North Clin Istanb 2023;10(2):157–162
doi: 10.14744/nci.2023.15579

Original Article Ophthalmology

Evaluation of clinical characteristics and risk factors of strabismus cases

Ali Asgar Yetkin, Ibrahim Halil Turkman

Department of Ophthalmology, Adiyaman University Faculty of Medicine, Adiyaman, Turkiye

ABSTRACT

OBJECTIVE: Strabismus, defined as the misalignment of the eyes, is a common disorder that is usually diagnosed in childhood. Strabismus is an important health problem with both functional and psychosocial effects on children. In this study, we aimed to determine the clinical features and risk factors of patients diagnosed with strabismus and followed up in our clinic.

METHODS: The data of pediatric patients who were followed up in our strabismus clinic between February 2016 and September 2022 were retrospectively reviewed. The patients' detailed ophthalmological and strabismus examination findings and anamnesis findings concerning the etiology of strabismus were recorded.

RESULTS: A total of 391 patients were enrolled in the study. The mean age of the patients was 8.66±4.7 years. Of the patients, 207 (52.9%) had esotropia, 172 (43.99%) had exotropia, and 12 (3.07%) had vertical deviation, with the mean ages of these groups being calculated as (7.27±4.1), (10.45±4.8), and (7.16±4.7) years, respectively. Amblyopia was present in 54 (26.09%) of the 207 esotropia cases, 27 (15.70%) of the 172 exotropia cases. Esotropia is more likely than exotropia to be related to amblyopia, according to our research. Of all the patients, 97 (24.81%) had a family history of strabismus, 38 (9.7%) had a history of preterm birth, 39 (10.0%) had a history of neonatal care unit stay, 38 (9.7%) had epilepsy, 4 (1%) had a history of trauma, and 14 (3.6%) had an additional eye disease.

CONCLUSION: Detection of risk factors such as family history, preterm birth, length of stay in the neonatal care unit and epilepsy that may be associated with strabismus can help identify high-risk children for early diagnosis and treatment.

Keywords: Amblyopia; esotropia; exotropia; risk factors; strabismus.

Cite this article as: *Yetkin AA, Turkman IH. Evaluation of clinical characteristics and risk factors of strabismus cases. North Clin Istanb 2023;10(2):157–162.*

Strabismus is a common childhood disorder characterized by the misalignment of the eyes [1]. It can cause diplopia, amblyopia, and loss of binocularity and have psychological effects on both the child and the parents [2]. It has been reported that the prevalence of strabismus in children varies between 2 and 6%, depending on ethnic populations in different parts of the world [3, 4].

Strabismus is classified as esotropia [eye(s) turning inward], exotropia (one eye deviating outward), vertical false hypertrophy (one eye turning up), hypotropia (one eye deviating downward), or incomplete rotation of one eye [5]. Strabismus can also be a manifestation of neurodevelopmental disorders, craniofacial disorders, abnormalities of extraocular congenital muscles, and nerve paralysis innervating extraocular muscles [2, 6].

The aim of strabismus treatment is to restore proper ocular alignment, which resolves amblyopia, preserves binocularity, and eliminates diplopia. In the treatment of strabismus, regular follow-up, observation, and medical (optical, pharmacological, and orthoptic) and surgical (resection, regression, facial surgery, muscle transposition, and myectomy) methods are used and have been reported to be mostly beneficial for patients [1, 7, 8].

Received: December 12, 2022 *Accepted:* February 05, 2023 *Online:* March 28, 2023

Correspondence: Ali Asgar YETKIN, MD. Adiyaman Universitesi Tip Fakultesi, Goz Hastaliklari Anabilim Dali, Adiyaman, Turkiye.
Tel: +90 505 234 18 42 e-mail: aliasgaryetkin@gmail.com

There are various risk factors that can affect strabismus. Among these are non-modifiable risk factors, such as ethnicity, family history, and genetic conditions, as well as partially modifiable risk factors, such as premature birth, low birth weight, refractive error, additional eye diseases, and neural deficiency [9–13].

The investigation of the risk factors of strabismus can provide important information for early diagnosis and timely treatment. Therefore, in this study, we aimed to define the clinical features of strabismus, determine the etiology of the disease, and evaluate risk factors associated with strabismus (family history, age of onset, premature birth, trauma, neurological disease, and additional eye diseases) in pediatric patients diagnosed with strabismus and followed up regularly in our clinic.

Highlight key points

- The incidence of esotropia was higher in strabismus patients with a positive family history.
- Esotropia was more ambiogenic than exotropia.
- Detection of risk factors nonoculer that may be associated with strabismus can help identify high-risk children for early diagnosis and treatment.

MATERIALS AND METHODS

This study was conducted in line with the principles of the Declaration of Helsinki after receiving approval from the Adiyaman University ethics review board (dated 15.11.2022 and numbered 2012/8-21). Written informed consent was obtained from the parents or legal guardians of all the children included in the study.

The study was planned retrospectively and included 391 pediatric patients followed up in our strabismus clinic between February 2016 and September 2022. For each child enrolled in the study, the regular follow-up files were reviewed, and data on the child's birth, maternal obstetric history, trauma history, family history, neurological disease history, chronic systemic disease history, and ocular surgery history were obtained according to the anamnesis of the parents. In addition, refractive error, visual acuity, anterior segment examination with biomicroscopy, and dilated fundus examination findings were recorded for all the patients.

For the measurement of refractive error, 1% cyclopentolate solution was instilled three times at five-minute intervals. After 45 minutes, the measurement was performed with the table-mounted Topcon Autorefractor KR-800 (USA) where possible or hand-held Pediatric Autorefractor plusoptiX A09 (Germany). In cases where these tools could not be used, the measurements were made using the Keeler Professional Retinoscope (USA).

Visual acuity examination was performed using light and other objects with the patient closing one eye at a time for pre-speech children, Lea symbols for children aged three to five years, "E" chart for preschool and illiterate children, and Snellen chart for school-age children.

In the strabismus examination, the nine cardinal positions of gaze, the presence of shifts in the primary and other gaze positions, and limitation and weakness in gaze directions were evaluated. The Hirschberg light reflex, cover, and alternative cover-prism tests were used. Strabismus was evaluated by an ophthalmologist using both the one-sided cover (cover/uncover) test and the alternative cover and prism tests at near (30 cm) and distant (6 m) fixations.

Among the strabismus cases, those that were fixed at both near and far distances were considered as constant tropia, and those that were not fixed were considered as intermittent tropia. The strabismus cases were also classified according to the direction of the tropia as esotropic, exotropic, and vertical [14].

Amblyopia was defined based on a best-corrected visual acuity (BCVA) value of less than 0.63 (equivalent to <0.2 logMAR units) without any pathology of eye structure or visual pathway or a two-line difference in BCVA between the eyes [15].

Statistical Analysis

Statistical analyses were performed using the Statistical Package for the Social Scienc-es (version 25.0, SPSS, Chicago, IL, USA). The normality of numerical data distribution was evaluated with the Kolmogorov-Smirnov test. Categorical data were analyzed with the chi-square test and numerical data with the independent-samples t-test and the Mann-Whitney test. A P value less than 0.05 was considered statistically significant.

RESULTS

The study included 391 patients, of whom 195 were female and 196 were male. The mean age of the patients was (8.66±4.7) years. According to the type of strabismus detected, there were 104 female and 103 male esotropia cases, 85 female and 87 male exotropia cases, and six female and six male patients with vertical deviation. There were no significant differences in terms of

Table 1. Distribution of strabismus types by age groups

	Esotropia		Exotropia		Vertical deviation
	Intermittent	Constant	Intermittent	Constant	
Age					
0–6 years	11 (2.9%)	81 (20.8%)	18 (4.7%)	28 (7.1%)	5 (1.3%)
7–12 years	9 (2.3%)	73 (18.7%)	16 (4%)	40 (10.3%)	4 (1%)
13–18 years	3 (0.7%)	30 (7.6%)	9 (2.3%)	61 (15.6%)	3 (0.7%)
Total	23 (5.9%)	184 (47.1%)	43 (11%)	129 (33%)	12 (3%)

Table 2. Distribution of refractive error by strabismus type

Refractive error	Esotropia (n=207)	Exotropia (n=172)	Vertical deviation (n=12)
Spherical			
≤1.00	25 (12.1%)	5 (2.9%)	3 (25%)
>1.00 to <+ 3.00	46 (22.1%)	4 (2.3%)	3 (25%)
≥3.00 to <5.00	75 (36.3%)	3 (1.7%)	2 (16.7%)
≥5.00	47 (22.3%)	1 (0.6%)	2 (16.7%)
≤-1.00	8 (4%)	59 (34.4%)	1 (8.3%)
>-1.00 to <- 3.00	4 (2%)	65 (37.8%)	1 (8.3%)
≥-3.00 to <-5.00	1 (0.50%)	25 (14.5%)	–
≥-5.00	1 (0.50%)	10 (5.8%)	–
Astigmatism			
<1.00	89 (43.0%)	75 (43.6%)	7 (58.3%)
≥1.00 to <2.00	98 (47.2%)	65 (37.8%)	5 (41.7%)
≥2.00	20 (11.8%)	32 (18.6%)	–
Anisometropia			
<0.50	61 (29.5%)	58 (33.7%)	10 (83.3%)
0.50 to <1.00	72 (34.8%)	53 (30.9%)	2 (16.7%)
≥1.00	74 (36.7%)	61 (35.4%)	–

gender. The mean age according to the type of strabismus was (7.27±4.1) years in the patients with esotropia, (10.45±4.8) years in those with exotropia, and (7.16±4.7) years in those with vertical deviation.

Of the 391 patients, 207 (52.94%) had esotropia, 172 (43.99%) had exotropia, and 12 (3.07%) had vertical deviation. The distribution of the patients according to the strabismus type and age ranges (0–6 years, 7–12 years, and 13–18 years) is shown in Table 1.

When the relationship between refractive error and strabismus type was examined, right and left mean spherical and cylindrical values were (2.85±2.0) – (2.97±2.0) and (-0.40±0.7) – (-0.41±0.75), respectively in the patients with esotropia; (-0.76±2.0) – (-0.75±2.0) and (-0.80±1.1) – (-0.77±1.7) in those with exotropia; and (1.76±1.9) – (1.64±1.6) and (-0.22±0.5) – (0.39±0.7), respectively in those with vertical deviation. The mean spherical and cylindrical anisometropia values of the patients were (0.60±0.7) and (-0.22±0.3), respectively in the esotropia group; (-0.50±0.9) and (-0.65±0.8), respectively in the exotropia group; and (0.35±0.4) and (-0.17±0.3), respectively in the vertical deviation group. Refractive error measurements according to the strabismus type are detailed in Table 2.

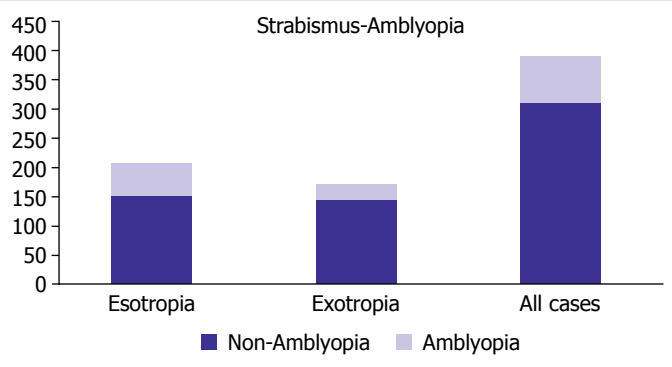
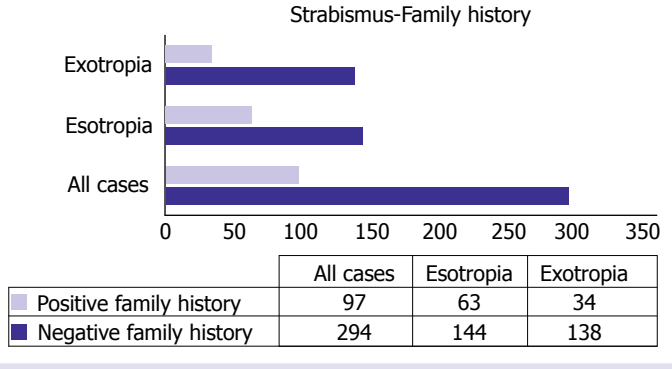


FIGURE 1. The graph of relationship between amblyopia and strabismus types.



	All cases	Esotropia	Exotropia
Positive family history	97	63	34
Negative family history	294	144	138

FIGURE 2. The graph of relationship between strabismus types and family history.

The mean BCVA values of the patients were (0.91±0.18) – (0.90±0.17) in the patients with esotropia, (0.91±0.21) – (0.93±0.20) in those with exotropia, and (0.95±0.10) – (0.96±0.11) in those with vertical deviation (right, left respectivitly). Amblyopia was detected in 54 (26.09%) of the 207 esotropia cases, 27 (15.70%) of the 172 exotropia cases. The mean BCVA values of the amblyopic patients were (0.65±0.24) – (0.66±0.25) in the patients with esotropia, (0.67±0.22) – (0.66±0.23) in those with exotropia (right, left respectivitly). We found that esotropia is more likely than exotropia to be associated with amblyopia (p=0,014). Figure 1 presents the relationship between strabismus types and amblyopia.

First-degree family history of strabismus was detected in 63 (30,4%) of the 207 esotropia cases, 34 (19,8%) of the 172 exotropia cases. Esotropia had more family history associations than exotropia (p=0.018). Figure 2 presents the relationship between strabismus types and family history.

There was a history of preterm birth in 26 (12.5%) patients with esotropia, 10 (5.81%) patients with exotropia, and two (16.4%) patients with vertical deviation group; history of neonatal care unit stay in 21 (10.1%) esotropia cases, 16 (9.3%) exotropia cases, and two (16.4%) vertical deviation cases; epilepsy in 19 (9.2%) esotropic patients, 18 (10.4%) exotropic patients, and one (8.3%) patient with vertical deviation; trauma history in two (0.97%) patients(orbital fracture, head and face injury) in the esotropia group and two (1.16%) patients(orbital fracture, nerve injury) in the exotropia group; and additional eye diseases in eight (3.8%) esotropia cases (3 patients cataract, 4 patients leukoma, 1 patient optic atrophy) and six (3.5%) exotropia cases (1 patients cataract, 3 patients leukoma, 2 patient optic atrophy). Table 3 presents the distribution of the above-mentioned risk factors according to the strabismus type.

DISCUSSION

In studies evaluating strabismus types in children, the most common type of strabismus in the first six years of childhood has been reported as esotropia (76.1%), while this age, exotropia seems to increase and becomes dominant until the teenage years (75.6%), and this has been attributed to patient age at diagnosis being significantly higher than the age of onset in some types of strabismus [16–18]. Similarly, in our study, we found that esotropia was dominant (24%) in the first six years of childhood, and exotropia increased (19%) in the following years, especially in the 13–18 years group.

Studies examining the relationship between strabismus and refractive error have shown that the probability of esotropia is very high, especially in children with hyperopia of 3 Diopter (D) and above, and the probability of esotropia in children with hyperopia of 5 D or greater is 122 times higher than in those with hyperopia of 1 D or less. In addition, it has been reported that there is a linear relationship between exotropia and myopia, astigmatism increases risk of developing exotropia [10, 19, 20]. It has also been shown that spherical anisometropia of 1 D and above increases the risk of esotropia, and cylindrical anisometropia of 1 D and above increases the risk of exotropia [10, 19–21]. In the current study, we found that approximately 59% of the cases with esotropia had hyperopia of 3 D and above, while approximately 56% of the exotropia cases had astigmatism above 1 D and approximately 58% had myopia above 1 D. We also detected anisometropia of more than 1 D in spherical

TABLE 3. Distribution of strabismus-related risk factors by strabismus type

	Esotropia	Exotropia	Vertical deviation	Total
Family history	63/207 (30.4%)	34/172 (19.8%)	–	97/391 (24.8%)
Premature birth	26/207 (12.5%)	10/172 (5,81%)	2/12 (16.4%)	38/391 (9.7%)
Neonatal intensive care unit stay	21/207 (10.1%)	16/172 (9.3%)	2/12 (16.4%)	39/391 (10.0%)
Epilepsy	19/207 (9.2%)	18/175 (10.4%)	1/12 (8.3%)	38/391 (9.7%)
Trauma	2/207 (0,97%)	2/172 (1,16%)	–	4/391 (1.0%)
Additional eye disease	8/207 (3.8%)	6/172 (3.5%)	–	14/391 (3.6%)

equivalent in approximately 36.7% of the patients with esotropia and mor than 1 D in cylindrical equivalent in approximately 35.4% of those with exotropia.

Sahin et al. [22] reported that the causes of amblyopia were anisometropic in approximately 30% of the cases, strabismus in ≈30%, and anisometropia and strabismus together in ≈30% [22]. Robaei et al. [19] found amblyopia in 25% of children diagnosed with exotropia and 50% of those with esotropia and stated that esotropia was more ambiogenic. In our study, amblyopia was detected in 81 children, of whom 54 had esotropia and 27 had exotropia. We found that esotropia was more ambiogenic than exotropia.

In a review of a cohort of 7,100 patients with strabismus from 12 studies involving families, Engle [11] reported that 2,171 patients with strabismus (30.6%) had a close relative with strabismus. Various studies have shown that strabismus is seen at a much higher rate in patients that have family members with strabismus, and this suggests the presence of a genetic component. Various genomes related to strabismus have been identified in genetic studies [23, 24]. Although families with a history of esotropia or exotropia have been reported, Ziakas et al. [12] stated that there was a stronger genetic component in hypermetropic accommodative esotropia than in hypermetropic accommodative esotropia than in infantile esotropia and anisometropic esotropia or exotropia, and heredity was a stronger factor [12]. Donnelly et al. [10] determined that there was more dominant heredity in esotropia compared to exotropia [10]. In our study, the rate of the patients with a family history of the disease was 30.4% in those with esotropia and 19.8% in those with exotropia. In line with the literature, we found that the incidence of esotropia was higher in strabismus patients with a positive family history.

Studies on strabismus investigating the effects of risk factors related to pregnancy and childbirth have shown that low birth weight, premature birth, neonatal intensive care requirement, cesarean delivery, and retinopathy of prematurity increase the risk of strabismus [25–27]. In our study, we found that the number of patients with a history of preterm birth was 38 (9.7%) and the number of those with a history of neonatal care unit stay was 39 (10.0%).

Studies on neurologic findings on strabismus have shown that cerebral palsy and developmental delay, abnormalities, seizures, and central nervous system diseases are associated with strabismus [28–30]. Concerning post-traumatic strabismus, it has been reported that many etiologies play a role (vascular injury, orbital fracture, muscle rupture, head and face injury, and nerve injury), but it is a less common type of strabismus [31–33]. Some eye diseases, such as chorioretinal atrophy, congenital cataract, optic atrophy, retinal disease, complicated cataract, leukoma, coloboma, high myopia, congenital glaucoma, penetrating trauma, contusional eye trauma, and traumatic cataract cause visual impairment and may lead to strabismus by resulting in suppression [34, 35]. In our study, the number of strabismus cases with epilepsy was 38 (9.7%), the number of those associated with trauma was 4 (1%), and the number of those associated with other ocular disorders was 14 (3.6%).

Conclusions

Strabismus is a disease that can be frequently seen in childhood but responds to regular follow-up and treatment. The detection of the risk factors of strabismus can help identify high-risk children for early diagnosis and treatment. Therefore, we consider that it is important to evaluate and follow-up children with risk factors, such as family history, preterm birth, neonatal care unit stay, and epilepsy, which may be associated with strabismus.

Ethics Committee Approval: This study was conducted with the approval of the Clinical Research Ethics Committee of Adiyaman University Faculty of Medicine, dated 15.11.2022 and numbered 2012/8-21.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: This study was not funded by any institution, organization, or person.

Authorship Contributions: Concept – AAY; Design – AAY; Data collection and/or processing – AAY, IHT; Analysis and/or interpretation – AAY; Literature review – AAY, IHT; Writing – AAY; Critical review – AAY.

REFERENCES

1. Ticho BH. Strabismus. Pediatric Clinics of North America 2003;50:173–88. [CrossRef]
2. Sharma P, Gaur N, Phuljhele S, Saxena R. What's new for us in strabismus? Indian J Ophthalmology 2017;65:184–90. [CrossRef]
3. Garvey KA, Dobson V, Messer DH, Miller JM, Harvey EM. Prevalence of strabismus among preschool, kindergarten, and first-grade Tohono O'odham children. Optometry 2010;81:194–9. [CrossRef]
4. Pineles SL, Repka MX, Velez FG, Yu F, Perez C, Sim D, et al. Prevalence of pediatric eye disease in the optumlabs data warehouse. Ophthalmic Epidemiology 2022;29:537–44. [CrossRef]
5. Mocan MC, Pastapur A, Kaufman L. Etiology-based strabismus classification scheme for pediatricians. Turk J Pediatr 2022;64:332–40.
6. Bommireddy T, Taylor K, Clarke MP. Assessing strabismus in children. Paediatr Child Health (United Kingdom) 2020;30:14–8. [CrossRef]
7. von Noorden GK, Campos EC. Binocular Vision and Ocular Motility. St. Louis: Mosby; 2002. p.393. [CrossRef]
8. Kushner BJ. The Functional benefits of strabismus surgery. J Binocul Vis Ocul Motil 2018;68:59–62. [CrossRef]
9. Multi-ethnic Pediatric Eye Disease Study Group. Prevalence of amblyopia and strabismus in African American and Hispanic children ages 6 to 72 months the multi-ethnic pediatric eye disease study. Ophthalmology 2008;115:1229–36. [CrossRef]
10. Donnelly UM. Horizontal strabismus worldwide what are the risk factors. Ophthalmic Epidemiology 2012;19:117–9. [CrossRef]
11. Engle EC. Genetic basis of congenital strabismus. Archives of Ophthalmology 2007;125:189–95. [CrossRef]
12. Ziakas NG, Woodruff G, Smith LK, Thompson JR. A study of hereditary as a risk factor in strabismus. Eye 2002;16:519–21. [CrossRef]
13. Sawers N, Jewsbury H, Ali N. Diagnosis and management of childhood squints: investigation and examination with reference to red flags and referral letters. Br J Gen Pract 2017;67:42–3. [CrossRef]
14. Wang Y, Zhao A, Zhang X, Huang D, Zhu H, Sun Q, et al. Prevalence of strabismus among preschool children in eastern China and comparison at a 5-year interval: a population-based cross-sectional study. BMJ Open 2021;11:e055112. [CrossRef]
15. Cumberland PM, Pathai S, Rahi JS; Millennium Cohort Study Child Health Group. Prevalence of eye disease in early childhood and associated factors: findings from the millennium cohort study. Ophthalmology 2010;117:2184–90. [CrossRef]
16. Pai ASI, Rose KA, Leone JF, Sharbini S, Burlutsky G, Varma R, et al. Amblyopia prevalence and risk factors in Australian preschool children. Ophthalmology 2012;119:138–44. [CrossRef]
17. Williams C, Northstone K, Howard M, Harvey I, Harrad RA, Sparrow JM. Prevalence and risk factors for common vision problems in children: data from the ALSPAC study. BJO 2008;92:959–64.
18. Paduca A, Arnaut O, Cardaniuc C, Spinei L, Bendelic E, Bruenech JR, et al. Epidemiology of childhood manifest strabismus in the Republic of Moldova. Strabismus 2020;28:128–35. [CrossRef]
19. Robaei D, Rose KA, Kifley A, Cosstick M, Ip JM, Mitchell P. Factors associated with childhood strabismus. Findings from a population-based study. Ophthalmology 2006;113:1146–53. [CrossRef]
20. Cotter SA, Varma R, Tarczy-Hornoch K, McKean-Cowdin R, Lin J, Wen G, et al. Risk factors associated with childhood strabismus: The multi-ethnic pediatric eye disease and baltimore pediatric eye disease studies. Ophthalmology 2011;118:2251–61. [CrossRef]
21. Tang SM, Chan RYT, Bin Lin S, Rong SS, Lau HHW, Lau WWY, et al. Refractive errors and concomitant strabismus: a systematic review and meta-analysis. Scientific Reports 2016;6:35177. [CrossRef]
22. Şahin T, Buyru Özkurt Y. Amblyopia in children and vision screening program in our country. Ortadogu Med J 2017;9:79–87. [CrossRef]
23. Vlachou C, Mellou K, Tsaras K, Sparos L. Determinants of strabismus frequency. Arch Hell Med 2003;20:276–80.
24. Ferreira R da C, Oelrich F, Bateman B. Genetic aspects of strabismus. Arq Bras Oftalmol 2002;65:171–5. [CrossRef]
25. Pathai S, Cumberland PM, Rahi JS. Prevalence of and early-life influences on childhood strabismus: Findings from the millennium cohort study. Arch Pediatr Adolesc Med 2010;164:250–7. [CrossRef]
26. Maconachie GDE, Gottlob I, McLean RJ. Risk factors and genetics in common comitant strabismus: A systematic review of the literature. JAMA Ophthalmology 2013;131:1179–86. [CrossRef]
27. Lingham G, Mackey DA, Sanfilippo PG, Mountain J, Hewitt AW, Newnham JP, et al. Influence of prenatal environment and birth parameters on amblyopia, strabismus, and anisometropia. J AAPOS 2020;24:74. [CrossRef]
28. Kang SL, Shaikh AG, Ghasia FF. Vergence and strabismus in neurodegenerative disorders. Front Neurol 2018;9:299. [CrossRef]
29. Collins ML. Strabismus in cerebral palsy: when and why to operate. Am Orthopt J 2014;64:17–20. [CrossRef]
30. Choi DD, Park KA, Yang M, Kim S, Roh JH, Oh SY. Association of mental disorders and strabismus among South Korean children and adolescents: a nationwide population-based study. Graefes Arch Clin Exp Ophthalmol 2022;260:1353–65. [CrossRef]
31. Anand N, Gupta J, Gupta R. Study of clinico-etiological profile of patients with paralytic and restrictive strabismus. IP Int J Ocul Oncol Oculoplasty 2020;6:48–54. [CrossRef]
32. Del Monte MA. Management of direct extraocular muscle trauma. Am Orthopt J 2004;54:32–44. [CrossRef]
33. Murray AD. An approach to some aspects of strabismus from ocular and orbital trauma. Middle East Afr J Ophthalmol 2015;22:312–9.
34. Piano M, Newsham D. A pilot study examining density of suppression measurement in strabismus. Strabismus 2015;23:14–21.
35. Ciftci S, Simsek A, Dogan E, Ciftci L. Sensory exotropia due to keratoconus and review of the literature. Clin Ophthalmol 2013;7:2069–72. [CrossRef]