Original Article

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Comparative Analysis of Refractive Error in Children with Unilateral and Bilateral Congenital Nasolacrimal Duct Obstruction

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Author`s Contribution

[1,2]Substantial contributions to the conception or design of the work; or the acquisition, [3]Drafting the work or revising it critically for important intellectual content [4]Supervision and Final approval. [5,6]Active participation in active methodology, analysis, or interpretation of data for the work,

Funding Source: None

Conflict of Interest: None

Received: Nov 12, 2025

Revised: Mar 09, 2026

Accepted: Mar 30, 2026

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ABSTRACT

Objectives: To determine and compare the frequency of various refractive errors in children with unilateral and bilateral congenial nasolacrimal duct obstruction.

Methodology: This comparative observational study was conducted at Al-Shifa Trust Eye Hospital, Rawalpindi from January-2025 to June-2025. A total of 220 children with congenital nasolacrimal duct obstruction (both unilateral and bilateral types) were included and were assessed for refractive errors. Comparison of refractive error types was performed using Chi-square test. Data was analyzed using SPSS version 22.

Results: Among 220 children, 160 (72.70%) patients had unilateral while 60 (27.30%) patients had bilateral disease. Median age was 5.00 (2.00) years. There were 139 (63.20%) male and 81 (36.80%) female patients. In patients with unilateral disease (n = 160), frequency of anisometropia was observed in 113 (70.63%) patients while in patients with bilateral disease (n = 60), it was 5 (8.33%), (p < 0.001). In patients with unilateral disease (n = 160), most common type of refractive errors was myopia observed in 47 (29.38%) patients followed by hypermetropia in 44 (27.50%) patients and astigmatism in 24 (15.00%) patients while in patients with bilateral disease (n = 60), most common type of refractive errors was myopia observed in 13 (21.67%) patients followed by astigmatism in 7 (11.67%) patients and hypermetropia in 6 (10.00%) patients, (p = 0.001).

Conclusion: Refractive errors, particularly anisometropia, are much higher in patients with unilateral rather than bilateral congenital nasolacrimal duct obstruction.

Keywords: Duct Obstruction, Frequency, Nasolacrimal, Refractive Errors.

Cite this article as: Anwar A, Malik H, Zafar R, Anjum S, Sharif N, Najmi S. Comparative Analysis of Refractive Error in Children with Unilateral and Bilateral Congenital Nasolacrimal Duct Obstruction. Ann Pak Inst Med Sci. 2026; 22(2):134-138. doi. 10.48036/apims.v22i2.1606.

Introduction

One of the most frequently encountered ophthalmologic morbidity in children encountered by the ophthalmologist at the healthcare facilities is congenital nasolacrimal duct obstruction (CNLDO) which results in repeated and persistent epiphora and ocular discharge of mucopurulent consistency,[1, 2] which makes the child irritable leading to frequent rubbing of the eyes, which can cause refractive errors especially astigmatism and decrease in VA and if left untreated, there is a significant risk of amblyopia.

Embryologically, development of CNLDO begins during the intrauterine life at around five weeks of gestation in which the usual canalization process of the solid cord of epithelial cells which leads to disruption in the outflow pathway of tears causing the characteristic symptoms of epiphora. [3]

According to an estimate, CNLDO has a global prevalence in newborns ranging from six to twenty percent and the vast majority of these cases spontaneously undergo resolution without the need of performing any intervention. [4, 5] However, in cases where the spontaneous resolution fails, intervention becomes a necessity but it is a complex process and requires multi-disciplinary approach with involvement of ophthalmologist, otorhinolaryngologist and pediatrics department. [6] For the management of this condition several measures have been reported to be effective including massaging over the blockage area, use of eye drops, blind probing and

syringing, dacryoendoscopy-guided probing and dacryocystorhinostomy. [7]

In general, this commonly occurring condition in pediatric population is quite benign and is not associated with major complications, however, one possible complication that can have an impact on the quality of life of the child in future as they grow up is the occurrence of refractive error due to this condition. Early interventions not only improves the patient's quality of life but also reduces the risk of development of the refractive errors due to the changes in corneal curvature caused by frequent rubbing of eyes.

Moreover, monitoring of the refractive error in the patient with congenital nasolacrimal duct obstruction can lead to the timely prescription of the glasses which can significantly improve the visual acuity and reduces the risk of the amblyopia especially in unilateral cases and amblyopia therapy can be started timely if needed. [8] Since the local data regarding the composite frequency and comparison of frequency of various refractive errors in children with unilateral and bilateral CNLDO is quite scarce, present study was conducted with the aim to determine and compare the frequency of various refractive errors in children with unilateral and bilateral congenial nasolacrimal duct obstruction.

Methodology

This comparative observational study was conducted at Al-Shifa Trust Eye Hospital from January 2025 to June 2025 after obtaining approval from the Institutional Ethical Review Committee (Ref No: ERC*47/AST*24). The sample size was calculated using the WHO sample size calculator based on a level of significance of 5% and a power of 80%. The anticipated frequencies of refractive error in unilateral and bilateral CNLDO cases were 11.2% and 1.9%, respectively.[9] The calculated sample size was 220. Participants were recruited using a non-probability consecutive sampling technique.

Male and female patients, aged 1-7 years who presented with CNLDO (either unilateral or bilateral) were included. Patients with surface abnormality which can affect assessment process of refractive error (blepharitis, cicatrizing conjunctivitis, chemical injury, entropion or ectropion), traumatic injury to the eye and lens related astigmatism were excluded.

Before inclusion in the study, an informed written consent was obtained from the caregiver, parent or guardian of every patient and the purpose of study was explained to the consent providers. After that baseline characteristics including age and gender were documented. Children who presented with unilateral CNLDO were placed in Group-U while those who presented with bilateral pathology were allocated into Group-B. Group allocation was disease laterality based so neither the randomization was performed nor the number of patients in each group were equalized. Once included, various parameters of vision were assessed. To avoid any bias, all the visual parameters were assessed through a single method, which was the cycloplegic retinoscopic refraction. Parameters that were assessed included spherical (SPHD) and cylindrical diopters (CYLD). In addition, visual acuity (VA) was assessed in all the children using the LEA gratings / Cardiff card (for age three years or less) or Tumbling E or Snellen chart (for children aged older than three years) reflected on a mirror placed two and a half meters away on the opposite side. In addition to that, based on the findings of retinoscopic refraction, presence of any refractive error was documented diagnosed based on 2013 American Association for Pediatric Ophthalmology and Strabismus (AAPOS) criteria.

The included patients then underwent the surgical correction of their CNLDO as per hospital standard protocol and it was ensured that the pre-, peri- and post-procedural care package was similar in all the patients to avoid any bias. Parents were advised to bring their children for follow up after 3 months of procedure to recheck their VA, SPHD and CYLD.

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 22. Quantitative variables normality was checked by Shapiro-Wilk test which showed that age, VA, SPHD and CYLD were not distributed normally and were thus presented as median interquartile range (IQR). Qualitative variables (gender, refractive errors) was presented as frequency and percentages. To compare pre and post-procedure VA, SPHD and CYLD, Wilcoxin signed rank test was used. To compare refractive errors between unilateral and bilateral CNLDO, Chi-square test was used. A p-value of ≤ 0.05 will be considered statistically significant.

Results

In this study, 220 patients were included. A total of 160 (72.70%) patients had unilateral CNLDO while 60 (27.30%) patients had bilateral CNLDO. Median age was 5.00 (2.00) years. There were 139 (63.20%) male and 81 (36.80%) female patients. Median pre-intervention VA in right eye was 0.00 (0.20) logMAR. Median pre-

intervention VA in left eye was 0.00 (0.20) logMAR. Median pre-intervention SPHD in right eye was 0.00 (0.00) diopters. Median pre-intervention SPHD in left eye was 0.00 (0.00) diopters. Median pre-intervention CYLD in right eye was 0.00 (0.00) diopters. Median pre-intervention CYLD in left eye was 0.00 (0.00) diopters. Baseline demographics are compared between patients with unilateral and bilateral CNLDO in Table I.

Table I: Comparison of baseline demographics between patients with unilateral and bilateral CNLDO. (n = 220)

Parameter	Unilateral (n = 160)	Bilateral (n = 60)	p-value
Median age	5.00 (2.00) years Min: 4.00; Max: 7.00	5.00 (1.75) years Min: 4.00; Max: 7.00	0.743
Gender Male Female	 104 (65.00%) 56 (35.00%)	 35 (58.33%) 25 (41.67%)	 0.361
Median pre-intervention VA right eye	0.00 (0.20) logMAR Min: 0.00; Max: 0.70	0.00 (0.28) logMAR Min: 0.00; Max: 0.60	0.906
Median pre-intervention VA left eye	0.00 (0.20) logMAR Min: 0.00; Max: 0.40	0.00 (0.28) logMAR Min: 0.00; Max: 0.60	0.150
Median pre-intervention SPHD right eye	0.00 (0.00) diopters Min: - 3.00; Max: + 3.00	0.00 (0.00) diopters Min: - 3.00; Max: + 3.25	0.138
Median pre-intervention SPHD left eye	0.00 (0.00) diopters Min: - 1.50; Max: + 1.50	0.00 (0.00) diopters Min: - 2.50; Max: + 3.25	0.005
Median pre-intervention CYLD right eye	0.00 (0.00) diopters Min: 0.00; Max: 1.50	0.00 (0.00) diopters Min: 0.00; Max: 1.25	0.912
Median pre-intervention CYLD left eye	0.00 (0.00) diopters Min: 0.00; Max: 1.75	0.00 (0.00) diopters Min: 0.00; Max: 1.25	0.091

In patients with unilateral disease (n = 160), frequency of anisometropia was observed in 113 (70.63%) patients while in patients with bilateral disease (n = 60), it was 5 (8.33%), ($p < 0.001$). In patients with unilateral disease (n = 160), most common type of refractive errors was myopia observed in 47 (29.38%) patients followed by hypermetropia in 44 (27.50%) patients and astigmatism in 24 (15.00%) patients while in patients with bilateral disease (n = 60), most common type of refractive errors was myopia observed in 13 (21.67%) patients followed by astigmatism in 7 (11.67%) patients and hypermetropia in 6 (10.00%) patients, ($p = 0.001$). This comparison of refractive errors between unilateral and bilateral CNLDO patients is given in Table II.

Table II: Comparison of refractive errors between unilateral and bilateral CNLDO patients (n = 220)

Parameter	Unilateral (n = 160)	Bilateral (n = 60)	p-value
Anisometropia	113 (70.63%)	5 (8.33%)	< 0.001
Refractive error			
None	45 (28.13%)	34 (56.67%)	
Myopia	47 (29.38%)	13 (21.67%)	0.001
Hypermetropia	44 (27.50%)	6 (10.00%)	
Astigmatism	24 (15.00%)	7 (11.67%)	

Comparison of pre-intervention and post-intervention median VA, SPHD and CYLD in patients with unilateral CNLDO is given in Table III.

Table III: Comparison of pre-intervention and post-intervention median VA, SPHD and CYLD in patients with unilateral CNLDO. (n = 160)

	Pre-intervention	Post-intervention	p-value
Median VA right eye (logMAR)	0.00 (0.20) (0.00^a ; 0.70^b)	0.00 (0.40) (0.00^a ; 0.40^b)	< 0.001
Median VA left eye (logMAR)	0.00 (0.20) (0.00^a ; 0.40^b)	0.00 (0.40) (0.00^a ; 0.40^b)	< 0.001
Median SPHD right eye (diopters)	0.00 (0.00) (- 3.00^a ; + 3.00^b)	0.00 (0.00) (- 3.00^a ; + 2.50^b)	0.721
Median SPHD left eye (diopters)	0.00 (0.00) (- 1.50^a ; + 1.50^b)	0.00 (0.00) (- 1.50^a ; + 1.50^b)	0.030
Median CYLD right eye (diopters)	0.00 (0.00) (0.00^a ; 1.50^b)	0.00 (0.00) (0.00^a ; 1.50^b)	0.008
Median CYLD left eye (diopters)	0.00 (0.00) (0.00^a ; 1.75^b)	0.00 (0.00) (0.00^a ; 1.75^b)	0.102

Comparison of pre-intervention and post-intervention median VA, SPHD and CYLD in patients with bilateral CNLDO is given in Table IV.

Table IV: Comparison of pre-intervention and post-intervention median VA, SPHD and CYLD in patients with bilateral CNLDO. (n = 60)

	Pre-intervention	Post-intervention	p-value
Median VA right eye (logMAR)	0.00 (0.28) (0.00^a ; 0.60^b)	0.00 (0.20) (0.00^a ; 0.40^b)	0.016
Median VA left eye (logMAR)	0.00 (0.28) (0.00^a ; 0.60^b)	0.00 (0.20) (0.00^a ; 0.40^b)	0.009
Median SPHD right eye (diopters)	0.00 (0.00) (- 3.00^a ; + 3.25^b)	0.00 (0.00) (- 3.00^a ; + 3.25^b)	0.027
Median SPHD left eye (diopters)	0.00 (0.00) (- 2.50^a ; + 3.25^b)	0.00 (0.00) (- 2.50^a ; + 3.25^b)	0.027
Median CYLD right eye (diopters)	0.00 (0.00) (0.00^a ; 1.25^b)	0.00 (0.00) (0.00^b ; 1.25^a)	0.180
Median CYLD left eye (diopters)	0.00 (0.00) (0.00^a ; 1.25^b)	0.00 (0.00) (0.00^a ; 1.25^b)	0.180

Discussion

CNLDO is a common ocular etiology in childhood which has the potential to cause certain complications which may impair the vision of affected child permanently in the form of variety of refractive errors. [10, 11] Despite this vision threatening potential of CNLDO, its impact on the frequency of refractive errors have not been studied much, especially when it comes to comparative analysis between unilateral and bilateral types of disease. Present study thus focused on this important aspect of CNLDO.

In present study, average age of the children at which they presented to ophthalmology checkups to get management for their CNLDO was five years. A study conducted in Iranian children by Jafarizadeh *et al*. [12], average presentation age was three and a half years which was relatively earlier compared to present study. In the similar vein, another study conducted in United Kingdom by Fenech *et al.* [13] reported this age to be even less at one and a half years, compared to present study. Multiple factors may have contributed to such delay in the presentation of these children in Pakistani population including lack of awareness among the parents regarding the vision threatening potential of this condition and lack of availability of expert ophthalmology services.

Upon analysis of the gender distribution, it was observed that majority of children who had CNLDO were male making up 63.2% of the total population. In a recently conducted study by Lekskul *et al*. [14], this male predominance in having CNLDO was also observed with males constituting more than half of the patients suffering from this condition. Contrarily, one study by Salehi *et al*. [15] analyzed the clinical characteristics of children suffering from CNLDO and reported that more sufferers of this ocular condition were females making up 51.4% of the total diseased population. The reason behind this male predominance is unknown.

Based on the age of patients (cut-off age of three years), VA was assessed in all the children using the LEA gratings / Cardiff card or Tumbling E or Snellen chart. All these methods have been well recognized and highly validated methods of assessing VA in children. [16, 17] For diagnosis of refractive errors in children, retinoscopic cycloplegic refraction was used which is also a highly accurate method of diagnosing refractive error in pediatric population. [18, 19]

When it comes to comparison of laterality of disease, unilateral disease was much more as compared to bilateral disease with the frequencies of 72.7% and 27.3%, respectively. Similar to this, Natarajan *et al.* [20] found higher frequency of unilateral rather than bilateral disease among CNLDO cases. Upon analysis of spectrum of refractive errors, it was found that patients with CNLDO were found to have myopia, astigmatism, anisometropia and hypermetropia with significantly higher frequencies of these errors of refraction in unilateral disease rather than bilateral disease. In addition, a significant proportion of patients in both the groups were found to have no visual disturbance or refractive error despite having CNLDO.

Compared to this, Hareendran *et al.* [9] also reported that anisometropia was much more common among unilateral cases of CNLDO rather than bilateral cases ($p = 0.005$). Similarly, in another study, the spectrum of refractive errors was also quite similar to present study, however, the common error of refraction was hypermetropia rather than myopia, which was more common error in present study.[21]

One unique feature of present study, which has not been studied previously, was comparison of the retinoscopic parameters and visual acuity before and after intervention for CNLDO. In this regard, it was observed that there was significant improvement in VA in both types of diseases, however, SPHD and CYLD was not improved significantly after intervention in unilateral cases while in bilateral cases, SPHD did exhibit significant improvement but CYLD did not exhibit any significant improvement.

This improvement exhibits the importance of intervention in CNLDO cases and its ability to improve pediatric visual outcomes. Present study suggests that unilateral CNLDO is much more commonly associated with anisometropia and other refractive errors and it is important to provide appropriate intervention to make sure that visual outcomes can be improved in any type of CNLDO.

LIMITATIONS: Since, pre- and post-intervention comparison of VA, SPHD and CYLD in CNLDO cases has not been studied previously, comparison of findings of present study was not possible with previous research since it has not been conducted till date to the best of knowledge, which was the only limitation of present study.

Conclusion

In conclusion, refractive errors, particularly anisometropia, are much higher in patients with unilateral rather than bilateral congenital nasolacrimal duct obstruction.

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