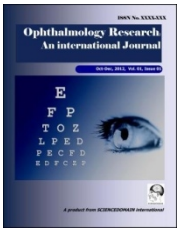

Ophthalmology Research: An International Journal
1(1): 67-73, 2013, Article no. OR.2013.006

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Comparison of Ocular Alignment Using Corneal Reflex Measurements with Plusoptix S08 between Non–strabismic Amblyopes and Normal Controls

Goktug Demirci[1*], Mustafa Ozsutcu[1], Banu Arslan[1], Mustafa Eliacik[1], Gokhan Gulkilik[1] and Selim Kocabora[1]

[1]Department of Ophthalmology, Medipol University Hospital, Istanbul, Turkey.

Authors' contributions

This work was carried out in collaboration between all authors. Author GD designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors MO, BA, ME, GG and SK managed the analyses of the study and managed the literature searches. All authors read and approved the final manuscript.

Research Article

Received 7th March 2013
Accepted 21st June 2013
Published 18th July 2013

ABSTRACT

Aims: Purpose of this study is to compare corneal reflex value measurements performed by the Plusoptix S08 photo-screener between anisometropic non–strabismic amblyopic children and non-amblyopic children.
Study Design: This is a randomized and controlled prospective study.
Place and Duration of Study: Department of Ophthalmology, Medical Faculty of Istanbul Medipol University between September 2012 and December 2012.
Methodology: Corneal reflex values of 39 amblyopic non-strabismic children and 28 normal children were compared after complete ophthalmoscopic examination by the same examiner. Only patients with anisometropic amblyopia without strabismus were included in the study group and only non-amblyopic children were included in the control group.
Results: There was no statistical significance between the study and the control group in means of age (p=0.100) and sex distribution (p=0.818). Corneal reflex values of the amblyopic eyes was 3.8±3.2 degrees and corneal reflex values of normal eyes was 2.4±4.1 degrees. There was no statistical significance between study and control group in means of corneal reflex values (p=0.127).

**Corresponding author: E-mail: drgdemirci@yahoo.com;*

Conclusion: Although Plusoptix has proved to be a reliable screener in terms of measurement of refraction, we did not know whether the corneal reflex value was also a reliable screening value, because there is no research about this value in the literature. According to the current literature this is the first research examining the corneal light reflex reliability of a Plusoptix S08 photo-screener and, in light of our results, the corneal reflex value of Plusoptix S08 is not a reliable tool for the screening of amblyogenic risk factors in non-strabismic children.

Keywords: Amblyopia; anisometropia; bruckner test; plusoptix.

1. INTRODUCTION

Amblyopia is defined as decreased visual acuity, either unilaterally or bilaterally, in spite of any refractive error being neutralised with lenses and in the absence of detectable eye disease. The acuity of the eye is still below normal, which results from a disturbance in retinal image formation during the first decade of human life [1-3]. Depending on the population studied, the prevalence of amblyopia is difficult to assess and varies in the literature, ranging from 1–3.5% in healthy children to 4–5.3% in children with ophthalmic problems, and is a significant preventable cause of vision loss in children and adults [4-6]. Amblyogenic risk factors include anisometropia, isoametropia, strabismus, media opacity, and ptosis. If treated in time, it can be fully reversible, so that how early it is detected is very important. There are two screening tools that can be used by a non-ophthalmologist in preverbal and nonverbal children, namely the Bruckner reflex and photo-screening. The Bruckner reflex involves utilisation of a direct ophthalmoscope in an undilated patient to compare the pupillary red reflexes for asymmetry of colour and brightness [7-9]. Roe et al. demonstrated that if the patient's fovea is not exactly conjugate to the light source, light from the retina spills past the light source at the ophthalmoscope mirror into the examiner's eye, creating the red reflex [10]. Therefore, binocular asymmetry of this conjugate relationship between the two eyes is strongly predictive of the amblyogenic risk factors of anisometropia, strabismus, or media opacity [11]. The Bruckner reflex alone has a high sensitivity for the detection of children with amblyopia (67 of 70 children; 95%) [7]. It is also quite sensitive for the detection of conditions likely to result in amblyopia [12].

In 1994, Cibis and Tongue described a digitisable analogue video system combining Bruckner pupil red reflex imaging with eccentric photo-refraction for video screening of young children for amblyogenic factors [7,8]. Since then video photo-screening has developed greatly. The Vision Screener, Plusoptix (Plusoptix®–Germany), was developed for the recognition of amblyogenic refractive errors without cycloplegia but will also refer children with normal refractive error who have other risk factors such as moderate large-angle strabismus, cataract, visually significant ptosis, anisocoria, iris colobomas, etc. Its high reliability and reproducibility of screening refractive errors as a photo-screener are discussed elsewhere [13-16].

Of the commercially available photo-screening instruments available, the most prominent are the MTI Photo-screener, the iScreen Photo-screener, the Spot Vision Screener, the 2win Vision Screener,REBIScan and the PlusoptixSO8 photo-screener. The MTI photo-screener requires manual interpretation of the flash reflections, and difficulties with interpretation currently limit the acceptance of photo-screening technology for widespread screening. However, the iScreen photo-screener, Spot, 2win, REBIScan, and Plusoptix S08 do not need advanced experience, and hence can be used for screening of large populations.

In this study our purpose is to measure how reliable corneal reflex measurement by the Plusoptix S08 photo-screener is in anisometropic non-strabismic amblyopic children by comparing their corneal reflex measurements with those of non-amblyopic children.

2. MATERIALS AND METHODS

In this prospective study we compared the corneal reflex values of 39 amblyopic non-strabismic children measured by Plusoptix S08 (PlusoptixVision Screener®–Germany) with 28 normal children's corneal reflex values. All patients' parents provided informed consent in accordance with the Declaration of Helsinki, and institutional review board approval was obtained from the hospital ethics committee. All patients underwent a complete ophthalmoscopic examination by the same examiner. Examination included dilated refractive measurement, visual acuity testing with Lea symbols and/or a Snellen chart, Hirschberg test, synoptophor test, and Plusoptix S08 test. Patients with any history of trauma, ocular pathology, or strabismus were not included in the study. Only patients with anisometropic amblyopia without strabismus were included in the study group and only non-amblyopic children were included in the control group.

As a statistical method frequency, ratio, mean, and standard deviations were used. In the distribution of data, the Kolmagorov–Smirnov test was used for control. In the analysis of variables independent sampling t test was used. Chi-square test was used for analysis of ratios. SPSS (version 20.0 for Windows, SPSS Inc., Chicago, IL, USA) was used for statistical analysis.

3. RESULTS AND DISCUSSION

The patient number included in the study group was 39 (22 female, 17 male) and in the control group was 28 (15 female, 13 male) (Table 1). The mean age of the study group was 11.4±8.4 and the control group was 8.3±6.2. There was no statistical significance between the study and the control group in means of t value of -1,67 (P=0,100) and sex distribution (P=0.818) (Table 1). Corneal reflex values of the amblyopic eyes were 3.8±3.2 degrees and corneal reflex and values of normal eyes was 2.4±4.1 degrees. As seen in Table 2 and Fig. 1, there was no statistically significant difference between the study and the control group in means of corneal reflex values (t = -1,55) and (P= 0.127).

Amblyopia is a preventable visual impairment of adults and children. Anisometropia (>1.50 D spherical or cylindrical), hyperopia (>3.50 D in any meridian), astigmatism (>1.5 D at 90° or 180° and >1.0 D in oblique axis), myopia (>3.00 D in any meridian), and strabismus are major amblyogenic risk factors according to the American Association for Pediatric Ophthalmology and Strabismus (AAPOS). If treated in time, it can be fully reversible, so that how early it is detected is very important. The Bruckner test is a valuable tool that helps to detect fundus disorders, myopia, anisometropia, and large-angle strabismus. It involves using an ophthalmoscope to compare the red reflexes between the two eyes from nearly arms' length. When both eyes fixate and focus on the ophthalmoscope light, both pupils constrict, the corneal light reflexes become centered, and both red reflexes become quite dark. If there is a brightness difference between the two reflexes, it means that there is asymmetry.(7,17) In many studies the sensitivity of the Bruckner test was found to be as high as 82–87.5%, with a specificity of 84.1–91 %; the positive (PPV) and negative predictive (NPV) values were 71.8% and 93.6%. Interestingly, accuracy was 84%.(18,19) In

another study by Cole et al. the Bruckner reflex alone had a high sensitivity for the detection of children with amblyopia (67 of 70 children; 95%) [12].

Table 1. Age and sex distribution of age and sex distribution of anisometropic amblyopic eyes versus control group

		Control Group		Anisometropic Amblyopia Group		t	P
		Mean ±s.d/n-%		Mean ±s.d/n-%			
Age		8,3 ± 6,2		11,4 ± 8,4		-1,67	0,100
Sex	Female	15	53,6%	22	56,4%		0,818
	Male	13	46,4%	17	43,6%		

** Chi-square/student t test*

Table 2. Comparison of corneal reflex values of anisometropic amblyopic eyes versus control group

	Control Group		Anisometropic amblyopia group		t	P
	Mean ±s.d/n-%	Degrees	Mean ±s.d/n-%	Degrees		
Corneal Reflex Value	2,4 ±4,1		3,8 ±3,2		-1,55	0,127

** Student t test*

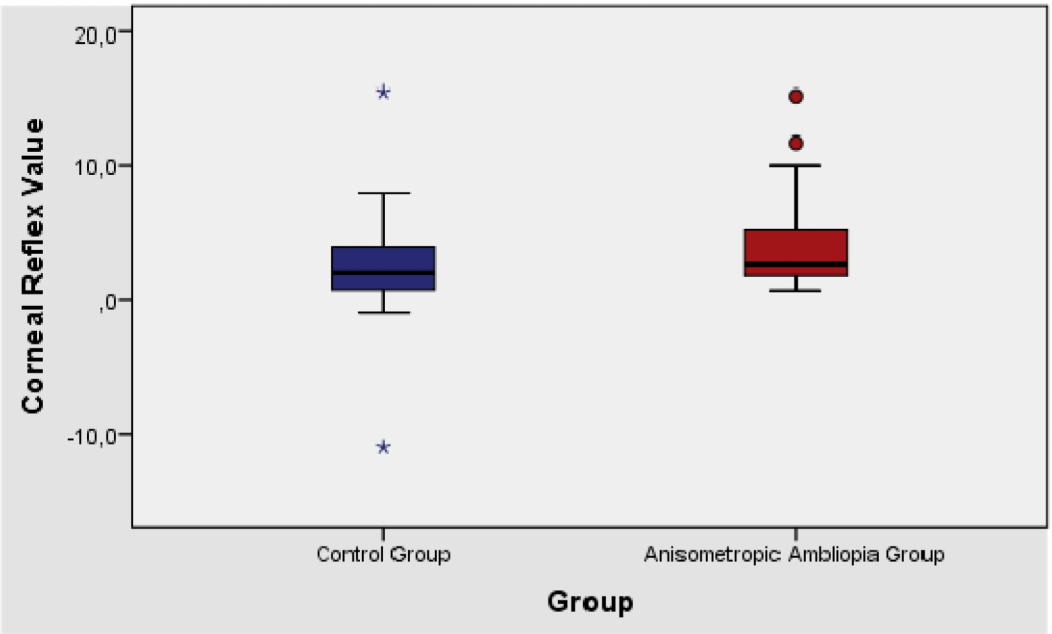

Fig. 1. Skeletal Box-and-Whiskers Plot representation of comparison of corneal reflex values of anisometropic amblyopic eyes versus control group

In the 1994 Transactions of the American Ophthalmological Society, Cibis described a digitisable analogue video system combining Bruckner pupil red reflex imaging with eccentric

photo-refraction for video screening of young children for amblyogenic factors [8]. The principle behind photo-screening is off-axis photo-refraction. A light source eccentric to the eye–camera axis gives rise to crescents within the pupils. The dimension of the dark crescent is correlated with the magnitude of the refractive error. In Plusoptix this is shown by a value of the corneal reflex. Images obtained from the position of the corneal light reflex and the overall reflection of the light from the fundus (Bruckner reflex test) are then analysed [7,8,20,21].

There are two types of photo-screeners, each based on the relationship between the flash source and the optical axis of the camera: the on-axis system, which has a coaxial camera and flash source, and the off-axis system, which has a flash source slightly off the optical axis of the camera. In some photo-screeners, the well-known MTI Photo-screener a trained reader is required to analyse the images. This is inefficient and leads to significant subjectivity and inter-observer variability, but Plusoptix is a digital photo-screener with a computerized image analysis program [22,23]. It acquires readings in as little as 1.5 seconds. It also provides non-cycloplegic auto-refraction. This feature reduces the need for an auto-refractor, and saves time by providing a useful starting point for performing cycloplegic refractions in children. Although assessing the magnitude of amblyopia is difficult in pre-literate children, it is important to include such children in studies of amblyopia therapy, because early intervention can be effective [24-27].

Although Plusoptix has proved to be a reliable screener in terms of measurement of refraction, we did not know whether the corneal reflex value was also a reliable screening value because there is no research about this value in the literature [13-15]. As we all know, because definite strabismus can affect the results and corneal reflex value cannot be derived in large-angle strabismus, with Plusoptix S08 we have to do measurements separately in each eye; hence, we only studied non-strabismic cases. According to our results, there was no statistical significance between the two groups in means of age, sex, and the corneal reflex value.

4. CONCLUSION

In conclusion, according to the current literature this is the first research examining the corneal light reflex reliability of a Plusoptix S08 photo-screener and, in light of our results, the corneal reflex value of the Plusoptix S08 is not a reliable tool in screening for amblyogenic risk factors in non-strabismic children.

CONSENT

All authors declare that ‘written informed consent was obtained from the patient (or other approved parties) for publication of this case report and accompanying images.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

ACKNOWLEDGEMENTS

There is no financial support from any organisation.

COMPETING INTERESTS

Authors have no financial or proprietary interest in any of the material.

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