

Our Midterm Outcomes of Strabismus Surgery in Vertical Deviations

Vertikal Kaymalarda Orta Dönem Şaşılık Cerrahisi Sonuçlarımız

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Abstract: The evaluation of cases operated for vertical deviation. Materials and Methods: Cases operated between January 2015 and June 2016 and followed-up for at least 1 year were evaluated. Pre and postoperative angle of deviations (PD), inferior oblique muscle (IO) functions, refractive errors, etiologies and surgeries performed were noted. Success was defined as alignment with 10 PD of orthophoria and/or inferior oblique overaction (IOOA) $\leq +1$ at the final examination. 32 out of 172 cases, surgery due to vertical deviation was performed. Primary IOOA cases (group 1; n=19; 15 was associated with esotropia, 4 with exotropia) were compared with cases (group 2; n=13) due to other etiologies [3 Duane retraction syndrome (DRS) type 3, 4 fourth nerve palsy, 4 dissociated vertical deviation (DVD), and double elevator palsy (DEP)]. IO recession was performed in all primary IOOA and fourth nerve palsy. Y-split and lateral rectus recession was performed in DRS, superior rectus recession in DVD, and inferior rectus recession in DEP. Right spherical equivalent (SE) (D) was 1.5 (0.75-2.5) in group 1 and 0.5 (-0.625-0.875) in group 2 (p=0.014). Left SE (D) was 1.5 (0.75-2.5) in group 1 and 0.5 (0.125-1) in group 2 (p=0.024). IOOA decreased from 3.16 \pm 0.60 to 0.89 \pm 0.81 postoperatively in group 1 cases (p<0.01). The upshoot regressed in 3 DRS type 3 cases postoperatively. Successful outcome was obtained in 16 cases in group 1 (84%) and 11 cases in group 2 (84%). Satisfactory outcome is possible by case-by-case approach in various vertical deviations.

Keywords: vertical deviations, inferior oblique muscle surgery, duane retraction syndrome, dissociated vertical deviation, double elevator palsy

Özet: Vertikal kayma nedeniyle cerrahi uyguladığımız olguların değerlendirilmesi. 2015 Ocak-2016 Haziran tarihleri arasında cerrahi uyguladığımız ve en az 1 yıl takip ettiğimiz olgular değerlendirildi. Cerrahi öncesi ve sonrası kayma açıları (PD) ve alt oblik (AO) fonksiyonları, görme keskinliği (GK), kırılma kusurları, etyolojileri ve uygulanan cerrahiler kaydedildi. Başarı, son muayenede 10 PD altında kayma açısı ve/veya alt oblik hiperfonksiyonunun (AOH) $\leq +1$ olması olarak tanımlandı. 172 olgunun 32'sinde vertikal kayma nedeniyle cerrahi uygulanmıştır. Primer AOH olguları (grup 1; n=19; 15 ezotropeya, 4 egzotropiye ile ilişkili) ile diğer etyolojilere (3 tip 3 Duane retraksiyon sendromu, 4 dördüncü sinir felci, 4 disosiyasyon ve 2 çift elevatör felci) bağlı olan vertikal kaymalar (grup 2; n=13) karşılaştırıldı. Tüm primer AOH ve dördüncü sinir felci olgularında AO geriletmesi uygulandı. Duane sendromunda Y-split ve dış rektus geriletmesi, DVD'de üst rektus geriletme ve çift elevatör felcinde alt rektus geriletmesi uygulandı. Sağ gözde sferik ekivalan değeri (SE) (D) grup 1'de 1,5 (0,75-2,5); grup 2'de ise 0,5 (-0,625-0,875) idi (p=0,014). Sol gözde SE (D) grup 1'de 1,5 (0,75-2,5), grup 2'de ise 0,5 (0,125-1) idi (p=0,024). Grup 1'de AOH'u cerrahi ile 3,16 \pm 0,60'dan 0,89 \pm 0,81'e düşmüştür (p<0,01). Üç tip 3 Duane sendromunun hepsinde cerrahi sonrası yukarı atım belirgin olarak geriledi. Grup 1'de 16 (%84), grup 2'de 11 olguda (84%) cerrahi başarı elde edildi. Olguya göre uygun cerrahi tedavi ile farklı vertikal kaymalarda tatminkar başarı elde etmek mümkündür.

Anahtar Kelimeler: vertikal kaymalar, inferior oblik kas cerrahisi, duane retraksiyon sendromu, disosiyasyon ve çift elevatör felci

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Received 18.02.2019

Accepted 07.03.2019

Online published 07.03.2019

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Cite this article as:

Gursoy HH, Cakmak AI, Ozalp O, Ozdemir OC, Colak E. Our Midterm Outcomes of Strabismus Surgery in Vertical Deviations, Osmangazi Journal of Medicine, 2020;42(3): 277-281 Doi: 10.20515/otd. 528287

1. Introduction

Strabismus is the misalignment of eyes and can be divided into two main groups. These are horizontal and vertical strabismus. Horizontal deviations are more commonly followed-up and treated by ophthalmologists, because they are more associated with amblyopia and more easily recognized by the patients themselves or by the parents in case of young cases.¹ Vertical deviations may be isolated or associated with horizontal deviations. Isolated cases are less prevalent than the associated ones. Primary inferior oblique muscle overaction (IOOA) with esotropia (ET) is the most common association, while isolated dissociated vertical deviation (DVD) is the most common isolated vertical strabismus.^{2,3} The prevalence of DVD in populations may be much more than the published literature.^{3,4} Indications for surgery and the management of vertical strabismus are not straightforward, when compared to those for horizontal strabismus. The approach in vertical strabismus is commonly case-by-case.³⁻⁶ Our aim was to analyze our cases with vertical deviations and compare our outcomes among vertical strabismus cases with various etiologies.

2. Materials and Methods

The charts of subjects who had undergone strabismus surgery between January 2015 and June 2016 were reviewed. The study had been approved by the Institutional Review Boards (2016-30). The data collection conformed to all local laws and was compliant with the principles of the Declaration of Helsinki. The inclusion criteria were: (1) any type of vertical deviation; (2) the patient was capable of describing his/her vision during the follow-up visits; (3) complete charts were accessible; and (4) follow-up of at least 12 months occurred. Informed consent was obtained from all patients prior to surgery. All surgeries were undertaken by the same surgeon (H.G.) under general anesthesia.

At each visit, the prism and alternate cover test was performed to evaluate the final outcomes. Hirschberg test was applied in cases, who could not cooperate. Cycloplegic

refraction, the best-corrected visual acuity (BCVA) in logMAR units, type of strabismus, the preferred surgical procedure were noted. Extraocular movements were checked. Oblique muscle surgery was performed for IOOA (IOOA) $\geq +3$. The spherical equivalent (SE) was calculated by adding the spherical value and half of the cylindrical value. Success was defined as alignment with 10 PD of orthophoria and/or IOOA $\leq +1$ at the final examination.

Cases were allocated into two groups. Group 1 included cases operated for primary IOOA. Inferior oblique recession (IOR) surgery was performed in all group 1 cases. Group 2 was composed of cases operated for vertical strabismus due to other etiologies.

The sex, age at surgery in years, follow-up time, SE refraction in diopters (D) for the right and left eyes, BCVA in logMAR units for the right and left eyes, the amount of deviation in prism diopters (PD) were evaluated. Vertical deviations included fourth nerve palsy, DVD, double elevator palsy (DEP), Duane retraction syndrome (DRS) type 3, and primary IOOA.

The data did not distribute normally according to Shapiro-Wilk, so evaluated with Mann-Whitney U test between group 1 and group 2. The median preoperative angle of deviations were compared with postoperative deviations using Wilcoxon signed rank test. The distribution of gender, presence of abnormal head posture (AHP) and surgical outcome between two groups were evaluated with Chi-square test. Significance was attributed when $p < 0.05$. Statistical analyses were performed using IBM SPSS Statistics version 22.0.

3. Results

The record review identified 36 vertical deviations out of 172 strabismus cases operated (%21). 32 out of 36 vertical deviations satisfied all inclusion criteria. The types of vertical deviations and the surgical procedures preferred were in Table 1. Bilateral surgery was performed in all cases with primary IOOA. Unilateral surgery was

performed in all DRS and DEP, two fourth nerve palsy and two DVD cases.

Group 1 included nineteen cases and group 2 included thirteen cases. The comparison of two groups were presented in Table 2. The success rate was 84% in both groups. One case associated with ET and one case associated with XT was failed in group 1. One

fourth nerve palsy and one DVD failed in group 2. Abnormal head posture (AHP) was present in eight out of thirteen cases in group 2, while in none of the cases with group 1. The median preoperative angle of deviation was decreased from 30.0 (25.0-35.0) PD to 5.0 (5.0-8.0) (p<0.01) in both groups. IOOA decreased from 3.16±0.60 to 0.89±0.81 postoperatively in group 1 cases (p<0.01).

Table 1.The Etiologies of Vertical Deviations and Surgical Procedures Performed.

Etiology	Primary IOOA ¹		DRS ⁵ Type 3	4th Nerve Palsy	DVD ⁷	DEP ⁹
	ET ²	XT ³				
Subjects (n)	15	4	3	4	4	2
Surgery	IOR ⁴		Y-split+LRR ⁶	IOR	SRR ⁸	IRR ¹⁰

¹IOOA: Inferior oblique overaction, ²ET: Esotropia, ³XT: Exotropia, ⁴IOW: Inferior oblique muscle recessions, ⁵DRS: Duane Retraction Syndrome, ⁶LRR: Lateral rectus recession, ⁷DVD: Dissociated vertical deviation, ⁸SRR: Superior rectus recession, ⁹DEP: Double Elevator Palsy, ¹⁰IRR: Inferior rectus recession

Table 2.The Comparisons of Group 1 (Primary IOOA cases) and Group 2 (vertical deviations due to other etiologies).

Variables	Group 1 (n=19)	Group 2 (n=13)	P value	
Sex (Female/Male)	9/10	6/7	0.946	
Age at surgery	6 (5-11)	12 (6.5-18.0)	0.059	
Follow-up time (months)	15 (13-18)	15 (12-18)	0.650	
SE ¹ (Diopters)	Right	1.5 (0.75-2.5)	0.5 (-0.625-0.875)	0.014*
	Left	1.5 (0.75-2.5)	0.5 (0.125-1)	0.024*
BCVA ² (logMAR)	Right	0.15 (0-0.4)	0.05 (0-0.15)	0.077
	Left	0.1 (0-0.22)	0.05 (0-0.125)	0.343
Presence of AHP ³	0	8/13	<0.01*	
Preoperative deviation (PD) ⁴	29.7 (25.0-35.0)	30 (25-35)	0.940	
Surgical success (%)	16/19 (%84)	11/13 (%84)	1.000	

¹SE: Spherical equivalent, ²BCVA: Best-corrected visual acuity, ³AHP: Abnormal head posture, ⁴PD: Prism diopters
*: Statistical significance, median values (25th and 75th percentiles) were given

4. Discussion

In the current review including 172 cases operated, approximately one fifth of the cases had primary IOOA or isolated vertical strabismus. IOOA is classified as primary IOOA, if there is no cause for ipsilateral superior oblique palsy or contralateral superior rectus weakness.^{1,6} The surgical success rate was the same in group 1 composed of primary IOOA and group 2 composed of isolated vertical deviations. Group 1 cases were more hyperopic than the other group, since the majority of group 1 cases were associated with ET. The age at

surgery was older in group 2, but this failed to reach a statistical significance. This may be related due to numerous etiologies and the difficulties in deciding to do a surgery. Different surgical procedures in vertical strabismus with various etiologies resulted in similar outcomes. The present findings support case-by-case approach in vertical deviatons.

The AHP is not observed and the head bending test is negative in the majority of primary IOOA, in contrast to vertical

deviations due to other etiologies, since the primary IOOA does not have cyclodeviation.⁷ We also found AHP in 62% of group 2 cases consistent with the literature. There are many procedures defined for IOOA management. Similar outcomes were published with different surgical techniques, such as IOR, inferior oblique myectomy, anterior transposition, and extirpation.⁸ IOR is the main procedure preferred by many surgeons in primary IOOA,⁸ we also performed IOW with 84% success rate. In a study including 63 cases, which underwent IOR, we ended up with 91.9% success rate. 28 cases were associated with ET. This retrospective review, which was published in 2014 was consistent with the present study.⁹ It is a well-known data that, IOOA is one of the characteristic findings for infantile ET.¹⁰ ET was associated in the majority of group 1 cases.

Fourth nerve palsy, DVD, DEP and DRS type 3 are other etiologies that cause vertical strabismus in our study. The most common cause of vertical strabismus due to dysfunction of oblique muscle and/or rectus muscles is superior oblique palsy. IOR is the most commonly used method in the treatment as we performed.¹¹ DEP describes a condition characterized by the development of hypotropia and the limitation in elevation as a result of paralysis of the two elevator muscles of an eye.¹² Different opinions were presented in the etiology of DEP. Jampel and Fells stated that they were caused by a defect in a unilateral supranuclear lesion in the pretectal area or by a defect in the nucleus of 3rd cranial nerve or near a nucleus.¹³ Scott and Jackson suggested that DEP could be caused by a strict inferior rectus due to concomitant restriction.¹⁴ Different surgical methods are used in the treatment of DEP, because of the variabilities in the pathogenesis in different cases. Knapp recommended horizontal muscle transposition towards the superior rectus insertion.¹⁵ In some cases, Scott and Jackson demonstrated that the inferior rectus restriction plays a role in DEP by conducting a forced duction test in these cases, so they recommended the technique of inferior rectus weakening and retractor ligament release in order to avoid the risk of anterior segment

ischemia due to transposition of horizontal rectus.¹⁴ In our study, we applied inferior rectus recession to two DEP patients.

DVD is a type of strabismus characterized by elevation, abduction and excyclotorsion of the non-fixing eye. Different treatment methods such as superior rectus recession (SRR), chemodenerivation, anterior transposition of the inferior oblique muscle, resection of the inferior rectus muscle and their combined surgeries are recommended in the surgical treatment of the DVD.^{4,16} Akar et al. compared the surgical results and possible complications of three surgical techniques namely SRR, posterior fixation suture surgery with the anterior transposition surgery and the anterior transposition surgery in DVD.¹⁷ In this study, 22 (69%) out of 32 eyes who underwent SRR surgery were considered successful (<5 prism diopter), while residual DVD was observed in other patients. In our study, 4 patients underwent SRR surgery.

Among patients with DRS, ET is the most frequent strabismus type. DRS with exotropia is a relatively rare form, which is because of the fact that lateral rectus is more potent than medial rectus due to its innervation or contracture. This rare group of patients is defined as DRS type 3. Abduction can be normal or restricted.¹⁸ This type of DRS generally has a severe muscle contracture with a tight lateral rectus, which results in severe retraction of the globe and upshoot. If globe retraction is severe, combined surgery with a vertical rectus transposition can be performed.¹⁹ There are studies showing that both retraction and overshoots spontaneously recover when lateral rectus recession (LRR) and Y splitting are performed.²⁰ In our study, we observed a significant regression of the upshoot after the Y-splitting and LRR applied to patients with DRS type 3. All cases were improved.

Our results supported that satisfactory outcomes may be obtained with case-by-case approach in vertical strabismus due to various etiologies. Additional analyses with larger sample size and longer follow-up durations are required to define the outlines of the management of vertical deviations.

REFERENCES

1. Kemp PS. The best of the best: a review of select pediatric ophthalmology and strabismus case reports published in 2015. *Digit J Ophthalmol*. 2016;22:72-74.
2. Kamlesh, Dadeya S, Kohli V, Fatima S. Primary inferior oblique overaction management by inferior oblique recession. *Indian J Ophthalmol*. 2002;50:97-101.
3. Christoff A, Raab EL, Guyton DL, et al. DVD--a conceptual, clinical, and surgical overview. *J AAPOS*. 2014;18:378-84.
4. Hatt SR, Wang X, Holmes JM. Interventions for dissociated vertical deviation. *Cochrane Database Syst Rev*. 2015;CD010868.
5. Farid MF. Y-split recession vs isolated recession of the lateral rectus muscle in the treatment of vertical shooting in exotropic Duane retraction syndrome. *Eur J Ophthalmol*. 2016;26:523-28.
6. Koller HP, Olitsky SE, O'Hara M, Nelson LB. Diagnosis and Treatment of Fourth Nerve Palsy. *J Pediatr Ophthalmol Strabismus*. 2016;53:70-74.
7. Erkan Turan K, Taylan Sekeroglu H, Koc I, Kilic M, Sanac AS. The frequency and causes of abnormal head position based on an ophthalmology clinic's findings: is it overlooked? *Eur J Ophthalmol*. 2017;27:491-94.
8. Sanjari MS, Shahraki K, Nekoozadeh S, et al. Surgical treatments in inferior oblique muscle overaction. *J Ophthalmic Vis Res*. 2014;9:291-95.
9. Bilgin B., Gursoy H, Niyaz L., Basmak H. Inferior oblique muscle surgery outcomes. *Turkiye Klinikleri Journal of Ophthalmology*. 2014;23: 7-11.
10. Koç F, Ozal H, Firat E. Is it possible to differentiate early-onset accommodative esotropia from early-onset essential esotropia? *Eye (Lond)*. 2003;17:707-10.
11. Helveston EM, Mora JS, Lipsky SN, Plager DA, Ellis FD, Sprunger DT, et al. Surgical treatment of superior oblique palsy. *Trans Am Ophthalmol Soc*. 1996;94:315-28.
12. Metz H. Double elevator palsy. *Arch Ophthalmol*. 1979;97:901-3.
13. Jampel RS, Fells P. Monocular elevation paresis caused by a central nervous system lesion. *Arch Ophthalmol*. 1968;80:45-57.
14. Scott WE, Jackson OB. Double elevator palsy: the significance of the inferior rectus restriction. *Am Orthop J*. 1977;27:5-10.
15. Luo WT, Qiao T, Ye HY, Li SH, Chen QL. Clinical features and surgical treatment of double elevator palsy in young children. *Int J Ophthalmol*. 2018;11:1352-57.
16. Santiago AP, Rosenbaum AL. Dissociated vertical deviation and head tilts. *J AAPOS*. 1998;2:5-11.
17. Akar S, Sabancı S, Gokyigit B, et al. Outcomes of surgical treatment in dissociated vertical deviation cases. *Turk J Ophthalmol*. 2014;44:132-37.
18. Velez FG, Velez G, Hendler K, Pineles SL. Isolated Y-splitting and recession of the lateral rectus muscle in patients with Exo-Duane syndrome. *Strabismus*. 2012;20:109e114.
19. Bhate M, Sachdeva V, Kekunnaya R. A High Prevalence of Exotropia in Patients With Duane Retraction Syndrome in a Tertiary Eye Care Center in South India. *J Pediatr Ophthalmol Strabismus*. 2017;54:117-22.
20. Altıntaş AG, Arifoglu HB, Koklu SG. Modified Y splitting procedure for the treatment of Duane retraction syndrome. *Turk J Ophthalmol*. 2015;45:152-55.