IE), 39.6 DP in (IfE) and 44.5 DP in (SE). A vertical syndrome was frequently found in (IfE) patients. Bilateral recession of lateral rectus was the most performed surgery type. The overall success rate after a single surgery was 72%. A multivariate logistic regression analysis showed that good prognosis factors were the absence of amblyopia, the intermittent form of the strabismus, a low preoperative deviation angle and the ocular alignment on day one postoperatively.

Conclusions: IE is the most common divergent strabismus. Surgery resulted in successful alignment in most of the cases. Early management and rigorous analysis of patients sensorimotor status are the best guarantors of long-term success

Keywords: Exotropia; surgery; management

Correspondance
Houda Lajmi
Hôpital des FSI La Marsa / Faculté de médecine de Tunis
e-mail ; houda.lajmi@gmail.com

INTRODUCTION

Exotropia is an oculomotor syndrome corresponding to the horizontal divergence of the visual axes occurring in 1.25% of the pediatric population (1). The frequency of exotropia is underestimated in our country because of the consultation delay. Exotropia is less common than esotropia; it is a quiet heterogeneous pathology with various specific forms, the most described of which are: Intermittent exotropia (IE), which is the commonest form, infantile exotropia (IFE), sensory exotropia (SE) and consecutive exotropia (CE). Surgical protocols are not standardized, and their results depend on many parameters such as the type of exotropia as well as the preoperative motor and sensory state.

The aim of our study is to describe our surgical protocols in exotropia, their results and the different factors influencing the postoperative results.

METHODS

The study was retrospective including 132 cases of exotropia followed up between 1995 and 2015. Exclusion criteria were patients with insufficient pre- or postoperative clinical or orthoptic report, insufficient postoperative follow-up (less than three months), restrictive syndromes and paralytic strabismus. This study adhered to the tenets of the Declaration of Helsinki.

All of our patients had a complete ophthalmological examination with refractive error correction after topical administration of 1% cyclopentolate or Atropine (0.3, 0.5 and 1%) in order to identify amblyopia which was classified according to its severity.

The angle of exodeviation was measured pre- and post-operatively with Hirschberg Test, modified Krimsky test, prisms and alternating cover test or with synoptophore. Associated vertical syndromes were noted. The Worth-4-dot test, the striated glasses of Bagolini, red glass, synoptophore and TNO test (Lang 1 test in children) were used to study our patients' sensory state (binocular vision, retinal correspondence, fusion and stereopsis). At the end of the motor and the sensory assessments, we classified our patients into the following groups: (IFE),(IE),(SE) and (CE).

All of our patients had a total optical correction, with an adequate treatment of amblyopia. Orthoptic rehabilitation was indicated in some cases of normosensory strabismus or postoperatively if the residual angle was small. Prismatic correction was indicated preoperatively in some cases of normosensory strabismus when the angle of deviation was less than 20 PD. Surgery was performed under a general anesthesia by the same surgeon after obtaining an informed written consent from all parents.

Bilateral lateral rectus muscle (LRM) recession was indicated in alternating strabismus with isoacuity, and unilateral recession-resection surgery was indicated for non-alternating strabismus. Bilateral asymmetric surgery on three muscles was reserved for strabismus with a large angle exceeding 40 prismatic diopters (PD).

Surgery of the vertical element was simultaneously performed. Unilateral or bilateral superior rectus muscle (SRM) recession was performed for a manifest dissociated vertical deviation (DVD), associated or not with posterior myopexy.

For inferior oblique overaction, a surgery according to Gobin or Parks techniques was performed. For alphabetic syndromes without oblique muscles overaction, we performed a vertical transposition of the horizontal rectus muscles. Surgical dosage was based on the maximal deviation angle: we considered that LRM recession of 1mm corrected 2 PD of deviation, and 1mm of medial rectus muscle (MRM) plication corrected 3 PDs.We considered that the result of our dosage increased by 20%, in case of horizontal muscles surgery in one eye.

Patients were examined on day 1, one month, three months and then every six months post operatively, with an orthoptic assessment in the first month. Motor success was defined by an orthotropy or a residual deviation of less than or equal to 10 PD of exotropy, 8 PD of esotropy and 4 PD of height. Sensory success was defined by stable binocular fusion and less than 200 seconds of arc of stereopsis, if the evaluation was possible. The following informations were recorded when available: age at onset, gender, presence of systemic diseases, preoperative maximum angle of deviation, associated ocular motility disorders, surgery delay and motor and sensory outcomes.

The studied factors that might influence the post-operative results were: the age of strabismus onset, surgery delay, amblyopia severity, preoperative deviation, postoperative day 1 angle and associated vertical element. The data were analyzed by SPSS version 21.0. All quantitative data were expressed as mean ± standard deviation, and qualitative

variables were expressed as effectives and percentages analyzed using Chi-squared test. Comparisons of means were made using the Student's t test. Correlation between continuous variables was analyzed using Pearson's correlation analyses. P values <0.05 were considered to be statistically significant. Correlation between a quantitative and a qualitative variable was studied by the (ANOVA) test. In order to identify the proper role of each factor that could have influenced the motor outcome, we performed a multivariate statistical analysis in logistic regression with the adjusted odds ratio "r" for each factor.

RESULTS

One hundred and thirty-two patients were included; there were 77 males (42%) and 55 females (58%) classified into four groups (table 1). The mean age of strabismus onset was 6.8 years old±8 SD and depended on the clinical form (figure 1). Severe amblyopia was noted in all patients with SE, in 36.4% of patients with IFE and in 50% of patients with CE. Retinal correspondence was normal in all cases of IE and in seven cases of CE. Most of the patients with IE showed good fusion but, only six of them had normal stereoscopic vision before surgery (table 2).

Table 1. Patients' distribution according to the clinical form and subform of exotropia

Forms of exotropia	Number and pourcentage of patients	Sub forms of exotropia	
IFE	22 (16,7%)		
IE	57 (43,2%)	Divergence excess	8 patients
		Convergence insufficiency	3 patients
		Basic exotropia	46 patients
SE	43 (32,6%)		
CE	10 (7,75%)		

*IFE: infantile exotropia - IE: Intermittent exotropia - SE: Sensory exotropia - CE: Consecutive exotropia

The motor assessment revealed that SE and IFE had the largest deviation angle (table 3). Vertical syndromes were commonly noted in IFE. We had eight cases of inferior oblique muscle overaction, seven cases of DVD, six cases of V syndrome, four cases of Hypertropia and one case of A syndrome. Figure 2 summarizes the mean age at the time of the surgery.

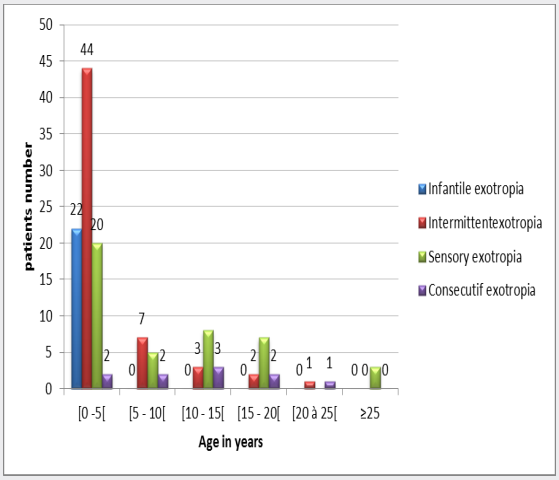

Figure 1. exotropia age of onset according to the clinical form

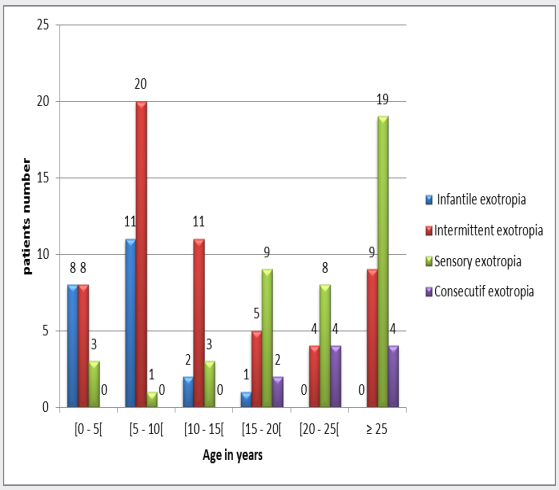

Figure 2. mean age of surgery according to the clinical form of exotropia

Table 2. Fusion state of our patients according to the clinical form of exotropia

Fusion	IFE	IE	SE	CE
Good	0	29	0	0
Instable	0	9	0	0
Absent	22	19	43	10

*IFE: infantile exotropia - IE: Intermittent exotropia- SE: Sensory exotropia CE: Consecutive exotropia

Table 3. The mean maximum deviation angle according to the clinical form of exotropia

Forms of exotropia	Mean maximal deviation angle
IFE	39,6 DP ± 16
IE	36,5 DP ± 9,1
SE	44,5 DP ± 12
CE	32 DP ± 4,2

*IFE: infantile exotropia - IE: Intermittent exotropia - SE: Sensory exotropia CE: Consecutive exotropia

Surgical protocols depended on the type of strabismus in addition to the preoperative motor and sensory findings (table 4). The postoperative motor results were summarized in table 5. On the first postoperative day, 105 patients (79.5%) were orthotropic, 22 (16.7%) had a residual exotropia, and five (3.8%) had a consecutive esotropia. Three months postoperatively, 51 patients (38.6%) were orthotropic, and 77 patients (58.3%) had residual exotropia, 42.4 % of whom had less than 10 PD of exodeviation. Only four patients were overcorrected, three of whom had an exodeviation of less than 8 PD. Thus, after a single surgery, motor success was obtained in 72% of cases (59.1% in IFE, 78.9% in IE, 65.1% in SE and 90% in CE). Twelve patients were reoperated because of exotropia recurrence: five had IFE; three had IE and four had SE. The final motor success was of 81.8% in IFE, 84.2% in IE, 74.4% in SE and 90% in CE. Good fusion was observed in 40 patients within the group of IE and in two cases of CE. Normal stereopsis was obtained in 42.1% of IE cases (24 patients).

According to a multivariate analysis in logistic regression, factors that influenced the motor result were the intermittent form of exotropia (r = 3.128, p = 0.046), the degree of relative amblyopia (r = 1.033, p = 0.02) and the motor outcomes on day 1 postoperatively (r = 0.184, p = 0.003). Other factors, such as the surgery age, sex, pre- and postoperative sensory state, preoperative angle, surgical dosage and associated vertical syndromes, did not show any significant influence on the probability of motor success.

Table 4. Surgical protocols according to the exotropia clinical form

Surgical protocol	IFE	IE	SE	CE
Unilateral surgery (LRM recession)	2	4	1	2
Unilateral surgery (LRM recession/MRM plication)	6	10	23	6
Bilateral surgery (double LRM recession)	9	36	5	1
Bilateral surgery (double LRM recession/ MRM plication)	5	7	14	1

*IFE: infantile exotropia - IE: Intermittent exotropia - SE: Sensory exotropia CE: Consecutive exotropia - LRM: lateral rectus muscle - MRM: medial rectus muscle

Table 5. Postoperative motor results according to the exotropia clinical form

Postoperative delay	Motor status	IFE	IE	SE	CE
First day	orthophoric	17	50	30	8
postoperatively	Residual XT	4	6	10	2
	ET	1	1	3	0
3 months after the surgery	Orthophoric	4	33	9	4
	XT<10 Dp	13	13	25	5
	XT>10 DP	4	10	7	0
	ET<8 Dp	0	1	2	0
	ET>8Dp	1	0	0	0
After a single surgery	Orthophoric	1	24	3	4
	XT<10 Dp	11	19	23	5
	XT>10 DP	8	12	15	1
	ET<8 Dp	1	2	2	0
	ET>8Dp	1	0	0	0
	total	22	57	43	10

*IFE: infantile exotropia- IE: Intermittent exotropia - SE: Sensory exotropia CE: Consecutive exotropia

DISCUSSION

Surgical protocols depended on the type of strabismus. For IFE, we indicated surgery if the maximum angle of deviation was higher than 15 PD and as soon as a reliable orthoptic assessment became achievable (3 to 4 years old). For IE, surgery was indicated if tropia episodes became frequent (more than 50% of the time), in the presence of functional signs like diplopia or in case of stereopsis

deterioration. It is often at this stage that patients consult, which explains the high average age found in our series. For CE, we operated when the deviation exceeded 15 PD and persisted six months after the first intervention. We used the maximum angle, after dissociation maneuvers in certain cases, to calculate the amounts of recession/plication. We aimed the orthotropy unlike some authors who indicate a slight surgical overcorrection (2-6). We believe that an exact measurement of the maximum angle allows a stable result and avoids consecutive esotropia.

In case of alternating strabismus, especially in case of IE, we preferred the bilateral recession of the LRM, to which we can associate a plication of a MRM of the most deviated eye under general anesthesia, if the angle exceeds 40 PD. Kushner et al. reported the superiority of unilateral recession/resection compared with the bilateral recession of LRM in the basic type of IE (7). Twenty years later, a second trial published by PEDIG concluded that there was no significant difference between the two approaches (8). In cases of non-alternating strabismus, we performed a unilateral recession/plication on the amblyopic eye, like most authors.

The vertical component, when it exists, was operated during the horizontal muscles surgery. This allows to promote the binocular fusion and thus, to consolidate the long-term results. A DVD was treated by unilateral recession of 4 to 6 mm of the superior rectus which was optionally combined with a posterior fixation. The inferior obliques overaction as well as the V syndrome, were treated by anteroposition of the inferior obliques according to the techniques of Parks or Gobin. We used sometimes, upward or downward transposition of horizontal recti muscles in some forms of alphabetic syndromes with low incomittance.

Most authors consider surgical success as a residual postoperative angle of less than 10 PD (9). We used, as success criteria, a postoperative angle of less than 10 PD of exotropia and 8 PD of esotropia, since consecutive esotropia is often less tolerated than residual exotropia.

Surgical success rates in the literature were widely variable. This was due to the non-comparability of the series in terms of classification systems, of postoperative follow-up durations and of the definitions used (10). Using the above-mentioned definitions of motor success, we obtained, after a single operating time, a success rate of 59.1% for IFE, 78.9% for IE, 65.1% for SE and 90% for CE. The surgical success rates reported in the literature were 58 to 82% for IFE (11-15), 50 to 79% for IE (12,16-25) and 75 to 90% for SE (26,27). After a second surgery on twelve patients, the final success rate increased to 81.8% for IFE, 84.2% for IE and 74.4% for SE.

We have demonstrated, by a multivariate analysis, that the factors significantly related to failure were the degree of amblyopia, the preoperative angle and the angle on postoperative day 1. The intermittent type of strabismus was significantly correlated with surgical success. These factors were found in several studies (12,18,28–35). Other factors were reported to have prognostic value, such as binocular vision status, vertical syndrome and vertical component surgery, but their impact was not significant in our analysis (33,36).

IE is the most common form of divergent strabismus. Surgery resulted in a successful alignment in most of the cases. Early management and rigorous analysis of patients' sensorimotor status are the best guarantors of long-term success.

The strengths of our study were the size of the sample, the length of the follow-up period and the group analysis by type of strabismus. The limits were the retrospective nature of the study and the heterogeneity of the population. Despite these limits, our results were comparable to those reported in the literature.

Declaration of Competing Interest

There is no conflict of interest in this study.

REFERENCES

1. Audren F. Exotropie précoce. In: Péchereau A, Denis D, Speeg-Schatz C, dir. Strabisme. Issy-les-Moulineaux: Elsevier Masson; 2013, p. 208-11.
2. Carta A, Pinna A, Aini MA, Carta A, Carta F. Intermittent exotropia: evaluation of results on the basis of different treatments. J Fr Ophtalmol 1994;17(3):1616. PMID: 8182252
3. Abroms AD, Mohney BG, Rush DP, Parks MM, Tong PY. Timely surgery in intermittent and constant exotropia for superior sensory outcome. Am J Ophthalmol 2001;131(1):1116. DOI: 10.1016/s0002-9394(00)00623-1
4. Suh SY, Kim MJ, Choi J, Kim SJ. Outcomes of surgery in children with early-onset exotropia. Eye 2013;27(7):83640. DOI:10.1038/eye.2013.75
5. Hardesty HH. Management of intermittent exotropia. In: Seminars in Ophthalmology. Taylor & Francis; 1988, p. 16974.

6. Schlossman A, Muchnick RS, Stern KS. The surgical management of intermittent exotropia in adults. Ophthalmology 1983;90(10):116671. DOI:10.1016/s0161-6420(83)34411-0

7. Kushner BJ. Selective surgery for intermittent exotropia based on distance/near differences. Arch Ophthalmol 1998;116(3):3248. DOI:10.1001/archopht.116.3.324

8. Donahue SP, Chandler DL, Holmes JM, et al. Randomized trial comparing bilateral lateral rectus recession versus unilateral recess-resect for basic-type intermittent exotropia. JAAPOS 2017 ;21(4) :e7-e8. DOI: https://doi.org/10.1016/j.jaapos.2017.07.020

9. Chiu AK, Din N, Ali N. Standardising Reported Outcomes of Surgery for Intermittent Exotropia. A Systematic Literature Review. Strabismus 2014;22(1):326. DOI: 10.3109/09273972.2013.877940

10. Kelkar JA, Gopal S, Shah RB, Kelkar AS. Intermittent exotropia: Surgical treatment strategies. Indian J Ophthalmol 2015;63(7):566. DOI:10.4103/0301-4738.167109

11. Paik HJ, Yim HB. Clinical effect of early surgery in infantile exotropia. Korean J Ophthalmol 2002;16(2):97102. DOI:10.3341/kjo.2002.16.2.97

12. Stoller SH, Simon JW, Lininger LL. Bilateral lateral rectus recession for exotropia: a survival analysis. J Pediatr Ophthalmol Strabismus 1994;31(2):8992. PMID:8014793

13. Livir-Rallatos G, Gunton KB, Calhoun JH. Surgical results in large-angle exotropia. JAAPOS 2002;6(2):7780. PMID:11997802

14. Schwartz RL, Calhoun JH. Surgery of large angle exotropia. J Pediatr Ophthalmol Strabismus 1980;17(6):35963. PMID:7205515

15. Aslanis D, Follidi V, Constantopoulos I, Spyropoulos G, Paikos P. Résultats chirurgicaux des exotropies primitives concomitantes à grand angle chez les enfants. J Fr Ophtalmol 2006;29(1):3742. Doi : JFO-01-2006-29-1-0181-5512-101019-200504054

16. Pratt-Johnson JA, Barow JM, Tillson G. Early surgery in intermittent exotropia. Am J Ophthalmol 1977;84(5):689–94. DOI:10.1016/0002-9394(77)90385-3

17. Maruo T, Kubota N, Sakaue T, Usui C. Intermittent exotropia surgery in children: long term outcome regarding changes in binocular alignment. A study of 666 cases. Binocul Vis Strabismus Q 2001;16(4):26570. PMID:11720592

18. Richard JM, Parks MM. Intermittent exotropia: surgical results in different age groups. Ophthalmology 1983;90(10):11727. PMID:6657192

19. Wu H, Sun J, Xia X, Xu L, Xu X. Binocular status after surgery for constant and intermittent exotropia. Am J Ophthalmol 2006;142(5):8226. DOI: 10.1016/j.ajo.2006.06.045

20. Ing MR, Nishimura J, Okino L. Outcome study of bilateral lateral rectus recession for intermittent exotropia in children. Ophthalmic Surg Lasers Imaging Retina 1999;30(2):1107. PMID:10037205

21. Saleem QA, Cheema AM, Tahir MA, Dahri AR, Sabir TM, Niazi JH. Outcome of unilateral lateral rectus recession and medial rectus resection in primary exotropia. BMC Res Notes 2013;6(1):257. DOI:10.1186/1756-0500-6-257

22. Ekdawi NS, Nusz KJ, Diehl NN, Mohney BG. Postoperative outcomes in children with intermittent exotropia from a population-based cohort. JAAPOS 2009;13(1):47. DOI:10.1016/j.jaapos.2008.06.001

23. Burian HM, Spivey BE. The Surgical Management of Exodeviations. Am J Ophthalmol 1965;59(4):60320. PMID:14270998

24. Hardesty HH, Boynton JR, Keenan JP. Treatment of intermittent exotropia. Arch Ophthalmol 1978;96(2):26874. DOI:10.1001/archopht.1978.03910050136006

25. Jeoung JW, Lee MJ, Hwang JM. Bilateral lateral rectus recession versus unilateral recess-resect procedure for exotropia with a dominant eye. Am J Ophthalmol 2006;141(4):6838. DOI:10.1016/j.ajo.2005.11.021

26. Park YC, Chun BY, Kwon JY. Comparison of the stability of postoperative alignment in sensory exotropia: adjustable versus non-adjustable surgery. Korean J Ophthalmol 2009;23(4):27780. DOI:10.3341/kjo.2009.23.4.277

27. Merino P, Mateos C, De Liaño PG, Franco G, Nieva I, Barreto A. Horizontal sensory strabismus: characteristics and treatment results. Arch Soc Esp Oftalmol Engl Ed 2011;86(11):35862. DOI:10.1016/j.oftal.2011.05.028

28. Gezer A, Sezen F, Nasri N, Gözüm N. Factors influencing the outcome of strabismus surgery in patients with exotropia. J AAPOS 2004;8(1):5660. DOI:10.1016/S1091853103002519

29. Faridi UA, Saleh TA, Ewings P, Twomey JM. Factors affecting the surgical outcome of primary exotropia. Strabismus 2007;15(3):12731. DOI:10.1080/09273970701506086

30. Gordon YJ, Bachar E. Multiple regression analysis predictor models in exotropia surgery. Am J Ophthalmol 1980;90(5):68791. DOI:10.1016/s0002-9394(14)75138-4

31. Abbasoglu OE, Sener EC, Sanac AS. Factors influencing the successful outcome and response in strabismus surgery. Eye 1996;10(3):31520. DOI:10.1038/eye.1996.66

32. Kushner BJ, Fisher MR, Lucchese NJ, Morton GV. Factors influencing response to strabismus surgery. Arch Ophthalmol 1993;111(1):759. DOI:10.1001/archopht.1993.01090010079030

33. Yam JCS, Chong GSL, Wu PKW, Wong USF, Chan CWN, Ko STC. Prognostic factors predicting the surgical outcome of bilateral lateral rectus recession surgery for patients with infantile exotropia. Jpn J Ophthalmol 2013;57(5):4815. DOI:10.1007/s10384-013-0262-8

34. Portes AV, Franco AMBV, Tavares MF, Souza-Dias CR, Goldchmit M. Surgical correction of permanent exotropia outcomes in amblyopic and non-amblyopic patients. Arq Bras Oftalmol 2011;74(4):26770. DOI:10.1590/s0004-27492011000400008

35. Roh JH, Paik HJ. Clinical study on factors associated with recurrence and reoperation in intermittent exotropia. J Korean Ophthalmol Soc 2008;49(7):11149. https://doi.org/10.3341/jkos.2008.49.7.1114

36. Beneish R, Flanders M. The role of stereopsis and early postoperative alignment in long-term surgical results of intermittent exotropia. Can J Ophthalmol 1994;29(3):11924. PMID:7922850