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Original Research Article

Refractive and Ocular Biometric Profile of Children Treated with Laser for Retinopathy of Prematurity

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Abstract:

Background and Objectives: To analyze refractive errors and its relationship with ocular biometry in children with retinopathy of prematurity (ROP) treated with laser and to find out possible associations of type of refractive error.

Material and Methods: This research included children who had previously had laser photocoagulation for retinopathy of prematurity (ROP) and had been followed up for at least one year. The records were examined for gestational age, birth weight, zone and stage of illness, and the presence of APROP. All children underwent comprehensive ophthalmic examination. Streak Retinoscopy was used to measure refractive error. The biometric profile including the axial length (AL), anterior chamber depth (ACD) and Lens thickness (LT) were measured using A- scan Biometry. The primary outcome measures were amount of refractive error {spherical equivalent (SE)}, and type of refractive error. SE was measured as spherical error + half cylindrical error. Myopia was defined as SE ≤−0.5 D; high myopia >-6 D and hyperopia +0.5D. Association between refractive error and ocular biometric profile was analyzed.

Results: Total 48 eyes were studied at mean age 24 months. Refractive error (SE) ranged from +4.50 to -19.75D. 64.58% were myopic, 37.5 % were hypermetropic, and Astigmatism was seen in 16.6%. Mean myopia was -3.19D (range -0.50 to -19.75D). Lens thickness was significantly associated with myopic refractive error (p=0.0043).

Conclusion: Substantial numbers of children treated for ROP with laser photocoagulation develop myopia and astigmatism. Hence, based on our research, we may deduce that identifying and treating refractive errors at an early stage is crucial for these children.

Keywords: Hypermetropia; Myopia; Refractive error; ROP.

Introduction

Retinopathy of prematurity is a prominent global cause of blindness and visual impairment. Timely screening and rapid treatment of ROP can prevent blindness caused by the illness. Although prompt intervention can help, there may still be a less than ideal visual result due to the existence of refractive error, strabismus, and other ocular abnormalities.

Prematurity, retinopathy of prematurity (ROP), and laser photocoagulation are established risk factors for the development of myopia. [1,2] Preterm newborns, with or without ROP, frequently have myopia, astigmatism, and anisometropia. [1-5] The exact role of the eye's refractive components in the development of myopia in ROP is not well known. Multiple studies have indicated that myopia in retinopathy of prematurity (ROP) may be caused by numerous factors, including an increase in corneal curvature, an increase in axial length, a decrease in anterior chamber depth, and an increase in lens thickness and power.[6-8]

Objectives:

1. To analyze refractive errors and its relationship with ocular biometry in children with retinopathy of prematurity (ROP) treated with laser.
2. To find out possible associations of type of refractive error.

Material and Methods

This research included all infants who had screening, diagnosis, treatment, and follow-up for any stage of retinopathy of prematurity (ROP) for a minimum duration of one year. All infants who underwent laser treatment were included in this research. The laser utilised to cure the eyes was a frequency-doubled Nd:YAG laser, namely the Iridex model. Infants who experienced negative structural outcomes such as retinal detachment were not included. A retrospective examination of medical records was conducted to document the birth weight, gestational age, stage and zone of retinopathy of prematurity (ROP), and the occurrence of severe ROP.
The refractive state was evaluated following complete cycloplegic refraction using atropine with the use of a streak retinoscope. Myopia is characterised by a refractive power equal to or more than -0.5D, hypermetropia is characterised by a refractive power equal to or greater than +0.5D, and astigmatism is characterised by a refractive power equal to or greater than ±0.5D. Hypermetropia was categorised into two groups: low hypermetropia (with spherical equivalent (SE) less than +5.0 D) and high hypermetropia (with SE more than or equal to +5.0 D). Myopia was classified into mild (ranging from less than 0.5 D to -3 D), moderate (ranging from -3 D to -6 D), and high (greater than -6 D). Astigmatism was separated into two categories: astigmatism with cylindrical degree (CD) greater than or equal to ±0.5 D, and severe astigmatism with CD greater than or equal to ±2.0 D. Anisometropia is characterised by a disparity of at least 1.0 D for hypermetropia and at least 2.0 D for myopia.

The sonomed A scan ultrasonography was used to scan all eyes and record the following data for ocular biometry: axial length (AL), lens thickness (LC), and anterior chamber depth (ACD). An analysis was conducted on all factors in order to identify potential associations with myopia.

Observation and results

We observe the functional and biometric outcome in terms of refractive errors, anterior chamber depth, axial length, and lens thickness. Mean age at the time of follow up was 24 months and its range was 14-36 months. Among them 12 were males and 12 were females. Mean birth weight was 1318.33 gram (range 750-1800g). Maximum number of children was >1500g (37.5%) and 29.16% children were in 1250g-1500g. Mean period of gestation of these children was 30.83weeks (SD 2.14), its range from 28-34 week, majority of children in our study population was extremely premature (28-30week) 46%. According to structural distribution maximum children have stage 2 (80%) and zone 2(83%) ROP. In our study population 41.66% children was diagnosed as APROP at the time of screening.

Children are hypermetropic at the time of birth till 3 yrs. after that over the first few years they undergo the process of emmetropization but this process is disrupted in premature and ROP babies. In our study refractive outcome was assessed with atropine under cycloplegic Retinoscopy. Most common refractive error in our study population was myopia (64.58%), we also found hypermetropia (37.5%) and astigmatism (16.6%). We stratified myopia in to mild (0 to -3), moderate (-3 to -6D), Severe (>-6D). Mean spherical equivalent was -1.33+4.43 and its range was -19.75 to +4.5. Mean cylindrical power was -0.35+0.85 and its range was (-3.75- 0).

After A scan biometry we found that mean axial length was 20.44mm range (18.07-24.33), Mean anterior chamber depth 2.74 range (2.18-3.97), Lens thickness 3.77 range (2.06-4.69). Analysis of correlation between refractive error and biometric parameters, we found that all parameters show positive correlation with all parameters but lens thickness show significant (p= 0.004) correlation.

Table 1: Mean biometric profile of the study group (N = 48)

	Mean (SD)	Range
Axial length	20.44 (1.32)	18.07 - 24.33
Anterior chamber depth	2.74 (0.32)	2.18 - 3.97
Lens thickness	3.77 (0.47)	2.06 - 4.69

Table 2: Correlation of spherical and cylindrical power with biometric measurements

	Pearson correlation coefficient	p-value
Spherical power		
Axial length	0.212	0.148
AC depth	0.112	0.449
Lens thickness	0.447	0.0043

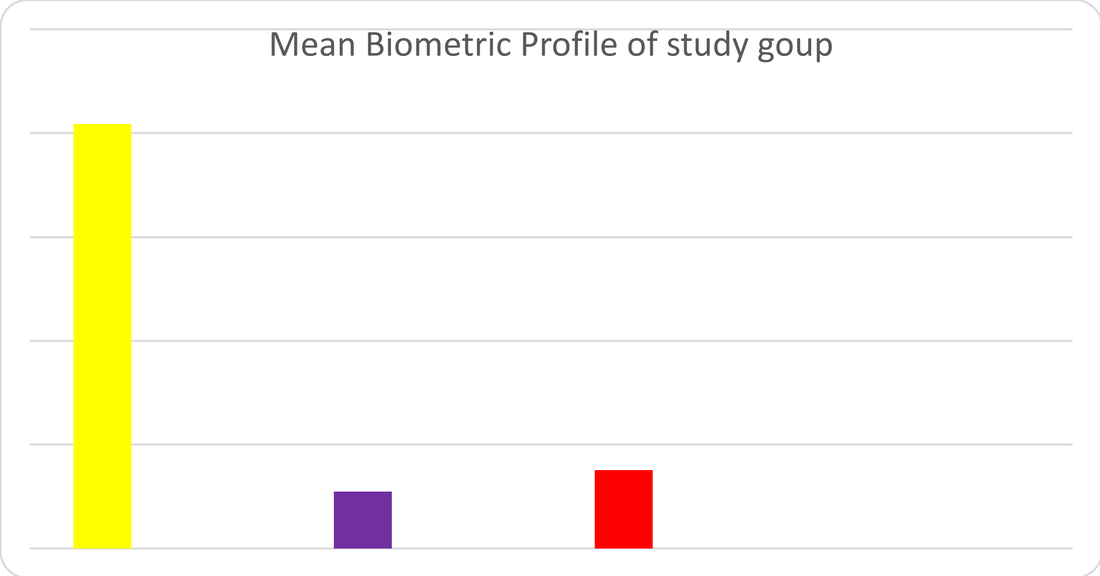

Figure 1:

Discussion

Infants who were born prematurely, particularly those who suffer retinopathy of prematurity (ROP), have a greater likelihood of developing myopia. There is a direct relationship between the occurrence of myopia and higher degrees of prematurity and more severe cases of ROP. [2] We have observed a significant occurrence of myopia in infants who had treatment for threshold and pre-threshold retinopathy of prematurity (ROP).

The incidence of myopia in our sample was 64.58%. Veleva et al documented a prevalence of myopia of 63.6% in their study population. [9] Further investigations have documented a range of myopia occurrence in eyes treated with laser, with incidence rates varying from 14% to 77%. [10,11] The Cryo ROP and ETROP studies have found that preterm children with severe ROP had a greater occurrence of substantial refractive errors compared to those with mild ROP or no ROP. [2,3] We found a significant association between myopia and the posterior zone of retinopathy of prematurity (ROP) in this group. Additionally, myopia was shown to be associated with a lower birth weight. In their study, Pidro A et al demonstrated that patients with myopia had the lowest birth weight, indicating a negative link between the development of refractive defects and birth weight. [12]

The myopia resulting from severe retinopathy of prematurity (ROP) can vary in severity, ranging from mild to severe myopia. The majority of patients in our cohort exhibit mild to moderate myopia, whereas only 8.33% were diagnosed with extreme myopia, defined as exceeding 6 diopters. One potential factor that may be associated with a decreased frequency of high myopia is the age at which the examination is conducted. It is essential to do a follow-up examination of these infants in order to determine the development of myopia.

Myopia of preterm (MOP) is caused by the halted growth of the front part of the eye and can happen regardless of the presence of retinopathy of prematurity (ROP). An eye with MOP is characterised by a low ratio of axial length to power, a shallow anterior chamber, and a thick lens. [1] There is a suggestion that myopia of prematurity (MOP) tends to improve over the first year of life, leading to normal or farsighted vision later. However, this improvement does not happen when severe retinopathy of prematurity (ROP) occurs. [13,14] The mean axial length in our research sample was 20.44± 1.32, with a range of 18.07-24.33.In our research sample, the average lens thickness was 3.77±0.47, with a range of 2.06-4.69. The anterior chamber depth was 2.74 ± 0.32, with a range of 2.18-3.19. Zeng X et al [14] found that there was a positive correlation (r=0.364) between the refractive status of children in the laser group and the thickness of their lenses. In a research conducted by Kaur S et al, [15] it was shown that laser treated children had a shorter axial length (20.35+1.65), greater lens thickness (4.33+0.35), and a deeper anterior chamber (2.95+0.47), which is similar to our study group.

Study limitation: This cross-sectional study did not include any preterm infants without retinopathy of prematurity (ROP) or children with ROP who did not get laser therapy. Therefore, it is uncertain whether the alteration in ocular biometry and refractive status was only due to prematurity or also influenced by laser photocoagulation.

Conclusion

After the completion of this study, data were analyzed and following conclusion were drawn. All laser treated children had low birth weight and low gestational age, mean birth weight was 1318.33g+259.27g and mean gestational age was 30.83+2.14week. Myopia (48%) was found to be most common refractive error in laser treated children.

Among these 17.39% children have severe myopia. Based on the biometric profile, there is a positive association between axial length, anterior chamber depth, and lens thickness. However, the correlation between lens thickness is determined to be statistically significant (p value - 0.0043). Therefore, it is crucial to promptly identify, rectify, and closely monitor the progress of ROP infants in order to achieve optimal visual recovery.

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