

# Study of etiological profile of patients with paralytic strabismus in a tertiary care hospital in India: a cross-sectional study

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## ABSTRACT

**Introduction:** Paralytic strabismus, a type of strabismus caused by paralysis of one or more extraocular muscles, can lead to a variety of ocular and psychosocial sequelae. Etiology varies in different types of paralytic strabismus. Numerous studies have shown that ocular motor cranial nerve palsies have a variety of causes including vascular disease, head trauma, intracranial tumour or aneurysm and inflammatory disorders. **Materials and Methods:** A cross-sectional study was conducted at a tertiary eye hospital to evaluate Paralytic squint by Neuroimaging in patients presenting to the Squint department of Sarojini Devi Eye Hospital Hyderabad from June 2021 to May 2022. Paralytic strabismus cases with limitation of ocular motility were enrolled and a detailed examination was performed to know the etiology. **Results:** 190 patients (1.35%) were diagnosed with paralytic strabismus. Ischemia constituted to be the major cause of paralytic strabismus i.e. (42.1%) followed by trauma (20%). The 3rd cranial nerve was the most commonly involved (34.73%), followed by the 6th cranial nerve (32.63%). Multiple cranial nerves were involved in 20% of cases. The 3rd CN was involved, primarily due to ischemia in both males and females while the 6th CN was affected with trauma, neoplasm, and ischemia being prominent causes. **Conclusion:** The study showed that ischemia, trauma and idiopathy are some of the major etiologies of paralytic strabismus with male predominance. The cranial nerve involvement also varied with the etiology of paralytic strabismus.

**KEYWORDS:** Paralytic strabismus, Cranial Nerves, Strabismus, Squint, Paralysis, Extraocular Muscles

## INTRODUCTION

Strabismus is a significant cause of ocular morbidity worldwide, including in India. [1, 2] The prevalence of strabismus is around 2 to 5%, with paralytic strabismus accounting for approximately 25-30% of all cases. [3-5] Paralytic strabismus, a type of strabismus caused by paralysis of one or more extraocular muscles, can lead to an ocular and psycho-social sequelae. [6]

Most of the patients presenting with paralytic squint may have other systemic pathologies like intracranial tumours carotidocavernous fistula, intracranial aneurysms; which needs appropriate Neuroimaging investigative modality to diagnose associated life threatening condition which will be life saving. There will be compensatory head posture, diplopia, strabismic amblyopia, loss of binocular single vision (BSV), eye strain, and cosmetic stigma. Psychosocial difficulties associated with strabismus can persist into teenage and adult years, potentially impacting quality of life. [5, 7]

In the past, strabismus had not been prominently featured in India's national program for control of blindness. However, its significance as a contributing factor to vision loss and impaired binocular function in children has now been acknowledged. Consequently, it has garnered the attention it deserves in the recent emphasis on Pediatric ophthalmology with the Vision 2020 initiative. [7]

Paralytic strabismus typically results in intractable diplopia, blepharoptosis, ocular motility disturbance, disturbance in pupil reaction and an unacceptable compensatory head or face posture. [8]

The etiology of ocular motor nerve palsies remains unknown in more than 25% of cases. Aetiology varies in different types of paralytic strabismus. Numerous studies have shown that ocular motor cranial nerve palsies have a variety of causes including vascular disease, head trauma, intracranial tumour or aneurysm and inflammatory disorders. [4, 5, 8, 9]

Various studies have reported that third cranial nerve palsy as the second most prevalent ocular motor palsy following sixth cranial nerve palsy. [8, 10]

For better management of incomitant strabismus, a complete clinical etiological profile is necessary. This helps in identifying the underlying risk factors and aetiology pertaining to paralytic and restrictive strabismus which is imperative in prevention, early detection, managing the etiology and timely recovery in these patients. [4]

This observational study examined patients with paralytic strabismus who were seen at a tertiary eye hospital's Pediatric ophthalmology and strabismus clinic to better understand the etiologies, clinical features, and risk factors for this condition.

## MATERIALS AND METHODS

**Study Design:** This was a cross-sectional observational study conducted at a tertiary eye hospital over a period of one year between June 2021 to May 2022. **Setting:** The study was conducted at a Pediatric ophthalmology and strabismus clinic in a tertiary eye hospital. **Participants:** All patients diagnosed with paralytic strabismus with limitation of ocular motility were enrolled. Patients with comitant strabismus, A and V pattern, myasthenia gravis, restrictive strabismus, previous strabismus surgery, critical illness, and mental instability were excluded.

**Data collection:** A detailed ocular examination was performed on all participants, including:

- **Clinical history:** Age of onset, duration and progression of symptoms, history of trauma, systemic illness, cigarette smoking, previous treatment, and family history.
- **Ophthalmic examination:** Best corrected visual acuity, age-appropriate cycloplegic refraction, fixation pattern, ocular motility (version and duction), and orthoptic evaluation.
- **Systemic examination:** Neurological examination for sensory and motor deficits.
- **Orthoptic evaluation:** Ocular motility: Cover test, Alternate Cover test at distance and near, Krimsky test (for patients with low visual acuity), prism bar cover test in all cardinal positions, and head tilt test to measure ocular deviation.
- **Sensory evaluation:** Worth Four Dot test to determine distance and binocular single vision, Double Maddox

rod test to evaluate subjective torsion, and indirect ophthalmoscopy to evaluate objective torsion.

- **Other tests:** Slit lamp examination Fundus examination Diplopia charting, Hess charting, and Forced Duction Test were performed on all patients.
- **Systemic investigations:** Relevant systemic investigations: Blood pressure recording, Blood sugar level, and serum lipid profile, Serum Homocysteine level, Carotid Doppler Cardiac and Neurological evaluation were done.
- **MRI orbit brain with contrast and MRA or CTA** is especially done in cases of third nerve palsy with pupillary involvement MRI orbit brain with contrast was performed on patients less than 50 years of age and on patients more than 50 years of age with pupillary involvement and multiple cranial nerve palsies. MRV was advised in patients with disc oedema with 6th nerve palsy.

**Data Analysis:** Qualitative data were presented as numbers and percentages. The prevalence of paralytic strabismus was calculated. The characteristics of the patients, including the etiology, type of strabismus, and associated findings were described.

## RESULTS

A total of 14,023 strabismus patients visited the Pediatric ophthalmology and strabismus clinic during the study period between June 2021 and May 2022. Of these, 190 patients (1.35%) were diagnosed with Paralytic strabismus and enrolled in the study.

Demographic Characteristics		No. of Cases	Percent
Gender	Male	132	69.5
	Female	58	30.5
Age groups	0-10 years	4	2.10%
	11-20 years	24	12.63%
	21-30 years	42	22.10%
	31-40 years	28	14.73%
	41-50 years	32	16.84%
	51-60 years	44	23.15%
	61-70 years	12	6.31%
	71-80 years	4	2.10%
Total		190	100.00%

**Table 1: Demographic Characteristics of patients with paralytic strabismus**

The majority of patients (66.32%) were between the ages of 21 and 60 years. Table 1

Etiology	No. of Cases	Percent
Ischemia	80	42.1%
Trauma	38	20%
Infective	16	8.42%
Neoplastic	12	6.32%
Inflammatory	10	5.26%
Vascular	8	4.21%
Congenital	8	4.21%
Idiopathic	18	9.47%
Total	190	100.00%

**Table 2: Etiology of paralytic strabismus in the study participants**

Ischemia constituted to be the major cause of paralytic strabismus i.e. (42.1%) followed by trauma (20%). Infective etiologies, with 8.42% of cases, and neoplastic causes, contributing to 6.32% of cases, were also noteworthy. Inflammatory factors were identified in 5.26% of cases, while vascular and congenital origins each accounted for 4.21% of the cases. Idiopathic cases, where the underlying cause remained unclear, constituted 9.47% of the total cases. Table 2

Cranial Nerve Involved	No. of Cases	Percent
3 <sup>rd</sup> cranial nerve	66	34.73%
4 <sup>th</sup> cranial nerve	6	3.15%
6 <sup>th</sup> cranial nerve	62	32.63%
Multiple cranial nerves	38	20%
IIH	18	9.47%
Total	190	100%

**Table 3: Cranial nerve involvement of paralytic strabismus in the study participants**

The 3rd cranial nerve was the most commonly involved (34.73%), followed by the 6th cranial nerve (32.63%). Multiple cranial nerves were involved in 20% of cases, while the 4th cranial nerve played a smaller role (3.15%). Additionally, cases related to Idiopathic Intracranial Hypertension (IIH) were seen in 9.47% of cases. Table 3

The 3rd cranial nerve was commonly involved, primarily due to ischemia in both males and females. The 6th cranial nerve was the second most affected, with trauma, neoplasm, and ischemia being prominent causes (Figure 1). The 4th cranial nerve had a relatively minor role, mainly linked to congenital and idiopathic factors. Multiple cranial

nerves showed diverse causes, with trauma, neoplasm, and ischemia being notable (Figures 2 and 3). Idiopathic Intracranial Hypertension (IIH) affected both genders, with more cases in females (Figure 4 Table 4).



**Figure 1:** A5-year-old male patient presented with an inward deviation of the right eye. MRI brain with contrast, T1 and T2 axials flair axial, T2 sagittal coronal showed 4.2X2.6X3.5cm multiloculated cystic suprasellar mass compressing 3<sup>rd</sup> ventricle, hypothalamus optic chiasm, cerebral peduncles with resultant dilation of the lateral ventricle. Suggestive of suprasellar craniopharyngioma presenting right 6<sup>th</sup> nerve palsy.

## DISCUSSION

Incomitant strabismus, such as paralytic strabismus, can cause more ocular morbidity than comitant strabismus due to its various associations and sequelae.

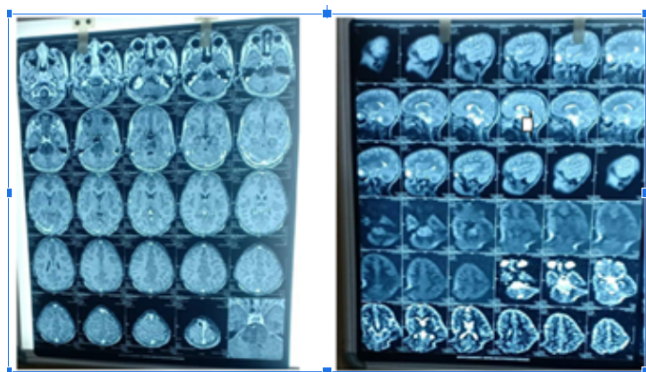
Out of 190 paralytic strabismus patients in this study, 132 (69.5%) were males and 58 (30.5%) were females. This male predominance can be justified by the higher incidence of trauma in males, who are involved more in fieldwork and roadside accidents. Also, the incidence of microvascular accidents is higher in males due to the higher prevalence of cigarette smoking and alcohol intake in the male population.

Similar results have been reported in several other studies, including a 1992 study by Richards et al., which found that 694 of 1278 patients with paralytic strabismus were males.<sup>[4]</sup> Two studies by Bagheri et al., conducted in 2010 and 2014, found a male predominance in patients with paralytic strabismus.<sup>[11, 12]</sup> Similarly, a 2018 study by Kim et

Cranial Nerves Involved	Gender	Etiology							
		Trauma	Neoplasm	Ischaemia	Vascular	Infective	Inflammatory	Congenital	Idiopathic
3rd CN	M	10	2	24	4	0	4	2	8
	F	4	2	10	4	0	0	0	10
4th CN	M	2	0	0	0	0	0	2	0
	F	2	0	0	0	0	0	0	0
6th CN	M	8	0	36	0	6	0	4	0
	F	2	2	2	0	2	0	0	0
Multiple CN	M	8	4	4	0	6	0	0	0
	F	2	2	4	0	2	6	0	0
IIH	M	0	0	0	0	0	0	0	6
	F	0	0	0	0	0	0	0	12

M=Male, F=Female,  
CN= Cranial Nerve

**Table 4: Gender wise distribution of etiology of cranial nerve involvement of paralytic strabismus in the study participants**



**Figure 2:** A 7-year-old female patient presented with an inward deviation of both eyes with left lateral rectus palsy, MRI brain with contrast, T1 and T2, FLAIR axial T2 sagittal DW1 ADC shows a lesion measuring 46X36X 30mm lobulated lesion in the brain stem T2 hyperintense and T1 hypointense indenting over the 4<sup>th</sup> ventricle and sella likely a brain stem Glioma.

al., found that 87 of 153 patients with new-onset paralytic strabismus were males. [13]

In this study, the 3rd cranial nerve was the most commonly involved (34.73%), followed by the 6th cranial nerve (32.63%). Multiple cranial nerves were involved in 20% of cases, while the 4th cranial nerve played a smaller role (3.15%).

There is a minor difference between third cranial nerve and sixth cranial nerve involvement in this study. This is different from other studies, which have reported a higher proportion of CN6 palsy. [2, 4, 8, 14] This difference may be due to the different referral patterns of the population under

study.

CN3 palsy is most commonly caused by vasculopathic causes, such as stroke. In contrast, CN6 palsy is more commonly caused by head trauma. [9] This is because the abducens nerve has a long intradural course, making it more vulnerable to injury.

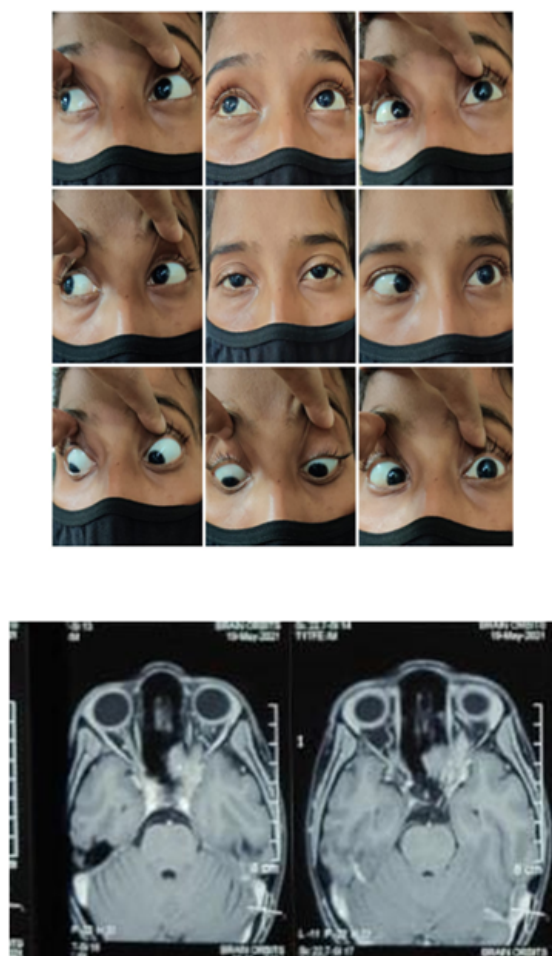
This study had similar findings as reported by various studies that CN6 palsy had a higher proportion of traumatic causes of paralytic strabismus compared to CN3 and CN4 palsies. [9, 12, 14]

In all patients enrolled in our study, an MRI orbit brain was conducted. Ischemic causes could readily be identified and thorough systemic examination along with relevant investigation performed on all patients helped to rule out / elicit various causes.

The distribution of paralytic strabismus by aetiology varied depending on the study population and setting. In a study by Ho et al. [15], vasculopathy i.e., ischemia (35.2%) was the most common cause, while in a study by Tiffin et al. [16], idiopathic cases (35%) were the most common. Studies involving Korean populations have reported trauma (48.9%) as the most common cause in Lee et al.'s study, while vasculopathy (30.0% and 54.9%, respectively) was the most common aetiology in studies by Park et al. [17] and Kim K et al. [13]

In the current study, the largest group of patients had strabismus caused by ischemia (42.1%), followed by trauma (20%), infective (8.4%), and neoplasm (6.3%). Almost 10% of cases had idiopathic etiology. These differences in distribution are likely attributable to differences in patient characteristics, diagnostic equipment, and classification

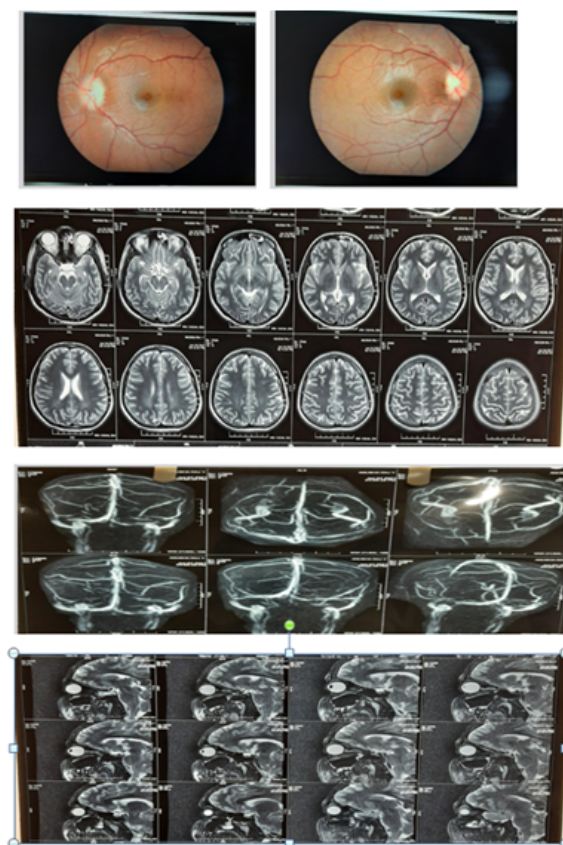




**Figure 3:** A 19-year-old female patient diagnosed as Non Hodgkins Lymphoma presented with a left-sided headache-associated with diminution of vision and limitation of outward movement of left eye for 1 month. MRI brain showed Isointense Metastatic Lesion Involving Left Orbital Apex, Optic Canal Infiltrating Optic Nerve, Extending Into Intraconal, Conal And Extraconal Regions Along With Partial Infiltration Of Left Cavernous Sinus (Lateral Border)

criteria used in the study. For example, in the current study, all patients had MRI brain to identify the cause of the palsy. Those who were found to have ischemic small vessel lesions or microinfarction on brain MRI were classified into the group with ischemia/vasculopathy. In contrast, previous studies included only patients with systemic vascular risk factors such as diabetes or hypertension in the vasculopathy group.

Literature shows that the etiological profile of paralytic strabismus is varied, mainly dependent on the profile of the study group. This can be explained by different referral patterns of the population under study. Our institute being a referral centre, trauma and ischemia cases showed a higher prevalence.



**Figure 4:** A 17-year-old female presented with headache, double vision, and vomiting for 1 month. EOM showed LE-1 abduction limitation. Both eyes' fundus shows Disc oedema. MRI brain and orbit fat suppressed sagittal, axial, coronal T2 weighted images of brain and orbit showed. Prominent peroptic and peritrigeminal CSF in the nerve sheaths. Sella appears partially empty—mild flattening of the anterior pituitary gland. MRV shows bilateral lateral transverse sinus stenosis. Findings suggest the possibility of Idiopathic Intracranial Hypertension.

## CONCLUSION

The study showed that ischemia, trauma to be commonest in adults and neoplasm to be commonest in children. Hypertension Diabetes Dislipidaemia were commonest among ischemic causes. III and VI cranial nerve palsy was commonest in among ischemia. Amongst Neoplasia in children craniopharyngioma was found. In multiple cranial nerve palsy orbital apex syndrome, Tolosa Hunt syndrome of inflammatory origin with preceding sinusitis was found. One case of Mucormycosis was found to be a cause in a patient who suffered with covid. The cranial nerve involvement also varied with the aetiology of paralytic strabismus. Understanding different aetiology of paralytic strabismus is helpful for ophthalmologists and other physicians in guiding diagnosis and evaluation and is useful for proper and timely intervention and recovery in these patients. It is important to note that the aetiology of paralytic strabismus can be dif-

difficult to determine, and in many cases, the cause remains unknown. However, a thorough understanding of the potential etiologies is essential for guiding appropriate management and treatment.

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