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Abstract
A clinical investigation into the significance of alignment methods as used with the Dioptron II Automated. Refractor was compared to the subjective refraction. A total of 110 eyes were tested. using two differing alignment modes: 1) instrument alignment target centered with the pupil, i.e. on the pupil axis; 2) instrument alignment target centered on the corneal light reflex, i.e. on the line of sight. Results showed no significant difference between either of the alignment methods when they were compared to the subjective refraction examination results.

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CLINICAL EVALUATION OF ALIGNMENT METHODS USING THE DIOPTRON II

Submitted by
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ABSTRACT

A clinical investigation into the significance of alignment methods as used with the Dioptron II Automated Refractor was compared to the subjective refraction. A total of 110 eyes were tested using two differing alignment modes: 1) instrument alignment target centered with the pupil, i.e. on the pupil axis; 2) instrument alignment target centered on the corneal light reflex, i.e. on the line of sight. Results showed no significant difference between either of the alignment methods when they were compared to the subjective refraction examination results.

Introduction

The age of the automated refractors has come to pass. The use of automated refractors in everyday optometric practice has become a commonplace occurrence. The ease with which one can ascertain a quick objective measure of refractive status has made these instruments an invaluable aid in obtaining an initial starting point for the examination. When considering the use of an automated refractor in actual practice, the question arises as to how one can use these instruments most efficiently to arrive at a valid measure of the patient's refractive error. Certain variables may need to be considered in the actual operation of these instruments to obtain the data we can most readily utilize. Consideration of these variables with the use of the Dioptron II automated refractor will be the purpose of this investigation.

The Dioptron II, manufactured by the Coherent Medical Division, measures the refractive error of the patient by the retinal image formation technique. An invisible, infrared bar pattern is projected onto the patient's retina while viewing a visible starburst target within the instrument. A focus detector determines the sharpness of the retinal image and adjusts the main measuring lens for maximum sharpness. The bars are oriented in various meridians while the movable lens is adjusted for the best focus. The relative location of the movable lens from its initial starting point yields a measure of the patient's refractive error. The backlighted starburst image which the patient is viewing, projects in such a way as to demonstrate to the operator the corneal light reflex reflected from the apex of the cornea. In previously reported studies, the location of this corneal light reflex determines the patient's own visual axis.

In placement of the patient in the Dioptron II, prior to carrying out the measurements, the operator will often note that the patient's corneal light reflex is decentered horizontally and/or vertically from the geometric center of the pupil. The instrument's manufacturer recommends that the operator center the pupil exactly within the target's starburst image. The authors have found that when measurements are made with the pupil exactly centered, and then placement of the pupil image is varied so as to place the corneal light reflex at the center of the starburst, different sets of data are obtained.

The literature reveals little information about possible variations in the autorefractor results due to varying alignment criteria. Most of the studies on the Dioptron and other autorefractors deal strictly with the accuracy relative to the subjective exam results. All the studies found a very high correlation to the subjective for sphere, r=.978, and a fair correlation for cylinder power, r=.766. The correlation for cylinder axis was very low for lower cylinder powers (less than .50D), and high for cylinders of greater power, r=.594 and r=.902, respectively. The Dioptron gave fairly accurate estimates of the refractive error over a wide range of refractive errors, pupil sizes, and subject limitations.

All the studies indicated that the autorefractor results were not reliable or accurate enough to substitute for the subjective refraction. The standard technique of retinoscopy showed a higher correlation to the subjective than to the Dioptron results. In certain people with poor stability of fixation (hyperactive children, the mentally retarded, patients with nystagmus, uncooperative patients, etc.), the instrument did not yield reliable or valid results. This leads to the possibility that the alignment changes induced by these fixation changes contributed to the erratic results. Since our study utilizes two different alignment conditions (pupil centered and corneal light reflex centered), the results should indicate if there is a significant change in measurements due to alignment changes. Also, the alignment which shows the higher correlation to the subjective exam results would obviously be recommended.

The purpose of this study is to determine if objective refraction with the corneal light reflex centered within the starburst image, provides an objective lens measurement that more nearly agrees with the practitioner derived subjective refraction to best visual acuity. It is our purpose to test this hypothesis in actual practice. This study will hopefully help the practitioner to better utilize instruments of this design, and at the same time, minimize possible errors in data collection due to improper initial alignment.

Methods

Data was accumulated in a local optometric practice where the Dioptron II is incorporated into the initial segment of the visual examination. Comparison of the Dioptron II measurements with the pupil centered, and then with the corneal light reflex centered, yielded data that was then compared to the practitioners distance subjective measurement of best visual acuity. This study will deal with accuracy of the spherical and cylindrical power measurements, as well as the accuracy of the location of the cylindrical axis. Refractive data, using the two different modes of alignment, was compared to the practitioner-derived subjective to best visual acuity.

Measurements were taken by one of three optometric assistants employed in the office. All measurements were obtained using the same basic procedures. Initially, the patient was comfortably seated at the instrument and adjustment for height was made. Placement of the chin and forehead was such that minimal movement could be achieved. The patient was instructed as to what he would be viewing, and the importance of keeping any eye movement to a minimum. Measurements were then taken using pupil centration as one criterion and centration of the corneal light reflex as the second criterion. The distance subjective was determined by one of the two optometrists employed by the office. Cycloplegic refractions were not included in this study.

Pearson's coefficients of correlation were used in data analysis. A total of 110 eyes were sampled with patients ranging in age from 8 years to 82 years. The practitioners subjective exam was used as our comparison standard. Calculations of coefficients of correlation were computed for spherical and cylindrical power, and cylindrical axis. Results of our data analysis follow.

Results

The results gathered were statistically analyzed using the Pearson Product Moment Correlation Coefficient. The data was broken down to separately analyze sphere power, cylinder power and cylinder axis.

Following are the coefficients of correlation for the various comparisons:

1) The correlation coefficients for the Dioptron II sphere power for 110 eyes as compared to the subjective refraction sphere findings was r=.987 for pupil alignment and r=.989 for corneal reflex centered.

2) The correlation coefficient for cylinder powers of .25D or greater were calculated for 64 eyes. Pupil alignment vs. subjective refraction revealed a correlation

of r=.748. Corneal alignment vs. subjective refraction indicated a correlation of r=.572.

3) Cylinder axis correlations were obtained from the same sample as cylinder power correlations. For pupil alignment vs. subjective refractive findings, r=.939; for corneal reflex centered vs. refractive findings, r=.976.

Table of Correlations

	pupil centered	corneal reflex centered
sphere sample size = 110 eyes	r=.987	r=.989
cylinder power sample size= 64 eyes	r=.748	r=.572
cylinder axis sample size= 64 eyes	r=.939	r=.976

Discussion

This study revealed no significant difference between either of the alignment methods tested when they were measured against the subjective. The sphere and cylinder axis correlations were both very high and almost identical. The values obtained were similar to those obtained in past studies. The lower correlation for the cylinder power can possibly be explained by the fact that the subjective cylinder power is often decreased from the amount which actually exists. This seems evident in that the average power of cylinder obtained by either alignment method was found to be approximately 0.12D greater than the subjective.

The results of the study correspond to the manufacturer's recommendation that alignment method is not as critical as might be expected. The manufacturer states that alignment is only crucial in that it allows the maximum amount of infrared to reach the instrument having been reflected from the retina.

The use of the Dioptron II gives the clinician a reasonably accurate measurement of refractive error regardless of the alignment method used. The authors therefore recommend that either alignment method can be used dependent only on the operator's preference. Either method will result in equal levels of success.

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