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Evaluation of demographic characteristics and management in cases of paralytic strabismus

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ABSTRACT

Aims: To evaluate the demographic characteristics of cases of paralytic strabismus followed up in our Strabismus Unit and to report on their management and long-term outcomes.

Methods: The records of 98 patients diagnosed with paralytic strabismus between 2010 and 2024 at the Strabismus Unit of Fırat University Eye Diseases Clinic were retrospectively reviewed. The diagnosis, etiology, management, and outcomes of the patients were evaluated.

Results: The average age of the patients was 16.8±18.5 years, with 48 (48.9%) being female and 50 (59.1%) being male. The average follow-up period was 7.1±6.7 years. The most commonly affected cranial nerve was the 4th cranial nerve, observed in 63 patients (64.2%). The 6th cranial nerve was affected in 25 patients (25.5%), and the 3rd cranial nerve was affected in 10 patients (10.2%). While 4th cranial nerve palsy was mostly congenital, the etiology of 3rd and 6th nerve palsy was due to underlying neurological, traumatic, and vascular causes. Spontaneous recovery was observed in 10 patients, Botulinum toxin injection was administered to 10 patients, and surgery was performed on 75 patients. Three patients were prescribed prismatic glasses.

Conclusion: Comprehensive clinical examination, detailed medical history, and neurological and systemic evaluations are required for the effective management of patients with paralytic strabismus. If managed correctly, treatment success is quite high.

Keywords: Paralytic strabismus, cranial nerve palsy, etiology, management

INTRODUCTION

Paralytic strabismus is a type of strabismus that occurs as a result of partial or complete paralysis of the cranial nerves that control eye muscle movement. Patients typically present with diplopia, limited eye movement, strabismus, or abnormal head position. The most commonly affected nerves are the 6th (N. Abducens), 4th (N. Trochlear), and 3rd (N. Oculomotor) cranial nerves (CN).[1] A detailed eye examination, along with a thorough neurological and systemic examination, is crucial for determining the etiology and planning treatment in the diagnosis of paralytic strabismus. Paralytic strabismus can be congenital or acquired. In congenital cases, anatomical developmental pathologies of the muscles are often responsible for the etiology, while in acquired cases, vascular diseases, trauma, brain tumors, and neurological diseases are often implicated.[2-4]

Paralytic strabismus is an important clinical condition that negatively affects patients' daily lives, social relationships, and functional abilities. Especially in adults, the sudden onset of double vision can cause serious problems in daily life and work by disrupting visual comfort. In children, however, diplopia is not always clearly expressed, and compensatory changes in head position can, over time, place strain on the musculoskeletal system, leading to postural abnormalities. While spontaneous resolution is not expected in congenital cases, considering these long-term effects, early diagnosis and treatment in the pediatric patient group can prevent both visual and physical complications. In acquired cases, improvements may be observed over time.[5,6] Therefore, the treatment approach varies depending on the patient's age, the duration and cause of paralysis, and the severity of the patient's symptoms.

The aim of this study is to report the demographic characteristics, treatment modalities, and outcomes of patients followed up in the strabismus unit due to paralytic strabismus.

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METHODS

The study was carried out with the permission of the Fırat University Hospital Scientific Researches Evaluation and Ethics Committee (Date: 13.02.2024, Decision No: 2024/03-48). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. In this retropspective study, the medical records of 98 patients with paralytic strabismus who applied to our clinic between 2010 and 2025 were retrospectively reviewed. Patients diagnosed with paralytic strabismus due to 3rd CN palsy, 4th CN palsy, and 6th CN palsy were included in the study. Patients with diplopia due to myopathic causes such as thyroid ophthalmopathy, myasthenia gravis, Duane retraction syndrome, Brown syndrome, ocular fibrosis syndromes, and chronic progressive external ophthalmoplegia were excluded from the study.

The patients' age, gender, diagnosis, complaints at the time of presentation and duration of complaints, affected eye, etiological causes, best-corrected visual acuity (BCVA), examination findings, treatment method applied, and follow-up information were evaluated.

Statistical Analysis

The data obtained in the study were analyzed statistically using SPSS version 25.0 software (Statistical Package for the Social Sciences version 25.0, SPSS Inc., Chicago, IL, USA). The data were analyzed using descriptive statistical methods. A one-way ANOVA test was used to compare the mean ages between groups. If a significant difference was detected, a post-hoc analysis test was performed to determine which groups differed. The significance level for statistical analyses was set at $p<0.05$.

Mean±standard deviation was used for continuous variables, and percentage values were used for categorical variables.

RESULTS

A total of 98 patients with paralytic strabismus were included in the study. The mean age of the patients was 16.8±18.5 years, and 48 (48.9%) were female and 50 (59.1%) were male. The most commonly affected cranial nerve was the 4th cranial nerve, observed in 63 patients (64.2%). The 6th cranial nerve was affected in 25 patients (25.5%), and the 3rd cranial nerve was affected in 10 patients (10.2%). The average follow-up period was 7.1±6.7 years. The demographic results of the study are presented in Table.

Table. The demographic results for cases of paralytic strabismus

	3rd CN (n: 10)	4th CN (n: 63)	6th CN (n: 25)
Age	31.9±27.3	14.2±13.8	13.5±19.8
Gender (F/M)	4/6	30/33	14/11
Bilaterality	0	8	2
Diplopia	1	8	20
Abnormal head position	0	35	5
Congenital	2	52	2
Acquired	8	11	23
Mean follow-up duration (years)	3.6	7.1	9.8

CN: Cranial nerves, F: Famele, M: Male

The mean age of the 10 patients with 3rd CN palsy was 31.9±27.3 years (Table). Two patients had congenital cases, and 8 had acquired cases. Among the acquired cases, 2 involved trauma, 2 involved diabetes, 2 involved neurological factors (aneurysm, intracranial tumor), and 2 had no identifiable cause. All 10 patients with cranial nerve palsy had restricted gaze in all directions except outward, and 4 patients had ptosis and 1 had diplopia. Five of these patients (50%) had significant exotropia in the primary position, with an average deviation of 23.7±8.5 PD. Spontaneous improvement was observed in 4 of the 10 patients during follow-up, and *Botulinum* toxin injection was administered to 2 patients. One patient who received a *Botulinum* toxin injection experienced recurrence after 6 months and underwent surgery. In 4 patients with partial paralysis, lateral rectus recession and medial rectus resection were performed on the paralyzed eye, resulting in orthophoria in 3 patients. Surgical success was not achieved in two patients with complete paralysis who underwent lateral rectus recession and medial rectus resection together with eyelid surgery. In one of these patients, periosteal fixation of the lateral rectus to the lateral orbital wall was performed, but surgical success was still not achieved.

The mean age of the 63 patients with 4th CN palsy was 14.2±13.8 years (Table). In 28 cases, the right eye was affected; in 27 cases, the left eye was affected; and in 8 cases, there was bilateral involvement. Fifty-two patients had congenital cases, and 11 patients had acquired cases. Among those with acquired strabismus, 4 had trauma as the etiology, 2 had neurological factors (vascular and multiple sclerosis), and 5 had no identifiable etiological factors. Of the 63 patients with 4th cranial nerve palsy, 48 (76.1%) had hypertropia, with an average deviation of 14.1±6.3 it was measured as prism diopters (PD). In addition, exotropia was observed in 10 (20.8%) of the patients with hypertropia, while esotropia was observed in 5 (10.4%). In 53 patients, inferior oblique hyperfunction (IOHF) was observed. The Parks-Bielschowsky three-step test was performed to differentiate these patients from those with isolated IOHF, and it was found to be positive. In the treatment of 63 patients with 4th CN, inferior oblique muscle recession/anteriorization or myectomy was performed in 59 (83%) of a total of 71 paralyzed eyes, including 8 with bilateral involvement. Superior oblique muscle plication surgery was performed in 3 patients, and in 2 eyes that underwent inferior oblique muscle surgery, inferior rectus recession was performed in the contralateral eye due to surgical failure. In 44 (83%) of the 53 patients who underwent inferior oblique muscle recession surgery, orthophoria was achieved at the postoperative examination, while microtropia was observed in 4, exotropia in 3, and minimal hypertropia in 2. In 1 of the cases with postoperative hypertropia, orthophoria was achieved at the end of the 3-month follow-up period. In 2 of the patients with postoperative exotropia, additional lateral rectus recession surgery was required, while no increase in the amount of deviation was observed in the other patients during the follow-up period.

The mean age of the 25 patients with 6th CN palsy was 13.5±19.8 years. Among the acquired cases, 6 had trauma as the etiology, 10 had neurological causes such as increased intracranial pressure (ICP) or tumors, and 7 had no identifiable etiological factor. Of the 25 patients with 6th cranial nerve palsy, 17 (68%) had significant esotropia with restricted outward gaze, with an average deviation of 19.1±8.2 PD. However, nystagmus was

present in 1 patient with 6th cranial nerve palsy, and inferior oblique hyperfunction was noticeable in 1 patient. Of the 25 patients with 6th cranial nerve palsy, 8 (24%) underwent *Botulinum* toxin injection into the medial rectus muscle of the paralyzed eye; after *Botulinum* toxin injection, recurrent esotropia developed in 6 patients after an average of 7±6.6 months, and 1 patient experienced temporary exotropia lasting 3 months after injection. In addition to the 3 patients who experienced recurrence after Botox injection, a total of 5 patients underwent recession surgery of the medial rectus muscle and resection surgery of the lateral rectus muscle. Orthophoria was achieved in all patients who underwent surgery during postoperative examination. In addition, prismatic glasses were prescribed for 3 patients with low deviation and diplopia who did not want surgery.

DISCUSSION

Eye movements are controlled by the third (N. Oculomotor), fourth (N. Trochlear), and sixth (N. Abducens) cranial nerves, which innervate the extraocular muscles in both eyes. Paralytic strabismus occurs as a result of damage to one or more of these nerves and is typically characterized by symptoms such as restricted eye movements, strabismus, diplopia, and compensatory head position.[1,2] In this study, the demographic data, clinical findings, etiological causes, treatment methods, and long-term outcomes of 98 patients diagnosed with paralytic strabismus and followed up at our clinic were retrospectively evaluated.

When we look at our study results in terms of age, the average age of patients with 3rd nerve palsy was higher. This finding can be interpreted as indicating that 3rd CN palsy may be more common in older age groups due to its greater association with systemic diseases.

The most common type of cranial nerve palsy observed in our clinic was 4th CN palsy, followed by 6th cranial nerve palsy. Fourth cranial nerve palsy is the most common cause in patients presenting with vertical diplopia. Additionally, due to its delicate structure and long course, the fourth cranial nerve is more susceptible to traumatic injuries compared to the third and sixth cranial nerves.[7,8] These characteristics may explain why the most common type is 4th cranial nerve palsy. Additionally, 4th CN palsy is more often congenital, and in many patients, the underlying cause cannot be identified. We believe that the result is due to patients spending more time in the relevant department in cases where trauma, neurological, and vascular secondary factors play a more frequent role in the etiology, such as sixth cranial nerve palsy, and that the number of referrals is lower because most of the symptoms are temporary, leading to more patients being referred to eye clinics when the etiology cannot be determined. In contrast, 6th CN palsy is frequently secondary to trauma, neurological, or vascular causes, and temporary symptoms often resolve with treatment of the primary condition in other departments. Therefore, these patients either present to ophthalmology at a later stage or are not referred at all.

In the study conducted by Holmes et al.,[9] the most common cranial nerve palsy was reported to be the 4th nerve, which was similar to the results of our study. Similarly, Bayramlar et al.,[10] Söylev et al.,[11] and Çakmak et al.[12] reported that 4th CN palsy was more common in their studies conducted in our country. In a study conducted in our country by Çolpak et al.,[13] 127 patients were evaluated, and the third cranial nerve palsy was found to be the most common type. However, unlike our study, the average age of this patient group followed up in the neuro-ophthalmology unit was 58.87±13.6, which is considerably higher than the average age in our study. However, unlike the results obtained in our study, there are numerous studies showing that the sixth cranial nerve is the most commonly affected nerve.[4,14,15] In a study by Park et al.[14] that included children and adolescents with acquired paralytic strabismus, cranial nerve VI palsy was observed in 35 of 66 patients, and the most common etiological cause was neoplasia (25%). In our study, acquired and congenital types of paralytic strabismus were evaluated together, and neurological factors were found to be the most common cause in acquired paralysis.

In a study conducted by Priya et al.,[16] 90 pediatric cases were retrospectively examined. In the study the most common cause of ocular motor cranial nerve palsy was congenital involvement of the 3rd and 4th cranial nerves. While congenital involvment was the second most common cause of 6th cranial nerve palsy. In our study, the most common cause of 4th cranial nerve palsy was congenital. However, contrary to the study by Priya et al., the most common reason for 3rd and 6th cranial nerve palsy was acquired. This may be due to the higher mean age of the patients in our study.

Paralytic strabismus can present with variable clinical findings depending on which cranial nerve is affected. Fourth cranial nerve palsy is often characterized by findings such as hypertropia, vertical diplopia, and compensatory head position, which are consistent with the presenting complaints of patients diagnosed with fourth cranial nerve palsy in our study. The high frequency of IOHF may be explained by the decrease in the antagonistic effect of the inferior oblique muscle secondary to paralysis of the superior oblique muscle and its relative overactivity.[17] Sixth cranial nerve palsy typically presents with marked esotropia and restricted outward gaze. In third cranial nerve palsy, ptosis, mydriasis, restricted eye movements in all directions except outward gaze, and often exotropia are encountered. In our study, these clinical findings were also observed to a large extent in our patient groups.

When evaluating the surgical outcomes in our study, the high rate of orthophoria achieved after inferior oblique recession surgery in patients with fourth cranial nerve palsy (83%) demonstrates that this method is an effective and reliable treatment option. The low recurrence rate and minimal residual deviations after surgery support the success of this technique. In 4 cases with high vertical deviation but no significant inferior oblique hyperfunction, surgical reinforcement of the superior oblique muscle was performed. Although inferior oblique muscle surgery is more commonly performed, superior oblique muscle surgery should be considered in necessary cases.

In 9 of 10 patients with paralytic strabismus who received *Botulinum* toxin injections, orthophoria was achieved, while in 1 patient, temporary consecutive exotropia was observed. However, recurrence of strabismus was observed in 7 of the patients who received *Botulinum* toxin injections. This finding indicates that *Botulinum* toxin injection offers a temporary solution and that surgical intervention may be necessary for permanent alignment. In a study by Metz et al.,[18] 22 of 29

patients (76%) who presented with acute sixth cranial nerve palsy and received *Botulinum* toxin injection in the early stage were successful. In a similar study by Holmes et al.,[19] conservative treatment was compared with *Botulinum* toxin application in patients with acute traumatic sixth cranial nerve palsy, and similar improvement rates were observed in both groups. In conclusion, *Botulinum* toxin injection can be used as a first-line treatment, especially in younger age groups or in patients who are not suitable for surgery. A conservative treatment approach may also be preferred, and surgical treatment options may need to be evaluated in patients who experience recurrence after *Botulinum* toxin treatment. When planning treatment, a personalized approach should be adopted based on the patient's preferences and complaints, and the most appropriate treatment method should be determined through a multidisciplinary evaluation.

In our study, third cranial nerve palsy was found to be the least common involvement among cases of paralytic strabismus (10.2%). This finding is consistent with the literature, as the third nerve contains both motor and parasympathetic fibers anatomically, making isolated nerve palsy rare and usually accompanied by other systemic findings. Due to the possibility of serious conditions such as neoplasia, meningitis, encephalitis, intracranial aneurysm, and substance poisoning in its etiology, these patients often present to neurology or emergency departments and may be referred to the ophthalmology department less frequently or at a later stage.[14] Therefore, the low incidence of third nerve palsy in our study can be explained by both the fact that patients present with systemic diseases and symptoms apart from ptosis, mydriasis, or strabismus, and by referral practices in the healthcare system.

Another important finding based on the data we obtained is that the underlying etiological factor could not be determined in 14 patients (14.2%). In particular, in pediatric patients, this situation may be explained by the difficulty of obtaining an accurate and detailed medical history, the forgetting of previous traumas, or the delayed diagnosis of some systemic diseases. In addition, some cranial nerve palsies are congenital and may go unnoticed for many years, which can lead to confusion in distinguishing between congenital and idiopathic types. At this point, a multidisciplinary approach is important for the proper management of both the diagnosis and treatment process.

CONCLUSION

As a result, comprehensive clinical examination, detailed medical history, and neurological and systemic evaluations when necessary are required for the effective management of patients with paralytic strabismus. In addition, the use of imaging methods in suspicious cases may contribute to elucidating the etiology. Long-term follow-up of patients is also extremely critical for the sustainability of treatment outcomes and the prevention of potential complications. Our study aims to contribute to clinical practice in this field and may guide future prospective studies with larger sample sizes. However, our study has certain limitations due to its retrospective design. The reliability of patients' subjective symptoms could not be fully assessed, and some clinical findings may have been incompletely recorded. Although the overall number of patients was sufficient, the small sample size in the 3rd CN palsy group may have contributed to heterogeneity among the patient groups. The fact that all surgeries were performed by a single surgeon may limit the generalizability of surgical decision-making and outcomes.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Fırat University Hospital Scientific Researches Evaluation and Ethics Committee (Date: 13.02.2024, Decision No: 2024/03-48).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Park UC, Kim SJ, Hwang JM, Yu YS. Clinical features and natural history of acquired third, fourth, and sixth cranial nerve palsy. *Eye (Lond).* 2008;22(5):691-696. doi:10.1038/sj.eye.6702720
2. Liu H, Tan N, Xu D, Li CY, Xian GJ. NGF and CNTF expression and regulation mechanism by miRNA in acute paralytic strabismus. *Int Ophthalmol.* 2020;40(4):975-984. doi:10.1007/s10792-019-01270-x
3. Kim M, Lew H. Binocular visual rehabilitation in paralytic strabismus by *Botulinum* A toxin chemodenervation. *Korean J Ophthalmol.* 2022; 36(1):60-65. doi:10.3341/kjo.2021.0054
4. Azizah ARN, Loebis R, Hidayati HB, Wahyuni I, Wulandari LR. The etiology of paralytic strabismus at an Indonesian tertiary hospital from 2017 to 2022. *Folia Medica Indones.* 2024;60(1):8-16. doi:10.20473/fmi.v60i1.52036
5. Martinez-Thompson JM, Diehl NN, Holmes JM, Mohney BG. Incidence, types, and lifetime risk of adult-onset strabismus. *Ophthalmology.* 2014;121(4):877-882. doi:10.1016/j.ophtha.2013.10.030
6. Atilla H. Diagnostic modalities in paralytic strabismus. *Turk Klin Ophthalmol Spec Topics.* 2014;7(3):38-44.
7. Kim JH, Choi HY, Jeon H. Clinical characteristics for predicting recovery of acquired fourth cranial nerve palsy. *J Neuroophthalmol.* 2022;42(2):234-238. doi:10.1097/WNO.0000000000001426
8. Gezer A. Paralitik şaşılıklar. 4. sinir felçleri. TOD Eğitim Yayınları Şaşılık Kitabı; 2008. s.185-191.
9. Holmes JM, Mutyala S, Maus TL, Grill R, Hodge DO, Gray DT. Pediatric third, fourth, and sixth nerve palsies: a population-based study. *Am J Ophthalmol.* 1999;127(4):388-392. doi:10.1016/s0002-9394 (98)00424-3
10. Bayramlar H, Aydın E, Totan Y, DağlıOğlu MC, Erten A. Which of the paralytic strabismus is most frequent? Abducens nerve palsy or trochlearis nerve palsy. *Turk J Ophthalmol.* 2000;30(2):188-191.
11. Söylev MF, Özkan SB, Kasım R, Duman S. The evaluation of etiological factors in 3rd, 4th and 6th cranial nerve palsies. *Turk Clin J Ophthalmol.* 1994;3(1):5-8.
12. Çakmak HB, Toprak B, Ozerdem U, Şener EC, Kansu T, Sanaç AŞ. Etiological factors in patients wıth paralytic strabismus. TOD XXX. Ulusal kongresi, Antalya, 877-883.
13. Çolpak, Aİ, Batur Çağlayan H. Isolated third, fourth, and sixth cranial nerve palsies in the Turkish population: etiologic factors and clinical course. *Turk J Neurol.* 2019;25(1):032-035. doi:10.4274/tnd.2019.29795

14. Park KA, Oh SY, Min JH, Kim BJ, Kim Y. Acquired onset of third, fourth, and sixth cranial nerve palsies in children and adolescents. *Eye (Lond).* 2019;33(6):965-973. doi:10.1038/s41433-019-0353-y
15. 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(1):48-54. doi:10.18231/j.ijooo.2020.009
16. Priya S, Guha S, Mittal S, Sharma S, Alam MS. Pediatric ocular motor cranial nerve palsy: demographics and etiological profile. *Indian J Ophthalmol.* 2021;69(5):1142-1148. doi:10.4103/ijo.IJO_1803_20
17. Meyer E, Ludatscher RM, Zonis S. Primary and secondary overacting inferior oblique muscles: an ultrastructural study. *Br J Ophthalmol.* 1984;68(6):416-420. doi:10.1136/bjo.68.6.416
18. Metz HS, Dickey CF. Treatment of unilateral acute sixth-nerve palsy with *Botulinum* toxin. *Am J Ophthalmol.* 1991;112(4):381-384. doi:10.1016/s0002-9394(14)76243-9
19. Holmes JM, Beck RW, Kip KE, Droste PJ, Leske DA. *Botulinum* toxin treatment versus conservative management in acute traumatic sixth nerve palsy or paresis. *J AAPOS.* 2000;4(3):145-149.