Refractive Status of Stage III and IV Retinopathy of Prematurity in Bangladesh: A Cross-Sectional Study

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ABSTRACT

Background: Retinopathy of prematurity (ROP) is a significant cause of childhood visual impairment among premature infants. Advanced stages of the disease are often associated with long-term ocular complications, including refractive errors that may affect visual development. Understanding the pattern of refractive status of children with severe ROP is important for early detection and appropriate visual rehabilitation. This study aimed to evaluate the refractive status among children with Stage III and Stage IV ROP. **Methods & Materials:** This cross-sectional study was conducted in the Department of Ophthalmology and Community Ophthalmology at Bangladesh Medical University and Bangladesh Eye Hospital, Malibagh from January 2025 to December 2025. A total of 50 children previously diagnosed with Stage III and Stage IV ROP were included using purposive sampling. **Results:** Among the 50 participants, 31 (62.0%) had Stage III ROP and 19 (38.0%) had Stage IV ROP. Myopia was the most common refractive error, observed in 23 (46.0%) cases, followed by hyperopia in 11 (22.0%), astigmatism in 9 (18.0%) and emmetropia in 7 (14.0%). In Stage III patients, myopia was present in 13 (41.9%) cases, while in Stage IV it was seen in 10 (52.6%) cases. The association between stage of ROP and type of refractive error was not statistically significant (p = 0.81). Among the myopic children, mild myopia was most common (39.1%). **Conclusion:** Refractive errors, particularly myopia, are common among children with advanced ROP. Regular ophthalmic follow-up and early refractive correction are essential to ensure optimal visual development in these high-risk children.

Keywords: *Retinopathy of prematurity, refractive error, myopia, premature infants, childhood visual impairment.*

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INTRODUCTION

Retinopathy of prematurity (ROP) is a vasoproliferative retinal disorder affecting premature and low birth weight infants and remains one of the leading causes of preventable childhood blindness worldwide [1]. The disease results from incomplete retinal vascular development at birth, followed by abnormal neovascularization triggered by fluctuations in oxygen levels and systemic instability [2]. Depending on severity, ROP is classified into five stages, with Stage III characterized by extraretinal fibrovascular proliferation and Stage IV involving partial retinal detachment [3]. Advanced stages are associated with a higher risk of permanent visual impairment if not properly managed [4].

With improved neonatal survival rates, particularly in developing countries, the incidence of ROP has increased significantly [5]. Advances in neonatal intensive care have allowed more extremely preterm infants to survive; however, these infants remain vulnerable to ocular complications, including refractive abnormalities [6]. Even after regression or successful treatment of ROP, affected children frequently develop long-term visual sequelae such as myopia, hyperopia, astigmatism, anisometropia, amblyopia and strabismus. Among these, myopia is particularly common in children with severe ROP and those who undergo treatment such as laser photocoagulation or intravitreal anti-vascular endothelial growth factor therapy [7].

Refractive errors in children with Stage III and Stage IV ROP may result from altered ocular growth, changes in corneal curvature, lens thickness and axial length abnormalities [8]. Early identification of refractive errors is crucial because uncorrected refractive status during childhood can interfere with visual development and learning, potentially leading to amblyopia and long-term visual disability [9]. Therefore, regular ophthalmic follow-up and timely refractive correction are essential components of comprehensive ROP management [10].

Neonatal care services have expanded in recent years, contributing to increased survival of premature infants. Consequently, the burden of ROP and its complications is also rising [11]. Despite this growing concern, limited local data are available regarding refractive outcomes in advanced stages of ROP. Understanding the pattern and frequency of refractive errors among children with Stage III and Stage IV ROP would help clinicians anticipate visual needs, plan appropriate follow-up strategies and counsel parents effectively [12].

This study was designed to evaluate the refractive status of children diagnosed with Stage III and Stage IV ROP attending tertiary eye care centers in Bangladesh. By identifying the distribution and severity of refractive errors in this high-risk group, the study aims to contribute valuable evidence for improving long-term visual care and reducing preventable visual impairment in affected children.

METHODS & MATERIALS

This cross-sectional study was conducted in the Department of Ophthalmology and Community Ophthalmology at Bangladesh Medical University and Bangladesh Eye Hospital, Malibagh from January 2025 to December 2025. A total of 50 children previously diagnosed with Stage III and Stage IV Retinopathy of Prematurity (ROP) were included in the study using purposive sampling. Children who had documented Stage III or Stage IV ROP in at least one eye and whose parents or guardians provided informed written consent were included. Patients who had media opacity interfering with refraction, congenital ocular anomalies, previous

intraocular surgery other than ROP-related treatment, neurological disorders affecting visual assessment, or incomplete medical records were excluded from the study.

A detailed ophthalmic evaluation was performed for all participants, including visual acuity assessment appropriate for age, anterior segment examination by slit-lamp biomicroscopy and posterior segment evaluation. Cycloplegic refraction was carried out using 1% cyclopentolate eye drops and refractive error was measured using retinoscopy followed by subjective refinement when possible. Refractive errors were categorized as myopia, hyperopia, astigmatism, or emmetropia and the severity of myopia was graded based on spherical equivalent values.

All relevant demographic and clinical data were recorded in a structured data collection sheet. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 25.0. Continuous variables were expressed as mean ± standard deviation and categorical variables were presented as frequency and percentage. The chi-square test was used to assess associations between stage of ROP and refractive status, with a p-value of less than 0.05 considered statistically significant.

RESULTS

Table I shows the distribution of study participants according to the stage of retinopathy of prematurity (ROP). Among the total 50 children included in the study, the majority 31 (62.0%) were diagnosed with Stage III ROP, while 19 (38.0%) had Stage IV ROP.

Table I
Distribution of Study Participants by Stage of ROP (*n* = 50)

Stage of ROP	Frequency (n)	Percentage (%)
Stage III	31	62.00%
Stage IV	19	38.00%
Total	50	100%

Table II illustrates the distribution of refractive status among the study eyes. Out of 50 participants, myopia was the most common refractive error, observed in 23 (46.0%) cases. Hyperopia was found in 11 (22.0%) children, while 9 (18.0%) had astigmatism. Emmetropia was present in 7 (14.0%) cases.

Table II
Refractive Status of the Study Eyes (*n* = 50)

Refractive Status	Frequency (n)	Percentage (%)
Myopia	23	46.00%
Hyperopia	11	22.00%
Astigmatism	9	18.00%
Emmetropia	7	14.00%
Total	50	100%

Table III presents the distribution of refractive errors according to the stage of ROP. Among Stage III patients (n=31), myopia was observed in 13 (41.9%) cases, followed by hyperopia in 8 (25.8%), astigmatism in 6 (19.4%) and emmetropia in 4 (12.9%). In Stage IV patients (n=19), myopia was also the most common finding, affecting 10 (52.6%) children, while hyperopia and astigmatism were each seen in 3 (15.8%) cases and emmetropia in 3 (15.8%). The difference in refractive error distribution between Stage III and Stage IV was not statistically significant (p = 0.81).

Table III
Type of Refractive Error According to Stage of ROP (*n* = 50).

Refractive Error	Stage III (n=31)	Stage IV (n=19)	p value
Myopia	13 (41.9%)	10 (52.6%)	
Hyperopia	8 (25.8%)	3 (15.8%)	
Astigmatism	6 (19.4%)	3 (15.8%)	0.81
Emmetropia	4 (12.9%)	3 (15.8%)	
Total	31 (100%)	19 (100%)	

Table IV shows the severity distribution of myopia among the 23 myopic children in the study. Mild myopia (< −3.00 D) was the most common, observed in 9 (39.1%) cases, followed by moderate myopia (−3 to −6 D) in 8 (34.8%) children. High myopia (> −6.00 D) was found in 6 (26.1%) cases.

Table IV
Severity of Myopia Among Myopic Children (*n* = 23).

Severity of Myopia	Frequency (n)	Percentage (%)
Mild (< -3.00 D)	9	39.10%
Moderate (-3 to -6 D)	8	34.80%
High (> -6.00 D)	6	26.10%
Total	23	100%

DISCUSSION

Retinopathy of prematurity (ROP) remains an important cause of visual morbidity among premature infants, particularly in developing countries where neonatal survival has increased in recent years. The present study evaluated the refractive status among children with Stage III and Stage IV ROP and found that refractive errors were common in this group. In our study, Stage III ROP was more frequent, accounting for 31 (62.0%) cases, whereas Stage IV constituted 19 (38.0%) cases. Similar observations have been reported in previous studies conducted in tertiary eye care centers where moderate to advanced stages of ROP were commonly identified during screening and follow-up programs. Studies by Sultana et al. and Azam et al. also reported a substantial proportion of Stage III and advanced ROP cases among screened premature infants, highlighting the importance of early detection and monitoring [13, 14].

Refractive error was frequently observed in the present study population. Myopia was the most common refractive error, affecting 23 (46.0%) children, followed by hyperopia in 11 (22.0%), astigmatism in 9 (18.0%) and emmetropia in 7 (14.0%) cases. These findings are consistent with previous research indicating that myopia is the predominant refractive abnormality among children with a history of ROP. Pétursdóttir et al. reported that individuals born prematurely and screened for ROP often develop myopia and other refractive abnormalities later in life [15]. Similarly, Leung et al. noted that preterm birth and ROP are strongly associated with adverse visual outcomes, including refractive errors and reduced visual function during childhood [16].

When refractive errors were analyzed according to the stage of ROP, myopia remained the most common abnormality in both groups. In Stage III patients, myopia was observed in 13 (41.9%) cases, whereas in Stage IV patients it was slightly higher at 10 (52.6%). Hyperopia was present in 8 (25.8%) of Stage III cases and 3 (15.8%) of Stage IV cases, while astigmatism occurred in 6 (19.4%) and 3 (15.8%) cases respectively. However, the association between stage of ROP and type of refractive error was not statistically significant ($p = 0.81$). These findings are comparable with the observations of Lu et al., who reported that refractive abnormalities are common among children with ROP regardless of treatment modality or disease stage [17]. Furthermore, Chen et al. described structural retinal and choroidal alterations in ROP that may influence refractive development, explaining the higher prevalence of refractive errors in affected children [18].

The present study also analyzed the severity of myopia among the affected children. Among the 23 myopic patients, mild myopia was the most common, observed in 9 (39.1%) cases, followed by moderate myopia in 8 (34.8%) and high myopia in 6 (26.1%) cases. This distribution suggests that mild to moderate myopia predominates among children with advanced ROP. Similar patterns have been described in previous studies investigating refractive outcomes after ROP regression or treatment. Park et al. reported that refractive errors, particularly myopia, are frequently observed during long-term follow-up of children with regressed ROP [19]. In addition, Pandiri et al. found that children treated for ROP often exhibit myopic refractive shifts and altered ocular biometric parameters during follow-up [20].

Advanced stages of ROP may also require surgical management in severe cases. Studies by Papageorgiou et al. and Chang et al. demonstrated that Stage IV ROP often requires surgical intervention such as scleral buckling or vitrectomy and these procedures may influence long-term ocular development and refractive status [21, 22]. Furthermore, Rashidian et al. emphasized that structural changes in the developing retina and vitreous in ROP can affect ocular growth and refractive outcomes [23].

LIMITATIONS

This study had several limitations that should be considered while interpreting the findings. First, the sample size was relatively small ($n = 50$), which may limit the generalizability of the results to the broader population of children with retinopathy of prematurity. Second, the study was conducted in two tertiary eye care centers, which may introduce selection bias as more severe cases are more likely to be referred to specialized facilities. Additionally, the cross-sectional design did not allow evaluation of long-term refractive changes over time in children with ROP.

CONCLUSION

The present study demonstrates that refractive errors are common among children with Stage III and Stage IV retinopathy of prematurity. Myopia was the most frequent refractive error, affecting nearly half of the participants, with mild to moderate myopia being the most prevalent. Although myopia appeared slightly higher in Stage IV cases, no significant association was found between stage of ROP and type of refractive error. These findings highlight the importance of regular ophthalmic follow-up and early refractive assessment in children with advanced ROP to ensure timely correction and better visual outcomes.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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