Refractive and Visual Outcome after Laser-Treated Retinopathy of Prematurity in Western Romania

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\textbf{ABSTRACT}

\textbf{Objectives:} The aim of this study is to assess the functional outcomes registered in patients from the Western part of Romania, who have been treated for retinopathy of prematurity, using a laser diode (810nm).

\textbf{Material and Methods:} In the current study 52 premature infants with gestational age<34 weeks and a birth weight <2000 grams, 96 eyes in total were included. The functional outcomes were assessed by determining the best corrected visual acuity and refractive error.

\textbf{Outcomes:} For the eyes with the best visual function (BCVA between 0.8 and 1.0), mean gestational age was 29.452 weeks (SD = 1.958), mean weight at birth was 1363.38 grams (SD = 304.655), the mean energy used during treatment was 370.73 mW (SD = 95.972), and the mean number of burns applied was 1470.44 (SD = 581.960). The spherical equivalent ranged between -24.6 D and +3.4 D. High astigmatism (>3.0 D) was found in 26 eyes (27.08%) and anisometropia in 29 patients (55.77%). There is a strong positive correlation, statistically significant (P<0.001) between best corrected visual acuity and refractive error.

\textbf{Conclusions:} A long term follow-up is necessary in order to obtain an improvement in the quality of life and visual function of the patients who received laser treatment for retinopathy of prematurity.

\textbf{Keywords:} diode laser, functional outcome, refractive error, retinopathy of prematurity, preterm infants

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Article received on the 26\textsuperscript{th} of January 2016. Article accepted on the 22\textsuperscript{nd} of June 2016.
INTRODUCTION

The improvement in the quality of health care for premature infants and the progress made in neonatology were followed by and increasing survival rate in the last 40 years, from 15% to 65% for extremely low birth weight infants (<1000g) and from 35% to 90% for very low birth weight infants (<1500g) (1). Over 50% of the premature neonates with a birth weight under 1250 g are going to develop retinopathy of prematurity (ROP) (2). This is a vascular retinal disease, the peripheral retina, incompletely vascularized, appears neovascularization and may cause haemorrhages, fibrovascular tissue changes, retinal detachment, vision loss and even blindness (3,4).

ROP was the cause of blindness in 95% of the blind children born in Sweden between 1980 and 1990, and while in the United States it represents the third cause of pediatric blindness (13% of childhood blindness) (5-7). In the United Kingdom, ROP caused 5-8% of complete or partial blindness in children between 1985 and 1990, and this incidence dropped to 3% in 2000 (8).

ROP is a major health issue for our modern society. The treatment applied (cryotherapy, laser therapy, anti-vascular endothelial growth factor) can prevent vision loss. The most frequent therapy used for improving visual and anatomical outcomes is laser photocoagulation (9-12). The visual performance for prematurely born children that had ROP depend to a great extent on the structural aspect of the retina and refractive error further developed (13).

The aim of this study is to assess the functional results in patients from Western Romania, who were treated for retinopathy of prematurity, by using a laser diode (810 mn).

MATERIAL AND METHODS

Patients

All the 52 premature newborns included in this study were admitted in the Neonatal Intensive Care Unit of the Municipal Clinical Emergency Hospital, between 2007 and 2012. During this period we have made laser treatment. After this stage the children were evaluated for refractive and visual results assessment at 6 months until in 2015.

The inclusion criteria for this study were: premature newborns with birth weight (BW) under 2000 grams and gestational age (GA) <34 weeks (GA evaluation is performed by the neonatologist using Ballard scale depending on the neonate’s physical and neuromuscular maturity); the informed consent which was previously received from the children’s legal representatives; a favourable clinical evolution of the disease, after laser treatment applied on treated eyes (regression); compliant patient at periodical examinations. Exclusion criteria were: major eye anomalies with significant impact on vision quality; the absence of cooperation during visits; neurological conditions with severe impact on the visual function; infants with a BW >2000 g and GA >34 weeks; the absence of informed consent previously received; unfaourable clinical evolution of the disease, after laser treatment applied on treated eyes (with changing the architecture of the retina).

Development of the retinal vascularization begins at the level of optic nerve head at 16 weeks of gestation and is ideally while the foetus is in the uterus. After the premature birth, development of the vascularization continues in a new environment and it’s abnormal. The appearance of the disease occurs in two phases: vessel growth retardation (31-32 weeks) followed by vascular proliferation (32-34 weeks). Under these conditions, the development of ROP starts at a few weeks from the moment of premature birth and it cannot be detected at a very early examination. The first ophthalmologic examination was made at 4-6 weeks after birth or at the postmenstrual age of 31-34 weeks, regardless the gestational age at birth, the subsequent examination being made according to the degree of retinal development, the stage of the disease, the affected area, the evolution rate and the associated risk factors (14-17). The ROP classification was made according to The International Classification of the Retinopathy of Prematurity (18). The disease is classified by using the staging and locating the active processes. Thus, there have been described 5 stages: stage 1 (a thin, white, well defined structure that separates the vascular retina of the avascular one), stage 2 (abnormal vessels grow and rise up from the retina creating a ridge), stage 3 (fibrovascular proliferation exceeds retinal plan and extend into the vitreous), stage 4 (partial detachment of the retina) and stage 5 (total retinal detachment). For locating the active process, the surface of the retina is divided as follows: area I...
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(area centered on the optic disc and extending from the disc to twice the distance between the disc and the macula), zone II (the circular areas surrounding zone 1, with the radius equal to the distance from the optic nerve to the nasal ora serrata) and III (the rest of the retina from the temporal area). In aggressive posterior form vascular tortuosity is marked, vascular shunts are numerous and the evolution to retinal detachment is fast. The laser treatment was applied within 24-72 hours due to the diagnosis results which made it imperative for zone I stage 3 disease, zone II stage 3 or aggressive posterior ROP (15,19). The indirect diode laser (IRIS Medical Instruments Inc., California, USA) was used. The administration of the systemic sedative agents and the monitoring of premature newborns were performed by the neonatology doctor. Laser ablation was focused on the avascular retina between the fibrovascular ridge and the ora serrata, and was applied on the entire circumference of the eye globe (20,21). Medium intensity (grey-white burn) scattered burns were applied. The distance between burns was a half of diameter (10).

Ethics Statement

Our study complies with the recommendations of the Ethics Committee and it is in agreement with Good Clinical Practice Regulation and the Declaration of Helsinki.

Visual Acuity

The visual function was clinically assessed by determining the best corrected visual acuity (BCVA) at distance. An optometric table projector was used (ACP-8 chart projector, Topcon, Japan). This equipment projects various types of optotypes on a screen, and then shows visual acuity on a decimal scale. The Lea test was used with pre-school children, the modified Snellen test and the „E” visual acuity chart. Normal visual acuity is expressed in 1.00 decimal. Visual acuity was divided in four groups, as follows: 0.1 to <0.3, 0.3 to <0.6, 0.6 to <0.8 and 0.8 to 1.0.

Refractive States of the Eyes

Cycloplegic refractions were determined by using a desktop auto refractometer (Auto Ref/Keratometer MRK-3100P Huvitz Co., Ltd, Korea) or paediatric autorefractometer (Plu-soptix A08, Germany) at 30 minutes from instillation with cyclopentolate 0.5 or 1 %, and registered as sphere, cylinder and axis (19,22-25). For each cycloplegic refraction measured in the eyes with laser treated ROP, a conversion to the spherical equivalent (SE) was made, as the algebraic sum of the value of the sphere and half the cylindrical value, for statistic reasons (25,26).

The myopia was classified into four categories, according to the value of the spherical equivalent, as follows: 0 to -3, < -3 to -6, < -6 to < -9 and more than -9 dioptres; hypermetropia was classified into two categories: 0 to < +3 and more than +3 dioptres, the astigmatism was classified into three categories, according to its magnitude: 1.00 to <3.00, 3.00 to <5.00 and ≥5.00 dioptres. Anisometropia was noted considering a difference of minimum 1.00 dioptre (D) between the refractive errors of the two eyes of an infant. Ocular motility, corneal reflex test, cover test and prism cover test were conducted (27,28).

Statistical analysis

The data were collected, stored and analysed in the IBM SPSS 20 software (Statistical Package for Social Science). For the purposes of this study, each eye of the same patient, fulfilling the inclusion criteria was used as an independent variable. Pearson Correlation was used to assess the presence, the strength of the relation between BCVA and SE, between BCVA and the energy/number of impacts during treatment and also between BCVA and BW, GA, the age of the subjects when laser treatment was applied and the astigmatism value.

Outcomes

Out of the original 104 eyes (52 infants), 96 eyes fulfilled the conditions required in order to be included in this study. The exclusion was: 4 eyes were diagnosed with retinal detachment involving the macula, 3 eyes were diagnosed with lens opacities, one eye was diagnosed with posterior retinal fold involving the macula. The functional assessment was performed at the time the subjects of the study were aged between 3 and 8 years.

The GA of the 52 subjects in this study varied between 25 and 34 weeks (29.37 ± 1.7), and the BW ranged between 860-2000 grams (1348.58 ± 323.5). The distribution of sexes was 44.23% (23) females and 55.77% (29)
males. The associated risk factors were: oxygen therapy 88.46% (46), anemia 80.76% (42), intraventricular hemorrhage 73.07% (38), neonatal respiratory distress syndrome 44.23% (23), sepsis 34.61% (18), severe hypoxic-ischemic encephalopathy 21.15% (11), blood transfusions 17.30% (9), and heart disease 5.76% (3).

The time of the laser treatment ranged between 2.5 and 11 weeks after birth, with a mean of 6.79 weeks. (SD) Out of the total 96 eyes, laser treatment was performed on 84 eyes in stage 3 (87.5%) and on 12 eyes in aggressive posterior stage (12.5%). In 17 cases, the location of the disease was in zone I, and in 79 of the cases at the level of zone II. The number of impacts applied ranged between 410 and 3200, and the energy used was between 225 and 650 mW, a 0.2 second exposure time.

Refraction and visual acuity were assessed when children aged between 3 and 8 years old. The laser treated eyes had a mean BCVA of 0.7 decimal. In 70 eyes (72.9%), BCVA was 0.5 or better vision, while in 43 eyes (44.8%) it was 1.0 Functional outcomes were assessed by reporting each group of visual acuity (from the 4 groups established through the protocol of this study) to the demographic data of the population studied and to the laser parameters used during the treatment. Thus, for the eyes with the lowest visual function (BCVA between 0.1 and 0.3), mean gestational age was 29.269 weeks (SD = 2.213), mean weight at birth was 1380.00 grams (SD = 384.101), the mean energy used during treatment 465.38 15.5 mW (SD = 111.120), and the mean number of burns applied 2010.38 (SD = 830.966). At the opposite pole, for the eyes with the best visual function (BCVA between 0.8 and 1.0), mean gestational age was 29,452 weeks (SD = 1.958), mean weight at birth was 1363.38 grams (SD = 304.655), the mean energy used during treatment was 370.73 mW (SD = 95.972), and the mean number of burns applied was 1470.44 (SD = 581.960) (Table 1).

Spherical equivalent (SE) ranged between -24.625 D and + 3,375 D (mean of - 4.12 D). Of the 96 eyes treated, 68 (70.83 %) were myopic (simple myopia or myopia associated to astigmatism). For a spherical equivalent between -3D and 0D, the mean BW is 1291.14 g, the mean GA is 29.273 weeks, the mean age at laser treatment time is 6.886 weeks, the mean energy used is 361.36 mW, and the number of impacts used is 1398.86, while for a SE greater than 0 D, but less than + 3 D, the mean BW is 1378 grams, the mean GA is 29.352 weeks, the mean age at laser treatment time is 7.074 weeks, the mean energy used is 366.3 mW, and the number of impacts used is 1170.35 (Table 1).

Seventy-three (76.04%) of the 96 eyes included in the study had astigmatism ≥ 1 D. Astigmatism greater than 3D, but less than 5D, was present in 20 eyes (20.83%), and astigmatism over 5 D was present in 6 eyes (6.25%). Anisometropia ≥1 D was observed at 29 (55.76%) of 52 children, while strabismus was present at 24 of them (46.15%) (esotropia in 19 cases, exotropia in 5 cases).

There is a positive correlation, statistically significant (P<0.001) between BCVA and SE

<table>
<thead>
<tr>
<th>Best corrected visual acuity</th>
<th>Birth weight (grams)</th>
<th>Gestational age (weeks)</th>
<th>Age of laser treatment (weeks)</th>
<th>Laser energy (mW)</th>
<th>Laser burns (number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 to &lt;0.3 (13 eyes) mean</td>
<td>1380.00</td>
<td>29.269</td>
<td>6.154</td>
<td>465.38</td>
<td>2010.38</td>
</tr>
<tr>
<td>standard deviation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.3 to &lt;0.6 (20 eyes) mean</td>
<td>84.101</td>
<td>2.213</td>
<td>1.4489</td>
<td>111.120</td>
<td>830.966</td>
</tr>
<tr>
<td>standard deviation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.6 to &lt;0.8 (11 eyes) mean</td>
<td>1211.00</td>
<td>28.750</td>
<td>6.725</td>
<td>406.25</td>
<td>1797.20</td>
</tr>
<tr>
<td>standard deviation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.8 to 1.0 (52 eyes) mean</td>
<td>1308.73</td>
<td>30.045</td>
<td>7.500</td>
<td>409.09</td>
<td>1479.00</td>
</tr>
<tr>
<td>standard deviation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TABLE 1. Mean values for BW, GA, the age at the time when the laser treatment was applied, the energy used and the number of burns relating to BCVA.</td>
<td></td>
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</table>
but also a negative correlation, statistically significant (P=0.008 and P=0.001 respectively), between BCVA and the energy/number of impacts during laser treatment (Pearson index -0.277" and -0.344" respectively). This is justified by the fact that as more aggressive the laser treatment is (high energy and great number of burns), the more important corioretinal scars, atrophy of the retina, gliosis and loss of retinal epithelium are. However, laser ablation of peripheral avascular retina allows maintaining the central vascular retina and the macula attached and, therefore, allows the child to see.

**DISCUSSION**

This is a retrospective study of premature infants with ROP (born between 2007-2012) that required laser treatment. Previous studies have proven that laser therapy is effective, most patients having favorable functional and structural results (20,28-30). This type of study has not been performed in Romania yet. Therefore, we decided to assess the refractive and visual outcomes after laser treatment applied to children with retinopathy of prematurity from the Western Romania, and to compare our results with those obtained from studies conducted in other countries where similar diagnostic criteria, treatment, and refractive and functional assessment methods have been used.

In terms of GA and BW, our inclusion criteria have been in line with those laid down in the National Health Program of screening and laser treatment for ROP: GA<34 weeks and BW<2000 g. Yang et al report similar data (34 weeks/2000 grams) (13,14). These criteria have varied in studies of investigators who analyzed the functional outcomes in relation to laser treatment in preterm infants with ROP. Shah et al and Wani et al maintain the same GA (34 weeks), but drop the WG (to 1800 grams, respectively 1500 grams) (19,23). Ospina et al

<table>
<thead>
<tr>
<th>Spherical equivalent (Diopter)</th>
<th>Gestational age (weeks)</th>
<th>Birth weight (grams)</th>
<th>Age of laser treatment (weeks)</th>
<th>Laser energy (mW)</th>
<th>Laser burns (number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;-9 (18 eyes)</td>
<td>mean 29.500</td>
<td>1463.61</td>
<td>6.250</td>
<td>387.50</td>
<td>1775.33</td>
</tr>
<tr>
<td></td>
<td>standard deviation 2.1963</td>
<td>349.562</td>
<td>1.0467</td>
<td>88.388</td>
<td>812.136</td>
</tr>
<tr>
<td>-9 to &lt;-6 (11 eyes)</td>
<td>mean 29.182</td>
<td>1195.00</td>
<td>6.273</td>
<td>500.00</td>
<td>2119.73</td>
</tr>
<tr>
<td></td>
<td>standard deviation 2.2167</td>
<td>253.801</td>
<td>1.6335</td>
<td>98.742</td>
<td>611.053</td>
</tr>
<tr>
<td>-6 to &lt;-3 (17 eyes)</td>
<td>mean 29.176</td>
<td>1179.47</td>
<td>6.941</td>
<td>421.76</td>
<td>1952.59</td>
</tr>
<tr>
<td></td>
<td>standard deviation 1.6292</td>
<td>171.915</td>
<td>1.6094</td>
<td>109.072</td>
<td>626.025</td>
</tr>
<tr>
<td>-3 to &lt;0 (22 eyes)</td>
<td>mean 29.273</td>
<td>1291.14</td>
<td>6.886</td>
<td>361.36</td>
<td>1398.86</td>
</tr>
<tr>
<td></td>
<td>standard deviation 1.7439</td>
<td>278.183</td>
<td>1.9206</td>
<td>113.318</td>
<td>573.344</td>
</tr>
<tr>
<td>0 to &lt;+3 (27 eyes)</td>
<td>mean 29.352</td>
<td>1378.00</td>
<td>7.074</td>
<td>366.30</td>
<td>1170.35</td>
</tr>
<tr>
<td></td>
<td>standard deviation 2.4092</td>
<td>292.052</td>
<td>2.5672</td>
<td>73.318</td>
<td>482.616</td>
</tr>
<tr>
<td>≥+3 (1 eye)</td>
<td>mean 33.000</td>
<td>2300.00</td>
<td>8.000</td>
<td>450.00</td>
<td>2769.00</td>
</tr>
<tr>
<td></td>
<td>standard deviation -</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**TABLE 2.** The mean values of the BW, GA, the age at the time of the laser treatment, the energy used and the number of burns, in relation to spherical equivalent.

(Pearson index 0.755”), but also a negative correlation, statistically significant (P=0.008 and P=0.001 respectively), between BCVA and the energy/number of impacts during laser treatment (Pearson index -0.277” and -0.344” respectively). This is justified by the fact that as more aggressive the laser treatment is (high energy and great number of burns), the more important corioretinal scars, atrophy of the retina, gliosis and loss of retinal epithelium are. However, laser ablation of peripheral avascular retina allows maintaining the central vascular retina and the macula attached and, therefore, allows the child to see.

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<table>
<thead>
<tr>
<th>Study</th>
<th>Number of eyes</th>
<th>Laser power (mW)</th>
<th>Exposure time (sec)</th>
<th>Number of laser burns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axer-Siegel et al. (10)</td>
<td>48</td>
<td>300-500</td>
<td>0.2-0.5</td>
<td>800-1350</td>
</tr>
<tr>
<td>Tsitsis et al. (15)</td>
<td>31</td>
<td>250-500</td>
<td>0.2-0.3</td>
<td>700-2000</td>
</tr>
<tr>
<td>Shah et al. (20)</td>
<td>48</td>
<td>300-750</td>
<td>0.2-0.5</td>
<td>300-1261</td>
</tr>
<tr>
<td>McLoone et al. (26)</td>
<td>16</td>
<td>225-650</td>
<td>0.2</td>
<td>410-3200</td>
</tr>
<tr>
<td>Our study</td>
<td>96</td>
<td>225-650</td>
<td>0.2</td>
<td>410-3200</td>
</tr>
</tbody>
</table>

**TABLE 3.** Comparison between laser diode treatment variables reported in the literature.
enrolled in their study preterm infants with greater GA (35 weeks/1335 grams) (11), while at other authors one can notice lower values for both GA and BW (33 weeks/1600 grams in Katoch et al (29) 32 weeks/1500 grams in Cook et al and Knight-Nanan et al. (25,31) 31 weeks/1500 grams in McLoone et al, Sahni et al, Kieselbach et al. (26-28,32) 28 weeks/1500 grams in Coats et al. (21)).

Considering our study, the laser variables were the following: 225-650 mW for the energy used, 0.2 sec for the exposure time, and 410-3200 for the number of laser burns per eye. We have registered comparing laser power, exposure time and number of laser burns reported in the literature for similar studies (Table 3). In the study conducted by Shah et al the number of laser burns were 800-6416 (20), but here the avascular retina surface was bigger, because infants included in the study showed only aggressive posterior ROP, in zone I.

The mean age of infants included in our study, at the time of the laser treatment, was 36 weeks post-menstruation age. Shah et al and Katoch et al report similar ages (35.6 weeks, 36.93 weeks, respectively) (20,29), while Ospina et al and McLoone et al identify a mean of 34.6 weeks (11,28).

In our study, conducted on 96 eyes, the BCVA of at least 0.5 decimal was achieved for 70 eyes (72.9%). Similar values were reported in the study conducted by Ospina et al (71.4% BCVA ≥0.5), McLoone et al (73.0% BCVA ≥0.5) and Shalev et al (70.0% BCVA ≥0.5) (11,28,33). The estimation of children’s visual acuity is a laborious process, and it requires assessment and reassessment phases. The child’s experience, knowledge and skills need to be taken into account (34). Therefore, it is difficult to compare the visual results obtained with different methods for the assessment of visual acuity in small children at different ages, while often in the presence of other medical associated conditions.

In most studies, patients treated with laser for ROP presented myopia predominantly as a refractive error. The mean SE in our study was -4.12 D, comparable to that identified by Yang et al(-3.87 D), respectively, and the one identified by Al-Otaibi et al. (-3.7D) (14,30). There were authors who reported higher values in their studies (Ospina et al found an SE of -4.95D) (11), or smaller values (Ruan et al report an SE of -0.5 D for the right eye, and an SE of -0.2 for the left eye, in a study conducted on 115 eyes) (19). The mean SE per refracted eye was positive, +0.75 D or +1.1 D in the reports made by Katoch et al and Kieselbach et al respectively (Table 4) (29,32).

Myopia is often associated with prematurity, both with and without ROP. It has been demonstrated that there is a direct connection between the degree of severity of myopia and ROP (24). The relationship between myopia and ROP is not fully explained, regardless of its axial, corneal or lenticular types (14,24,35). In this category of patients, the mechanisms of short-sightedness were related to be the diameter anomalies (a longer axial length), and the curvature of the cornea (smaller corneal curvature radius), previously shallow chamber, high crystalline power (14,24,28,35,36). Laser treatment leads to scleral weakening and can contribute to myopia evolution (14). Retinal, choroidal and vascular atrophy, gliosis and loss of the retinal pigmented epithelium are present in eyes with chorioretinal scar after laser treatment (35,37).

In our study 70.83% of eyes treated with laser diode for ROP were shortsighted and 30.2%...
had myopia over -6D. Al-Otaibi et al reported similar results with 64% myopia, out of which 28.9% had myopia of at least -6 D, and Yang et al found myopia in 77% of 60 eyes, 16.7% of them having myopia of at least -6 D (14,30).

In opposition to these data, Katoch et al observed nonsignificant hyperopia with an average of +0.75 D at 59.4% of the 69 eyes that were included in the study, high myopia (> -5.0 D) is found in only one eye, and Kieselbach et al reports a SE of +1.1 D in a study on 28 eyes hyperopia representing the refractive error for 86% of the evaluated eyes (Table 4) (29,32).

It has been suggested that the laser treatment might have affected the natural course of corneal curvature (38). A significant proportion of preterm newborn eyes with ROP developed astigmatism. In our study, astigmatism ≥1 D was found in 73 eyes (76.04%). Shah et al reported astigmatism ≥1 D in 90.7%, while Yang et al identified astigmatism in 98% of the eyes with laser treated ROP (20,38). Davitt et al found astigmatism ≥1D at the age of 3 in 40% of eyes with high-risk pre-threshold ROP(22). High astigmatism (≥3 D) was present in 26 (27.08%) of the total of 96 eyes included in our study. Yang et al evaluates the presence of high astigmatism in 35% of eyes (14). Kieselbach et al don’t notice significant astigmatism in their studies (32). In this study no statistically significant association between astigmatism and BW, BCVA, GA and the age at the time of the laser treatment was found.

Anisometropy (unequal refractive power between the two eyes) can be consecutive to ROP of different severity degree of the two eyes, or it can be the consequence of laser treatment that was not performed into an identical manner for the two eyes (35). The presence of anisometropy in our study (≥1 D) was noted in 29 (55.7%) of the 52 children, unlike Shah et al, who identified this anisometropy ≥1 D at a rate of 27.9% (20). Other authors reported anisometropy ≥1.5 D. Yang et al finds this at 46.7% of the patients (14). This anisometropy is associated with poor visual outcomes in infants with laser treatment for ROP (14,20).

In this study, the prevalence of strabismus was 46.15% in patients with laser treatment for ROP (24 premature babies of a total of 52) and 79.16% of them features esotropia. Our results were similar to those obtained by Sahni et al and Al-Otaibi et al, who found an incidence of 50%, and 54.4% respectively (27,30). The strabismus rate is lower at Katoch et al. (8.3%) (29). Most of the authors find in their studies that esotropia is the main form of strabismus. Also, the presence of strabismus is generally associated with age related neonatal neurological pathology, with anisometropy and high myopia (14).

A further study in order to correlate this functional outcome with genetic markers or polymorphisms is considered and undergoing.

In conclusion, our study shows that the diode laser treatment for ROP can lead to favorable refractive and visual results. The analysis of the results showed predominance of myopia in these patients. Long term follow-up is necessary in order to obtain an improvement in the quality of life regarding the visual function of the patients treated with laser for retinopathy of prematurity.

Conflict of interests: none declared.
Financial support: none declared.
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