1-1957

A reliability and validity study of the clock dial and the Raubitschek arrow test for astigmatism

Francis M. Meagher
Pacific University

Donald Bettger
Pacific University

Stanley Kurilo
Pacific University

A reliability and validity study of the clock dial and the Raubitschek arrow test for astigmatism

Abstract

A reliability and validity study of the clock dial and the Raubitschek arrow test for astigmatism

Degree Type

Thesis

Degree Name

Master of Science in Vision Science

Committee Chair

D.T. Jans

Subject Categories

Optometry

A RELIABILITY AND VALIDITY STUDY OF THE CLOCK DIAL AND THE RAUBITSCHEK ARROW TEST FOR ASTIGMATISM

A thesis presented to the Optometric Faculty of Pacific University, College of Optometry, Forest Grove, Oregon.

In Partial Fulfillment

Of The Requirements For The

Doctorate Degree In Optometry

Francis M. Meagher
Donald Bettger
Stanley Kurilo

January - 1957

ACKNOWLEDGEMENTS

We are grateful for the advice and materials made available to us by Dr. D.T. Jans, Professor of Optometry; for the help in statistical computation by Dr. Paul Eskildson, O.D.; and to the subjects who served as observers.

F.M.M.
D.B.
S.K.

TABLE OF CONTENTS

A RELIABILITY AND VALIDITY STUDY OF THE CLOCK DIAL AND THE RAUBITSCHEK ARROW TEST FOR ASTIGMATISM

INTRODUCTION

The Clock Dial and the Raubitschek Dial are the two charts used in this experiment. The Clock Dial is so designed that groups of three lines, spaced at thirty degree intervals, represent a full 360 degrees; and is so named because of its similarity to the actual time piece of our day. On the other hand, the Raubitschek Dial is composed of only two lines, "forming a specially designed arrow, each wing of which is a section of a parabolic curve. The parabolic arcs forming the arrow contain all the 180 degree meridians in every position of the arrow," so that at least part of one or both arcs will be coincident with the principle meridian and therefore will appear darker. It is this darkness of the line or lines in each case that aids in the determination of both power and axis of astigmatism where measureable.

The Clock Dial chart used in this experiment was a standard slide designed for use in an American Optical projector. The Raubitschek Dial used was projected from a Bason projector. The slide used was the same as that described in a thesis submitted for partial fulfillment of requirements for a degree of Doctor of Optometry at Pacific University, Forest Grove, Oregon.*

*Turk and Price, "Raubitschek Test For Astigmatism." 1955.

PURPOSE

Of the various methods for determining astigmatism subjectively, many of the methods employed make use of line charts, the lines varying from two upwards, in number. The concensus of opinion was that the more lines used, the more difficult it became to make the necessary comparison. For that reason, the revolving cross became a very useful auxilliary to the multiple line chart permitting a comparison based on fewer lines; but, failing in the usefullness of determining a precise axis determination.

The Clock Dial and the Raubitschek Dial are considered improvements over the multiple line charts, whereby cylinder axis and power could be determined by use of the same chart. The purpose, therefore, of this paper is to determine a correlation test retest between the amount of cylinder power and the location of cylinder axis by the Clock Dial and Raubitschek methods.

PROCEDURE

Both the Clock Dial and the Raubitschek Dial tests are performed monocularly, and while the eye is slightly fogged. So that uniformity may be maintained, each subject will be fogged to the 20/60 line on Distant Snellen chart, plus power being reduced in 0.25 dippter steps until the patient can just clear a 20/30 line. For the Clock Dial, this is approximately the amount of acuity required to distinguish the three lines of one spoke of the dial. The same control lens will be used for the Raubitschek Test. It should closly approximate the recommended lens of plus 0.50 diopters above the #7 finding. Minus cylinders alone are used for determining power.

I. Clock Dial

a. Axis Determination:

The left eye is occluded and the patient has replied that he is just able to clear the 20/30 line with the right eye. The patient is then directed to look at the projected Clock Dial and is asked the following question. "Are all of the spokes equally blurred?; or is one spoke blacker than the others?" (The patient is previously made aware of the fact that each spoke consists of three lines). If all the spokes appear equally blurred, then astigmatism may be ruled out. If one line does look blacker than the others, the subject informs

the observer as to the blacker spoke by giving that spoke a number corresponding to a numeral which on a clock would have the same corresponding position. This number is then multiplied by 30, to give in degrees the placement of the minus cylinder axis. (Example: Patient says 2 o'clock; 2x30 equals 60; thus, 60 degrees.)

b. Power Determination:

The patient having decided that one of the spokes looks blacker than all the others, and minus cylinder having been placed on axis by means of the "thirty" rule, the subject is now directed to compare the blackest line with the line at right angles to it. (Example: If the 2 o'clock line was seen to be the blackest, then the comparison is made between that line and the line at 5 o'clock; in terms of degrees, the 60 line and the 150 line). Now, minus cylinder is added (axis 60) and the subject instructed to tell the experimenter when the two lines of regard are seen equally black. More minus cylinder is added to get a reversal of the lines, and now reduced until once again equal. The amount of minus cylinder which brings about the response that the two

lines are equally black is considered to be that amount which corrects the astigmatic error.

II. Raubitschek Dial

a. Axis Determination:

The left eye is occluded and the subject has replied that he is just able to clear the 20/30 line. The patient is then directed to the projected Raubitschek Dial and asked if both arcs of the dial are equally blurred, or if one "wing" of the dial is blacker than the other. (The work wing is used in reference to one of the two parabolic arcs making up the dial.) The dial has first been shown with the arrow set at 90 degrees. If both wings are equally blurred, the dial is rotated so that the axis is at 45 degrees, and the same question is asked. If in both positions the parabolic arcs were seen equally blurred, then astigmatism is ruled out. If on the other hand, in the first position one wing was seen blacker than the other (this is called "shadow) then the dial is rotated away from the side of the arc bearing the "shadow". The rotation is continued until each wing is seen to exhibit an equal amount of shadow, measured from the

point of the arrow down toward the ends of the wings. This position can be checked easily, for rotating the dial five to ten degrees to either side increases the amount of shadow on the respective side. By moving the projection slide, the cylinder axis can be read from the accompanying line chart, in degrees for the actual placement of the axis of minus cylinder.

b. Power Determination:

The subject having decided that both wings of the dial exhibit an equal amount of shadow at the tip, the experimenter is now prepared to determine the amount astigmatism. Note; if the arrow points to 90 degrees when the two wings are equally black, the minus cylinder axis is indicated by the fainter ends of the wings, and is thus 90 degrees away, or at 180 degrees. This axis can be read from the accompanied line dial as mentioned above. The experimenter now employs the Pascal-Raubitschek technique which makes use of two angles, a test angle and a rotation angle, usually taken as 20 and 35 degrees respectively. The 20 degrees gives the position of the temporary axis, and the 35

degrees gives the new position of the arrow tip. Both angles are taken within the quadrant formed between the position of the arrow tip and the actual minus cylinder axis. The temporary axis is 20 degrees away from the axis of the minus cylinder, thus at 160 degrees. This is where the axis of the minus cylinder is placed. Then the arrow of the dial is rotated until it is 35 degrees away from the axis of the minus cylinder, or at 125 degrees. Now, minus cylinder is actually added in the phoropter. As cylinder power is added, the wing nearest the cylinder axis will be the blacker; if too much minus cylinder is added, the line further from the minus cylinder axis will become the darker. Minus cylinder is then reduced until the two wings look alike. The amount of minus cylinder remaining in the phoropter is the amount needed to correct the astigmatic error. The amount of cylinder found by this method placed at 180 degrees (the original position of the linned wings) represented the eye.

Note:

The above procedure was used first on the

right eye, then on the left eye. An interval of not less than twenty-four hours took place between each examination on a given subject.

STATISTICAL ANALYSIS

In comparison of the Raubitschek Arrow test for astigmatism on test and retest with the clinically accepted Clock Dial astigmatic test on retest, a very high correlation was found for each. Two statistical methods were used, the Pearson Product Correlation and the rank order method. The Pearson Product Correlation coefficient for cylinder power and axis shows a higher correlation than that determined by the rank order method.

Reliability

Clock Dial		
a.	Power	.617
b.	Axis	.400
Raubitschek		
a.	Power	.771
b.	Axis	.129

Validity

Rank Order Correlation		
a.	Power	Rho = .938
b.	Axis	Rho = .949
Pearson Product Correlation		
a.	Power	r = .989
b.	Axis	r = .988

Therefore it is statistically substantiated that the Raubitschek test for astigmatism may be substituted for the Clock Dial method when this is desirable.

DISCUSSION

The determination of axis by means of the Clock Dial test is a more gross measurement than the Raubitschek Arrow test, and therefore, the Clock Dial axis would require further refinement, while the Raubitschek test would not. Perhaps a more comparable correlation would have resulted between axis as determined by the Raubitschek and Clock Dial, if instead of a Clock Dial a Sunburst had been used.

However, each experimenter found that it was more difficult to explain to the subject what they would see and how they should interpret the Raubitschek Arrow. The experimenters also found that the Raubitschek test was the more time consuming. The majority of subjects were able to descriminate the Clock Dial test more easily resulting in a more rapid response.

Those subjects having a high degree of astigmatism were able to descriminate more easily on the Raubitschek test than persons having a low degree of astigmatism. Those persons who had not previously worn an astigmatic correction were not as descriminate on the Raubitschek test as they were on the Clock Dial test.

Further Studies:

1. A Raubitschek study on test-retest of non-corrected and previously corrected astigmatic subjects.
2. A correlation of power on test-retest of a group of hyperopic and myopic astigmatic subjects.
3. A comparison of variations on different dioptric levels of manifest cylinder.
4. A correlation of power on test-retest of non-dominant eyes vs. dominant eyes of individuals manifesting cylinder.

REFERENCES

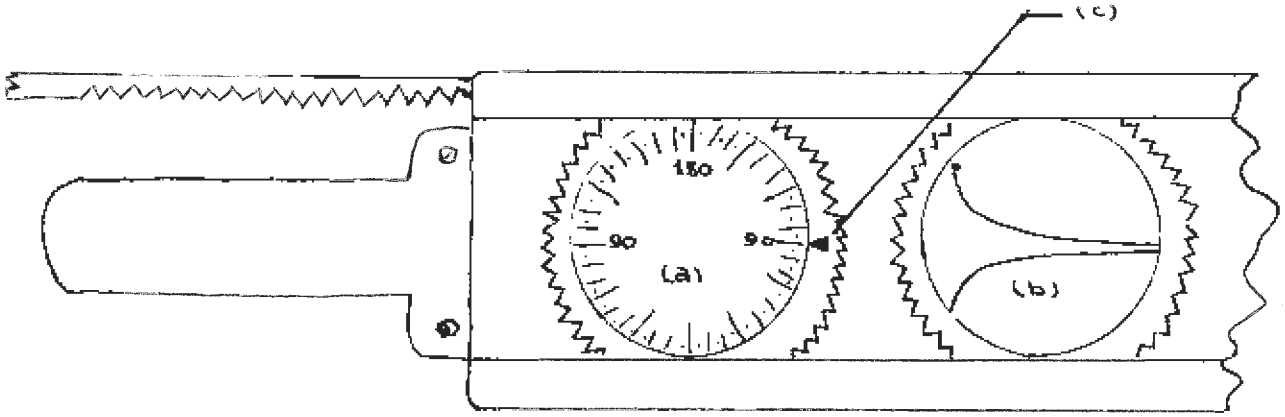
BORISH, I. : Clinical Refraction.

TURK AND PRICE : Raubitschek Test For Astigmatism.

PASCAL, J. : The Pascal-Raubitschek Test for Astigmatism; Journal of the AOA, Vol. XXV. no. 9.

RAUBITSCHEK, E. : The Raubitschek Test For Astigmatism; Opt. World, Vol. XLI, no. 9.

RAUBITSCHEK SLIDE



a. stationary dial, 5° intervals

b. moveable dial

c. marker moves in equal amount and direction as (b) dial

SUBJECT I

Comparative Astigmatic Study

Clock Dial		Raubitschek	
O.D.	O.S.	O.D.	O.S.
Power Axis	Power Axis	Power Axis	Power Axis
-0.50x 135°	-1.25 x 65°	-0.75 x 127°	-0.75 x 65°
-0.50 x 150°	-0.75 x 75°	-0.75 x 125°	-0.75 x 65°
-0.75 x 120°	-1.25 x 70°	-0.75 x 142°	-0.75 x 68°
-0.75 x 130°	-1.00 x 60°	-0.75 x 137°	-0.75 x 62°
-0.50 x 120°	-1.00 x 60°	-0.75 x 117°	-0.75 x 60°
-0.75 x 105°	-0.75 x 55°	-0.50 x 120°	-0.75 x 55°
-0.50 x 120°	-0.75 x 70°	-0.62 x 122°	-0.75 x 66°
-0.75 x 110°	-0.75 x 75°	-0.75 x 119°	-0.75 x 69°
-0.50 x 120°	-0.75 x 75°	-0.50 x 112°	-0.50 x 70°
-0.62 x 120°	-0.75 x 74°	-0.50 x 124°	-0.75 x 72°

SUBJECT II

Comparative Astigmatic Study

Clock Dial				Raubitschek			
O.D.		O.S.		O.D.		O.S.	
Power	Axis	Power	Axis	Power	Axis	Power	Axis
-0.50	x 150°	-1.50	x 20°	-1.25	x 152°	-1.50	x 21°
-1.25	x 150°	-1.25	x 25°	-1.50	x 149°	-1.50	x 18°
-1.50	x 150°	-1.50	x 20°	-1.50	x 152°	-1.25	x 17°
-0.50	x 150°	-1.25	x 20°	-1.50	x 150°	-1.50	x 13°
-1.25	x 150°	-1.00	x 20°	-1.75	x 151°	-1.50	x 13°
-1.50	x 150°	-1.75	x 16°	-1.50	x 152°	-1.50	x 19°
-0.50	x 150°	-1.50	x 19°	-1.75	x 153°	-1.25	x 21°
-1.50	x 150°	-1.50	x 20°	-2.50	x 152°	-1.50	x 15°
-0.75	x 150°	-1.50	x 20°	-1.75	x 152°	-1.25	x 18°
-0.62	x 150°	-1.50	x 30°	-1.75	x 151°	-1.50	x 20°

SUBJECT III

Comparative Astigmatic Study

Clock Dial		Raubitschek	
O.D.	O.S.	O.D.	O.S.
Power Axis	Power Axis	Power Axis	Power Axis
-5.25 x 180°	-5.25 x 180°	-5.25 x 176°	-5.00 x 176°
-5.25 x 180°	-5.25 x 180°	-4.50 x 179°	-4.50 x 2°
-5.75 x 180°	-5.25 x 180°	-5.50 x 175°	-5.00 x 20°
-4.25 x 180°	-4.25 x 180°	-4.75 x 180°	-4.50 x 177°
-5.25 x 180°	-5.00 x 180°	-5.00 x 177°	-3.50 x 10°
-5.50 x 180°	-4.25 x 180°	-5.75 x 176°	-4.25 x 180°
-4.75 x 180°	-4.75 x 3°	-5.75 x 175°	-4.75 x 4°
-5.00 x 180°	-4.50 x 180°	-4.87 x 178°	-5.00 x 178°
-4.50 x 180°	-5.25 x 180°	-5.00 x 174°	-5.00 x 178°
-5.50 x 180°	-5.50 x 180°	-4.50 x 170°	-6.00 x 176°

SUBJECT LV

Comparative Astigmatic Study

Clock Dial				Raubitschek			
O.D.		O.S.		O.D.		O.S.	
Power	Axis	Power	Axis	Power	Axis	Power	Axis
-0.25	x 95°	-0.50	x 85°	-0.37	x 100°	-0.25	x 80°
-0.50	x 100°	-0.62	x 100°	-0.25	x 110°	-0.25	x 65°
-0.62	x 100°	-0.37	x 90°	-0.25	x 100°	-0.37	x 95°
-0.50	x 95°	-0.62	x 95°	-0.25	x 105°	-0.50	x 80°
-0.62	x 100°	-0.50	x 100°	-0.50	x 110°	-0.25	x 95°
-0.37	x 90°	-0.50	x 90°	-0.25	x 95°	-0.37	x 100°
-0.50	x 95°	-0.37	x 95°	-0.50	x 100°	-0.25	x 95°
-0.75	x 100°	-0.50	x 90°	-0.50	x 100°	-0.50	x 100°
-0.75	x 95°	-0.37	x 95°	-0.62	x 95°	-0.50	x 90°
-0.50	x 95°	-0.50	x 90°	-0.37	x 100°	-0.50	x 85°

SUBJECT V

Comparative Astigmatic Study

Clock Dial				Raubitschek			
O.D.		O.S.		O.D.		O.S.	
Power	Axis	Power	Axis	Power	Axis	Power	Axis
-0.50	x 110°	-0.50	x 60°	-0.25	x 110°	-0.37	x 50°
-0.50	x 90°	-0.50	x 60°	-0.25	x 105°	-0.50	x 60°
-0.50	x 115°	-0.75	x 60°	-0.50	x 110°	-0.50	x 60°
-0.50	x 120°	-0.75	x 60°	-0.50	x 122°	-0.50	x 60°
-0.50	x 95°	-0.50	x 60°	-0.50	x 130°	-0.50	x 65°
-0.37	x 115°	-0.50	x 55°	-0.37	x 112°	-0.50	x 58°
-0.50	x 115°	-0.75	x 55°	-0.12	x 110°	-0.50	x 63°
-0.75	x 105°	-0.62	x 60°	-0.37	x 112°	-0.50	x 60°
-0.75	x 115°	-1.00	x 60°	-0.50	x 112°	-0.67	x 50°
-0.75	x 115°	-0.75	x 60°	-0.50	x 115°	-0.50	x 60°

SUBJECT VI

Comparative Astigmatic Study

Clock Dial		Raubitschek	
O.D.	O.S.	O.D.	O.S.
Power Axis	Power Axis	Power Axis	Power Axis
-1.00 x 180°	-1.25 x 180°	-1.00 x 180°	-1.25 x 180°
-1.25 x 5°	-1.00 x 180°	-1.25 x 180°	-1.25 x 180°
-0.75 x 5°	-1.12 x 180°	-1.12 x 180°	-1.00 x 180°
-1.00 x 180°	-1.00 x 180°	-1.00 x 180°	-0.87 x 180°
-0.75 x 5°	-1.25 x 180°	-0.75 x 5°	-1.00 x 180°
-1.25 x 5°	-1.25 x 180°	-1.00 x 180°	-1.00 x 180°
-1.00 x 180°	-1.12 x 180°	-1.00 x 180°	-1.25 x 180°
-1.00 x 180°	-1.25 x 180°	-0.87 x 5°	-1.00 x 180°
-1.25 x 5°	-1.00 x 180°	-1.00 x 180°	-1.00 x 180°
-0.75 x 180°	-1.25 x 180°	-1.25 x 5°	-1.12 x 180°

SUBJECT VII

Comparative Astigmatic Study

Clock Dial				Raubitschek			
O.D.		O.S.		O.D.		O.S.	
Power	Axis	Power	Axis	Power	Axis	Power	Axis
-1.25	x 96°	pl		-1.00	x 101°	-0.50	x 87°
-1.25	x 94°	-0.25	x 90°	-1.25	x 98°	-0.50	x 92°
-1.37	x 96°	-0.25	x 90°	-0.87	x 100°	-0.37	x 92°
-1.25	x 96°	-0.12	x 90°	-1.25	x 97°	-0.50	x 97°
-1.00	x 92°	-0.25	x 120°	-1.25	x 99°	-0.50	x 94°
-1.25	x 95°	pl		-0.87	x 98°	-0.25	x 95°
-1.37	x 92°	-0.25	x 90°	-1.37	x 103°	-0.50	x 90°
-1.12	x 95°	-0.12	x 90°	-1.25	x 97°	-0.37	x 92°
-1.25	x 96°	-0.25	x 90°	-1.25	x 95°	-0.75	x 94°
-1.25	x 90°	-0.25	x 90°	-1.25	x 97°	-0.50	x 93°

SUBJECT VIII

Comparative Astigmatic Study

Clock Dial				Raubitschek			
O.D.		O.S.		O.D.		O.S.	
Power	Axis	Power	Axis	Power	Axis	Power	Axis
-3.00	x 90°	-2.50	x 180°	-3.25	x 91°	-3.00	x 2°
-3.75	x 91°	-2.50	x 180°	-2.87	x 90°	-2.75	x 2°
-3.12	x 90°	-2.25	x 180°	-3.00	x 90°	-2.75	x 180°
-3.25	x 90°	-2.50	x 180°	-3.50	x 90°	-2.25	x 179°
-3.87	x 94°	-2.62	x 180°	-3.25	x 93°	-2.37	x 1°
-3.75	x 95°	-2.50	x 180°	-3.00	x 90°	-2.50	x 180°
-3.25	x 90°	-2.75	x 180°	-3.12	x 90°	-2.25	x 180°
-3.25	x 89°	-2.50	x 180°	-3.25	x 88°	-2.25	x 179°
-3.12	x 90°	-2.37	x 180°	-3.50	x 91°	-2.37	x 2°
-3.00	x 92°	-2.50	x 180°	-3.25	x 93°	-2.50	x 178°

SUBJECT IX

Comparative Astigmatic Study

Clock Dial				Raubitschek			
O.D.		O.S.		O.D.		O.S.	
Power	Axis	Power	Axis	Power	Axis	Power	Axis
-0.50	x 180°	-1.00	x 180°	-0.50	x 175°	-1.25	x 180°
-0.50	x 180°	-0.87	x 180°	-0.50	x 180°	-0.75	x 182°
-0.75	x 180°	-1.00	x 180°	-0.50	x 179°	-1.12	x 179°
-0.37	x 180°	-1.00	x 180°	-0.25	x 180°	-1.00	x 180°
-0.75	x 180°	-0.75	x 30°	-0.37	x 182°	-1.25	x 178°
-0.75	x 180°	-1.00	x 180°	-0.50	x 178°	-1.00	x 180°
-0.50	x 180°	-1.00	x 180°	-0.50	x 180°	-1.25	x 179°
-0.50	x 180°	-1.12	x 180°	-0.25	x 176°	-1.75	x 2°
-0.50	x 180°	-1.00	x 180°	-0.50	x 178°	-1.00	x 180°
-0.50	x 180°	-1.00	x 180°	-0.50	x 176°	-1.00	x 180°