สารศิริราช

SIRIRAJ HOSPITAL GAZETTE

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Outcome of Manifest Refraction Performed by First Year Residents Evaluating the Schematic Eye

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Abstract :

Purpose : **To evaluate the efficacy of manifest refraction performed by beginners (first year residents)**

Methods : **Prospective study of manifest refraction obtained by first year residents at the Department of Ophthalmology, Faculty of Medicine Siriraj Hospital, Mahidol University was done. The schematic eye (model BC 2174, Bernell Corporation 1995) was preset to 7 types of refractive error, including simple hyperopia, simple myopia, simple hyperopic astigmatism, simple myopic astigmatism, compound hyperopic astigmatism, compound myopic astigmatism and mixed astigmatism. Blind manifest refraction was performed by all residents. The results were analyzed.**

Results : **Eight residents with 56 manifest refractions were included. The overall mean error in the spherical equivalent was 0.26 ± 0.99 diopter. The maximum error in the spherical component and spherical equivalent was found in the simple hyperopic astigmatism group (1.32 ± 1.01 diopter and 1.34 ± 0.63 diopter, respectively). The minimum error in the spherical component and spherical equivalent was found in the simple hyperopic group (0.12 ± 0.37 diopter and 0.09 ± 0.02 diopter, respectively). The maximum error in the cylinder was found in the mixed astigmatism group (0.84 ± 0.59 diopter) but no error in the axis was found. The maximum error in the axis of the cylinder was also found in the simple hyperopic astigmatism group (13.75 ± 17.06 degree).**

Conclusion: **Manifest refraction performed by beginners is most likely to have an error in the simple hyperopic astigmatism. The axis cylindrical component is easiest to identify in mixed astigmatism but difficult to quantify in its amount. Refraction of these types of refractive error should be cautionary for the beginners.**

Key words: Maniest refraction, Refractive error, Beginner

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เรื่องย่อ : การวิเคราะห์ผลการวัดสายตาโดยแพทย์ประจำบ้านชั้นปีที่ 1 โดยใช้แบบจำลองดวงตา

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วัตถุประสงค์: เพื่อประเมินผลการวัดสายตาในผู้ที่เริ่มฝึกหัดการวัดสายตาใหม่ (แพทย์ประจำบ้านจักษุวิทยาชั้นปีที่ 1)

วิธีการ: การศึกษานี้ทำในแพทย์ประจำบ้านจักษุวิทยาชั้นปีที่ 1 ภาควิชาจักษุวิทยา คณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดล โดยจัดให้มีการวัดสายตาในแบบจำลองดวงตา (รุ่น BC 2174, Bernell Corporation 1995) ซึ่งจัดตั้งค่าระดับสายตาผิดปรกติออกเป็น 7 กลุ่มคือ simple hyperopia, simple myopia, simple hyperopic astigmatism, simple myopic astigmatism, compound hyperopic astigmatism, compound myopic astigmatism and mixed astigmatism และให้แพทย์ประจำบ้านตรวจวัด โดยไม่ทราบชนิดมาก่อน

ผลการวิจัย: แพทย์ประจำบ้าน 8 ราย ทำการวัดสายตาทั้งหมด 56 ครั้ง ค่าความผิดพลาดโดยรวมของ spherical equivalent เท่ากับ 0.26 ± 0.99 diopter ค่าความผิดพลาดสูงสุดของส่วน spherical และ spherical equivalent พบในกลุ่ม simple hyperopic astigmatism (1.32 ± 1.01 diopter และ 1.34 ± 0.63 diopter ตามลำดับ) ค่าความผิดพลาดต่ำสุดของส่วน spherical และ spherical equivalent พบในกลุ่ม simple hyperopia (0.12 ± 0.37 diopter และ 0.09 ± 0.02 diopter ตามลำดับ) ค่าความผิดพลาดสูงสุดของส่วนปริมาณ cylinder พบในกลุ่ม mixed astigmatism (0.84 ± 0.59 diopter) แต่กลับไม่พบความผิดพลาดในส่วนแกนของ cylinder ในกลุ่มนี้ ค่าความผิดพลาดสูงสุดของส่วนแกนของ cylinder พบในกลุ่ม simple hyperopic astigmatism เช่นกัน (13.75 ± 17.06 degree)

สรุป: ผลการวัดสายตาในผู้ที่เริ่มฝึกหัดวัดสายตาใหม่ มักจะมีความผิดพลาดมากที่สุดในกลุ่มสายตาแบบ simple hyperopic astigmatism ซึ่งเป็นกลุ่มที่ควรระวังมากที่สุดในการวัดโดยผู้ที่เริ่มฝึกหัดวัดสายตาใหม่

คำสำคัญ: ค่าสายตาเอียง, กระจกตา, การวัดสายตา

INTRODUCTION

The term "refraction" refers to the measurement of the refractive error of the eye. It is one of the most frequent procedures that ophthalmologists have to perform in clinical practice. Accuracy of refraction is very critical in prescribing glasses. There are generally two methods of refraction: subjective refraction and objective refraction. Most ophthalmologists begin with objective refraction to obtain the starting point and then refine the result with subjective refraction. The more accurate the objective refraction, the better refinement achieved. Retinoscopy is the technique for objective measurement of the refractive error of the eye. By observing the movement of the light reflected from the retina, a refractive state can be identified. Different types of refractive errors give different reflection movements and characteristics. The learning curve of retinoscopy varies from one person to another. For the beginner, knowing the most sensitive error of refraction could help to shorten the learning curve.

This study was conducted to evaluate the error of manifest refraction using a streak retinoscope and schematic eye by beginners.

MATERIALS AND METHODS

All the first year residents in the Department of Ophthalmology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand, were included in this study. After clinical teaching on optics and refraction, the residents were requested to perform the refraction of the schematic eye (model BC 2174, Bernell Corporation 1995) with the maxi-

mum size of artificial pupil aperture (8 mm). The phantom lens was set in the schematic eye for the different types of refraction, including simple hyperopia (group 1), simple myopia (group 2), simple hyperopic astigmatism (group 3), simple myopic astigmatism (group 4), compound hyperopic astigmatism (group 5), compound myopic astigmatism (group 6) and mixed astigmatism (group 7). The residents were unaware of the different types of refraction in this study. Each refraction was performed in the same room condition with the same retinoscope (Neitz Retinoscope, model RX 1, Neitz Instruments C. Ltd, Tokyo, Japan). There was no limitation of time for any of the refractions. The refraction was reported in a customary format: spherical component, astigmatism and axis of astigmatism. All the results of refraction were converted into positive cylinder and the axis was adjusted periodically (90') with respect to the astigmatism conversion. Each component of the result was analyzed.

RESULTS

Eight residents with 56 refractions were enrolled in this study. All residents had never performed refraction prior the study. There were four residents who had refractive error of -7.00 diopters (spherical equivalent, SE) or less. Best corrected visual acuity (BCVA) of all residents was 20/20 or better. The refraction was performed by the right eye of the resident with the best corrected vision.

The overall group mean error of refraction (SE) was 0.26 ± 0.99 diopter. The mean error in each group of refraction (SE) is shown in Figure 1. The maximum error of SE was found in group 3 (1.34 ± 0.63 diopter). The analysis was also done separately for each component of refraction (spherical and cylindrical component). The error in the spherical and cylindrical components is shown in Figure 2 and 3, respectively. The maximum error in the spherical component was found in group 3 (1.32 ± 1.01 diopter). The maximum error in the cylinder was found in group 7 (0.84 ± 0.59 diopter) but no error in the axis was found in this group. The maximum error in the axis of the cylinder was also found in group 3 (13.75 ± 17.06 degree). The minimum error in spherical component and spherical equivalent was found in group 1 (0.12 ± 0.37 diopter and 0.09 ± 0.02 diopter, respectively).

CONCLUSION

Refractive error of the eye can be divided into 7 types including simple hyperopia, simple myopia, simple hyperopic astigmatism, simple myopic astigmatism, compound hyperopic astigmatism, compound myopic astigmatism and mixed astigmatism. The difference among each type of refractive error is based on the location of the focal point related to the retina. For the myopic group, the focal point is located in front of the retina. For the hyperopic group, the focal point is located behind the retina. For astigmatism, the focal point is split into two spots. Each spot is located differently depending on the type of myopic or hyperopic astigmatism.

The basic goal of refraction is to bring the focal point to the retina through the application of corrective lenses placed in front of the eye, no matter how many focal points there are. The lens will combine all focal points into one spot and then move the spot exactly to the retina. This will allow one to see everything clearly without discomfort or eye strain. In order to obtain this goal perfectly, an accurate measurement of the refractive error is required.

Experience of the refractionist is very important in measuring the refractive error of the eye. For the beginner, the early period of the learning curve is variable. There were several methods to reduce the time for the learning period. Previous reports explored the positive benefit of teaching ophthalmologists to perform refraction by optometrists because it is the area in which optometrists are strongly qualified[1]. Several reports also showed the benefit of a reduced schematic eye which is capable of simultaneously accounting for the chromatic, spherical, and oblique astigmatic aberrations typically found in human eyes[2-4]. This schematic eye can be used for refraction training.

Our study was conducted to evaluate the influence of the type of refractive error in the efficacy of

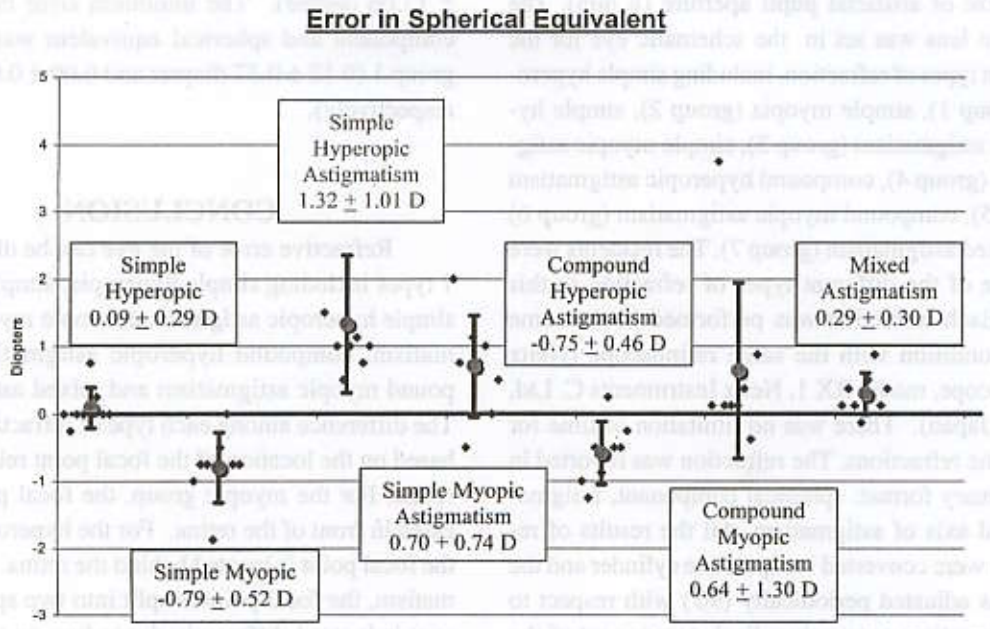

Figure 1. Shows the error of the spherical equivalent in each group. Note that the maximum error was found in the Simple Hyperopic Astigmatism group. The minimal error was found in the Simple Hyperopic group.

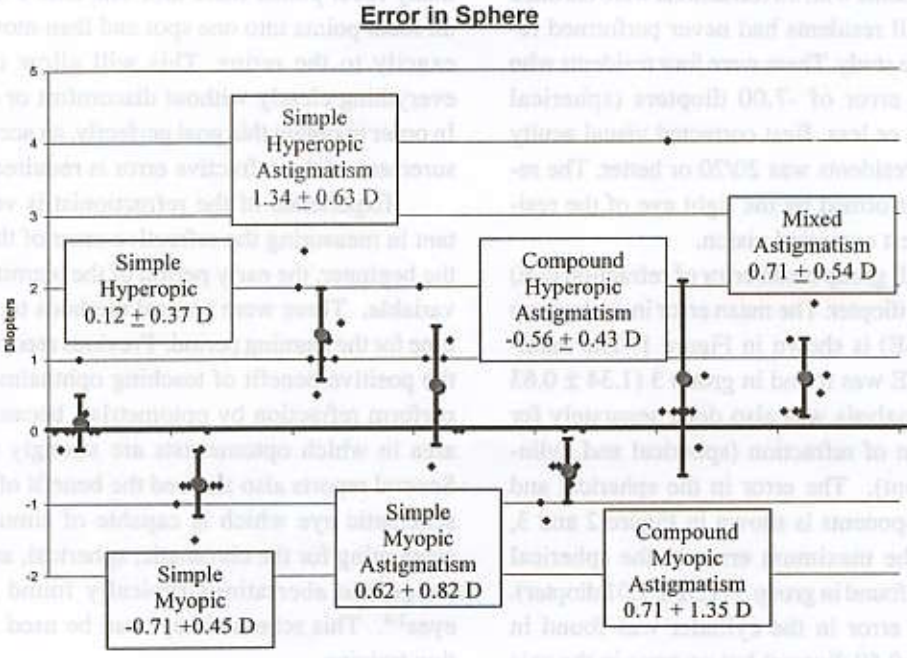

Figure 2. Shows the error of the spherical component in each group. Note that the maximum error was found in the Simple Hyperopic Astigmatism group. The minimal error was found in the Simple Hyperopic group.

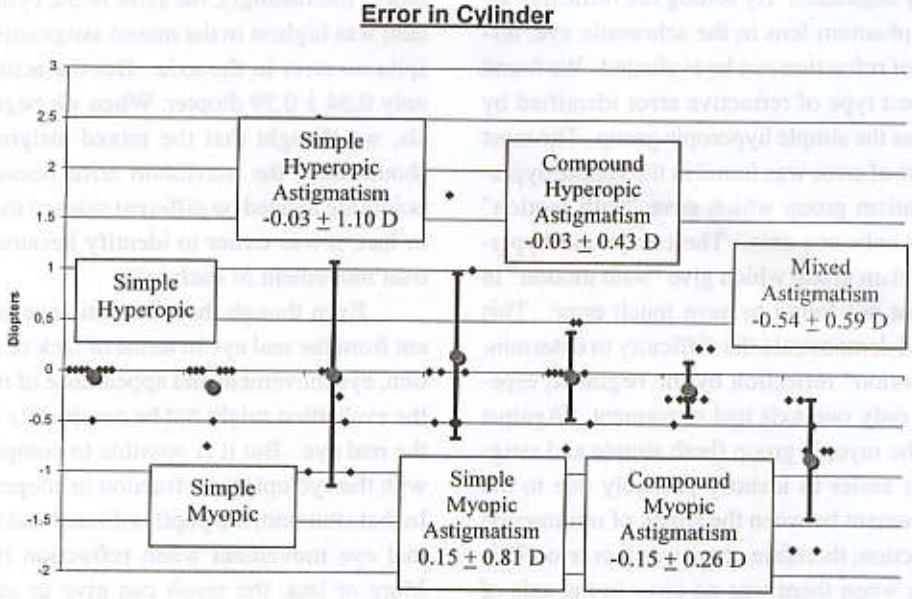

Figure 3. Shows the error of the cylindrical component (amount) in each group. Note that the maximum error was found in the Mixed Astigmatism group.

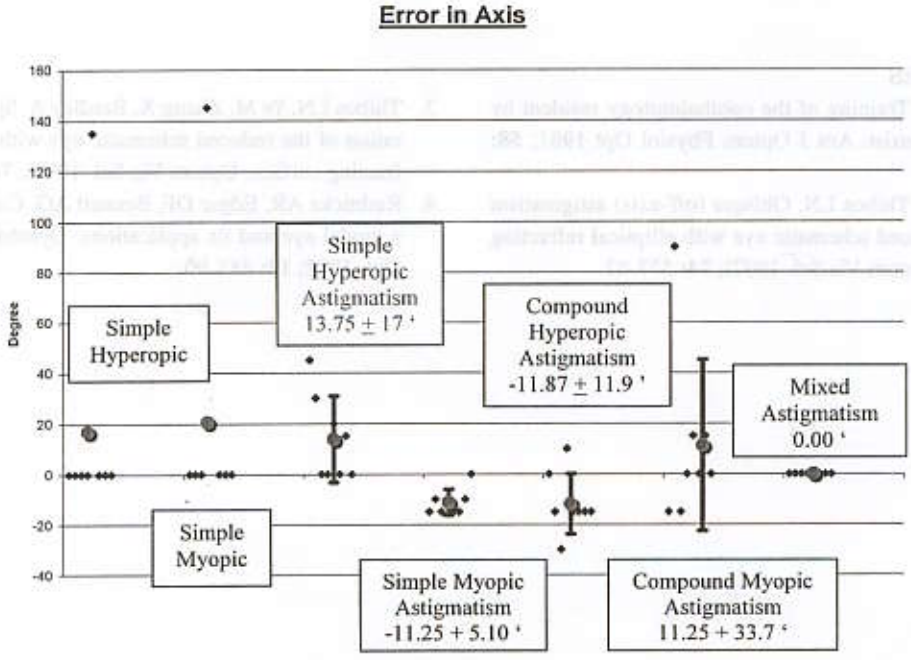

Figure 4. Shows the error of the cylindrical component (axis) in each group. Note that the maximum error was found in the Simple Hyperopic Astigmatism group.

refraction by beginners. By setting the refractive error, using a phantom lens in the schematic eye, different types of refraction can be evaluated. We found that the easiest type of refractive error identified by beginners was the simple hyperopic group. The most common type of error was found in the simple hyperopic astigmatism group which gave "with motion" reflection in only one axis. The compound hyperopic astigmatism group which give "with motion" in both axis was not found to have much error. This finding could demonstrate the difficulty in determining "with motion" reflection by the beginner, especially when only one axis had movement. "Against motion" in the myopic group (both simple and astigmatism) was easier to identify probably due to the reverse movement between the streak of retinoscope and the reflection; therefore, there was less error. This was obvious when there was no error in the axis of astigmatism in the mixed astigmatism group, which give "with motion" in one axis and "against motion" in the other. Beginners were able to identify the angle of the axis correctly because they could use the reverse movement of each axis as a reference to each other. Interestingly, the error in the cylinder component was highest in the mixed astigmatism group despite no error in the axis. But the actual value was only 0.54 ± 0.59 diopter. When we began the analysis, we thought that the mixed astigmatism group should have the maximum error because the focal points are located on different sides of the retina. But, in fact, it was easier to identify because of the contrast movement of each axis.

Even though the schematic eye is very different from the real eye in terms of lack of accommodation, eye movement and appearance of the reflection, the evaluation might not be completely applicable to the real eye. But it is possible to compare the result with the cycloplegic refraction in cooperative adults. In that situation, the pupil is dilated and there is minimal eye movement when refraction is performed. More or less, the result can give us an idea of the most common type of error in refraction that the beginner has to encounter.

In conclusion, the most common type of refractive error that beginners should be aware of is simple hyperopic astigmatism.

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