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Professional paper

Comparison Between Refractometer and Retinoscopy in Determining Refractive Errors in Children – False Doubt

Rajko Pokupec, Danijela Mrazovac, Smiljka Popović-Suić, Višnja Mrazovac, Rajko Kordić and Igor Petriček

University of Zagreb, Zagreb University Hospital Centre, Department of Ophthalmology, Zagreb, Croatia

A B S T R A C T

Early detection of a refractive error and its correction are extremely important for the prevention of amblyopia (poor vision). The golden standard in the detection of refractive errors is retinoscopy – a method where the pupils are dilated in order to exclude accomodation. This results in a more accurate measurement of a refractive error. Automatic computer refractometer is also in use. The study included 30 patients, 15 boys, 15 girls aged 4–16. The first examination was conducted with refractometer on narrow pupils. Retinoscopy, followed by another examination with refractometer was performed on pupils dilated with mydriatic drops administered 3 times. The results obtained with three methods were compared. They indicate that in narrow pupils the autorefractometer revealed an increased diopter value in nearsightedness (myopia), the »minus overcorrection«, whereas findings obtained with retinoscopy and autorefractometer in mydriasis – cycloplegia, were much more accurate. The results were statistically processed, which confirmed the differences between obtained measurements. These findings are consistent with the results of studies conducted by other authors. Automatic refractometry on narrow pupils has proven to be a method for detection of refractive errors in children. However, the exact value of the refractive error is obtained only in mydriasis – with retinoscopy or an automatic refractometer on dilated pupils.

***Key words**: retinoscopy, refractometer, refractive error, children*

Introduction

Early detection of a refractive error and its well-timed correction are extremely important for the prevention of amblyopia, the so-called »poor vision«. The golden standard in the detection of refractive errors is retinoscopy – a method where the pupils are dilated using mydriatic drops, in order to exclude accomodation by blocking the ciliary body[1]. This results in a more accurate measurement of a refractive error. Atropine and homatropine drops are in use. The examination is conducted in a dark room, at a distance of 1 meter from the patient's eye. The examiner directs light into the eye through a retinoscope, then watches the reflection of light in the pupil. Refractometry is the method of determining refractive error using an optical device refractometer. Computerized automatic refractometers contain infrared light, fixation point and Badel optometer. Infrared light of 800–900 nm is used for transmission and reflection from the sclera. At this wavelength the light is reflected from deeper parts of the eye, sclera and choroidea[2–4].

The aim of our study was to determine whether there is a statistically significant difference between the values of the refraction obtained by a homatropine retinoscopy and by those obtained by an automated refractometry.

Patients and Methods

Our study included 30 patients (60 eyes), aged between 4 and 16. 15 patients were boys, 15 were girls. Few patients have been examined for the first time. They have often been sent to a specialist from the school medical doctor, and some have themselves complained of poor vision. Most of the patients have already been under a review at our Department of strabismus. On every patient,

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TABLE 1
RANGE OF DIOPTERS

	Spherical dioptre	Cylindrical dioptre
Refractometer – narrow pupils	–3.25 Dsph to +6.0 Dsph	–3.75 Dcyl x5 to +2.75 Dcyl x55
Retinoscopy	–2.0 Dsph to +5.50 Dsph	0 to +4.0 Dcyl x90
Refractometer – dilated pupils	–1.25 Dsph to +6.75 Dsph	–4.0 Dcyl x5 to +2.75 Dcyl x60

Dsph – spherical diopter; Dcyl – cylindrical diopter

the first examination was conducted with a refractometer on narrow pupils. Retinoscopy, followed by another examination with a refractometer, was performed on pupils dilated with mydriatic (homatropine) drops administered 3 times during thirty minute intervals. For refractometry we used R1 Righton Speedy-K refractometer. In statistical analysis we used Wilcoxon matched pairs »signed ranks« test.

Results

The results correlate with studies of other authors, who also state retinoscopy as a reliable method in diagnosing refractive errors[4,5] and refractometer as a good screening method[6]. Values obtained by the automatic refractometer on narrow pupils, retinoscopy, and refractometer on dilated pupils were compared and statistically analyzed (Tables 1 and 2). Wilcoxon test showed a statistically significant difference between the spherical (Z=–2.384, p=0.017, Tables 3 and 4), and cylindrical (Z=–4.315, p<0.001, Tables 3 and 4) diopter obtained by an automated refractometer on narrow pupils and by retinoscopy. Autorefractometer on narrow pupils shows an increased diopter of nearsightedness (myopia) and myopic astigmatism, whereas autorefractometer on dilated pupils shows an increased diopter of hypermetropic astigmatism (Table 2). Considering hypermetropic, »plus«, spherical diopter, values obtained by an automated refractometer on narrow pupils were of lower values than of the values obtained by a retinoscopy and refractometer on dilated pupils (Table 1, Figure 1). By myopic, »minus«, spherical diopter, values obtained by an automated refractometer on narrow pupils were of higher values, than of the values obtained by a retinoscopy and refractometer on dilated pupils (Table 1, Figure 1). We have also found a statistically significant difference on the values of cylindrical diopter (Figure 2). When comparing values of a refractive error obtained by retinoscopy and refractometer on dilated pupils, we have also found a statistically significant difference – by spherical (Z=–3.564, p<0.001, Table 4), and cylindrical (Z=–2.883, p=0.04, Table 4) dioptres (Figure 1 and 2). In diagnosing cylinder

TABLE 2
DISTRIBUTION OF A REFRACTIVE ERROR

Refractive error	Refractometer – narrow	Retinoscopy	Refractometer – dilated
Hypermetropia	9	6	7
Hypermetropic astigmatism	23	35	40
Myopia	6	6	3
Myopic astigmatism	16	0	3
Mixed astigmatism	4	10	6
Without refractive error	2	3	1
Total	60	60	60

TABLE 3
DESCRIPTIVE STATISTICS

	N	Mean values	SD	Minimum	Maximum	Percentiles		
						25.	50. (Medianus)	75.
Diopter: refractometer on narrow pupils	30	1.00	1.92	–1.50	5.50	–0.34	0.50	2.25
Cylinder: refractometer on narrow pupils	30	0.03	1.11	–3.88	2.50	–0.25	0.00	0.25
Cylinder axis: refractometer on narrow pupils	30	82.50	55.05	0.00	180.00	40.00	90.00	116.25
Diopter: retinoscopy	30	1.32	2.02	–2.00	5.50	–0.41	1.06	2.84
Cylinder: retinoscopy	30	0.77	0.91	0.00	4.00	0.19	0.50	0.88
Cylinder axis: retinoscopy	30	92.83	60.01	0.00	180.00	67.50	97.50	137.50
Diopter: refractometer on dilated pupils	30	1.85	1.85	–1.13	5.63	0.59	1.44	3.31
Cylinder: refractometer on dilated pupils	30	0.28	1.10	–3.75	2.50	0.09	0.25	0.59
Cylinder axis: refractometer on dilated pupils	30	103.00	45.04	0.00	180.00	90.00	95.00	130.00

N – total number of patients; SD – standard deviation

TABLE 4
SIGNIFICANCE LEVEL

	Z	p
Dioptre: retinoscopy – Dioptre: refractometer on narrow pupils	–2.384[a]	0.017
Cylinder: retinoscopy – Cylinder: refractometer on narrow pupils	–4.315[a]	<0.001
Cylinder axis: retinoscopy – Cylinder axis: refractometer on narrow pupils	–1.143[a]	0.253
Dioptre: refractometer on dilated pupils – Dioptre: retinoscopy	–3.564[a]	<0.001
Cylinder: refractometer on dilated pupils – Cylinder: retinoscopy	–2.883[b]	0.004
Cylinder axis: refractometer on dilated pupils – Cylinder axis: retinoscopy	–0.830[a]	0.407

a. based on negative ranks; b. based on positive ranks; c. Wilcoxon signed ranks test

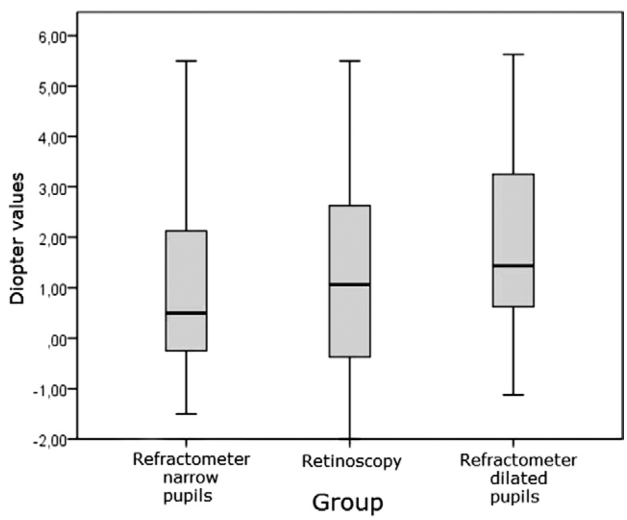

Fig 1. Mean values and standard deviation of the spherical dioptre obtained by all methods.

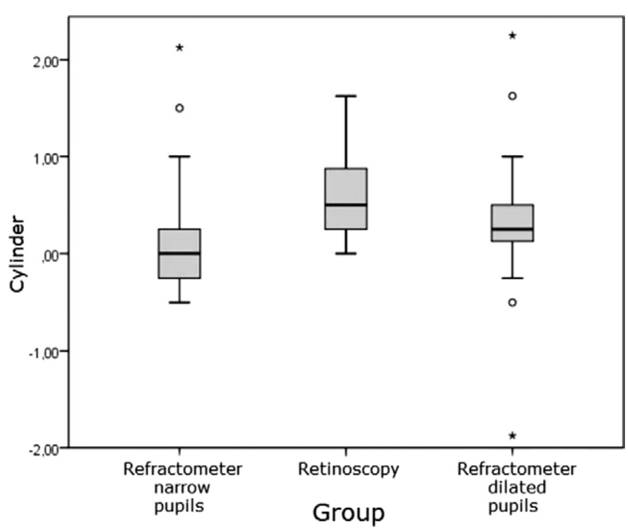

Fig. 2. Mean values and standard deviation of the cylindrical diopter obtained by all methods.

axis all methods give us practically equal values, they do not differ much statistically – when comparing refractometer on narrow pupils and retinoscopy (Z=–1.143, p=0.253, Table 4), also retinoscopy and refractometry on dilated pupils (Z=–0.830, p=0.407, Table 4), shown in Figure 3.

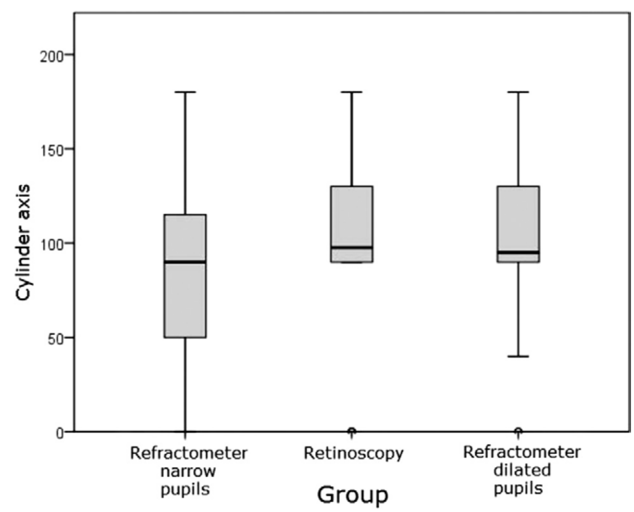

Fig. 3. Mean values and standard deviation of the cylinder axis obtained by all methods.

Discussion and Conclusion

According to the results of previous studies, retinoscopy has been shown as a reliable method in determination and diagnostics of refractive errors[4,5], it is considered to be a »golden standard«. Refractometry has been found as a good screening method[6]. It has been shown that the autorefractometer on narrow pupils shows an increased diopter of nearsightedness (myopia), the so-called »minus overcorrection«. Some authors find automated refractometer reliable only when performed on dilated pupils[2,6], and the most reliable values, ones that have been obtained by retinoscopy.

According to the results of this study, it has also been shown that the automated refractometer on narrow pupils can be used as a screening method in determining refractive errors in children. Its major drawback is that it shows increased »minus« diopter, and the exact values of a refractive error (which are later taken into consideration when prescribing corrective glasses) are obtained only through mydriasis – by retinoscopy or automated refractometer on dilated pupils.

Refractometer gives us the basic information, it is pleasant for the patient, it does not require special procedure and does not take much time to examine. However, it does not provide us correct information. On the other hand, retinoscopy and refractometer in cycloplegia (on dilated pupil) provide us a secure basical information by which we determine the value of the refractive error.

R E F E R E N C E S

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R. Pokupec

Department of Ophthalmology, University Hospital Centre Zagreb, Kišpaticeva 12, 10000 Zagreb, Croatia
e-mail: pokupec.rajko@gmail.com

USPOREDBA REFRAKTOMETRA I SKIJASKOPIJE U ODREĐIVANJU REFRAKCIJSKIH GREŠAKA – LAŽNA SUMNJA

S A Ž E T A K

Rano otkrivanje refrakcijske greške te njena pravodobna korekcija iznimno su bitni kako bi se prevenirao nastanak slabovidnosti – ambliopije. Zlatni standard u dijagnostici refrakcijske greške je skijaskopija – metoda širenja zjenica midrijaticima kako bi se isključila akomodacija, čime se dobiva točniji nalaz refrakcijske greške. Za postizanje midrijaze koristimo atropin i homatropin kapi. Pregled se radi u tamnoj sobi, na udaljenosti od jednog metra, kada ispitivač usmjerava svjetlo direktno u oko, te promatra refleksiju svjetla u zjenici oka pacijenta. Refraktometrija, s druge strane, metoda je gdje se koristimo kompjuteriziranim uređajem koji sadrži infracrveno svjetlo valne duljine 800–900 nm, točku fiksacije i Badelov optometar. Cilj našeg rada je dokazati postoji li statistički značajna razlika u vrijednostima refrakcijske greške dobivenima homatropin skijaskopijom i automatskim refraktometrom.