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The effect of vertical ductions on the near lateral phoria

Snowden M. Booth  
Pacific University

John R. Lofgren  
Pacific University

Carl D. Thome  
Pacific University

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Abstract
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Degree Type
Thesis

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THE EFFECT OF VERTICAL DUCTIONS ON THE NEAR LATERAL PHORIA

Snowden M. Booth
John R. Lofgren
Carl D. Thome

June, 1965

Submitted in Partial Fulfillment
of Requirement for the Degree
Doctor of Optometry

Approved 

_________
March 1, 1964

Dr. Carol B. Pratt  
College of Optometry  
Pacific University  
Forest Grove, Oregon  

Dear Dr. Pratt:

We propose to investigate the possible existence of a functional relationship between the near phoria finding and the vertical ductions. We further propose to investigate the normal variation of a phoria with time under the testing conditions to provide a basis for analysis of significant changes due to the vertical phoria and ductions.

The area of investigation will be: the effect of the far vertical ductions on the No. 13B phoria when taken immediately preceding the near lateral phoria.

This investigation will be carried out by Snowden M. Booth, John R. Lofgren and Carl D. Thomé. The projected number of patients to be examined for this study will be seventy-five (75).

Respectfully submitted,

Snowden M. Booth  
John R. Lofgren  
Carl D. Thomé

Approved by:

Dr. Carol B. Pratt (Advisor)
ACKNOWLEDGEMENTS

We gratefully acknowledge the assistance of Dr. C. B. Pratt of the Faculty of Pacific University College of Optometry for his advice and interest.

We also wish to acknowledge the encouragement given by Dr. Irvin M. Borish by letter that provided added impetus to the completion of this study. A copy of this letter is reproduced on the next page.

Our heartfelt thanks go to the persons who patiently cooperated with us by serving as subjects for this study.
Mr. S. M. Booth  
1303 Filbert Street  
Forest Grove, Oregon 97116

Dear Mr. Booth,

The criteria are both the results of a study done many years ago by Mat Alpern upon the residual effects of ductions upon subsequent tests, my own observation of the physiology of contraction of muscles when fully extended to the extra-ocular ones. This applies incidentally to lateral as well as vertical ductions. Many clinicians have observed the effects of lateral ductions upon the phorias taken immediately afterwards. Likewise Lancaster refers to variations in vertical duction taken supra then infra upon the same eye as contrasted to supra ductions taken first OD, then OS----indicating the effect of residual contraction.

Off hand, I can think of little to contribute to your study that I am sure has not already been suggested. Your study should be interesting as I know of none done along this line recently.

With the very best wishes for your project, I am

Sincerely,

I.M. Borish, O.D.

IMB/sm
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Dr. Irvin M. Borish makes the following statement in his book, *Clinical Refraction*. "The vertical ductions are rarely ever taken at the far point, particularly at this point, since they will leave a residual muscular contraction which will influence the near phorias."

Dr. Borish seems to indicate that the No. 12 ductions taken in sequence will influence the No. 13B phoria finding, and, therefore, if taken, the far ductions (vertical) should be at some other point in the analytical routine.

There appears to be a need for statistical and clinical verification of the statements made by Dr. Borish as he advocates a method that is not followed at the Pacific University College of Optometry where we take the analytical findings in sequence.

**Null Hypothesis:** There is no statistically significant effect on the near phoria as a function of the placement of the No. 12 in the analytical routine.
THE EFFECT OF VERTICAL DUCTIONS
ON THE NEAR LATERAL PHORIA

METHODOLOGY

Apparatus

Standard clinical instruments were employed in taking all data for this experiment. The refractors utilized included the Bausch and Lomb Greens phoropter, the American Optical RX Master and the American Optical Double Bank. The refractors were located in standard clinical examination rooms. Near-point findings were taken at the 16" distance with the standard reduced Snellen letter chart, employing the 20/20 acuity letters. The far-point tests were taken at a distance of twenty-feet from the subject to the chart using the 20/20 standard size acuity letters as the projected row of letters.

Illumination Standards

The illumination levels in the rooms at the far testing distance and near testing distance were measured by the use of a standard light meter reading in units of foot-candles. At a distance of 16" with an illumination source of a 40-Watt bulb, the illumination at the center of the near-point card was 25 foot-candles. The room illumination for the far vertical ductions was six (6) foot-candles.
**Method for Taking Findings**

1. The patient is fixating binocularly and the No. 7A subjective is in place.

2. Number 11 far ductions are taken, followed immediately by Number 13B, at the far PD.

3. No. 13B:
   
   Conditions: (a) Hood light on reduced Snellen Chart  
   (b) Illumination of 25 foot-candles  
   (c) Prism settings: 15 BI OD and 8 BD OS  
   (d) Phoropter set for patient’s far PD

   Phraseology: "How many charts do you see? Can you read the bottom line in the top chart? Keep that line clear; when the lower chart passes beneath the top chart, say 'now.' Are the two charts overlapping?"

4. No. 12 test follows immediately after the No. 13B.

   Conditions: (a) Target - horizontal 20/20 line  
   (b) Illumination of 6 feet-candles  
   (c) Prism settings: 6 BD OS and 6 BI OD  
   (d) Put BI prism in before the BD prism

   Phraseology: "How many charts do you see? Watch the lower chart; when the two are across from one another, say 'now.'"
"How many lines do you see? When you see two lines, say 'two'; and when the two become one, say 'one'."

5. Repeat the No. 13B taken previously.

6. With the near PD in place, retake the No. 13B.

Design of Study

In order to properly test the null hypothesis and to gather data in an orderly manner, a sequence of recording and analysis of data was devised. The No. 11 was taken before the first No. 13B in order to preset the patient and more nearly approximate the normal routine.

1. The No. 13B (near lateral phoria) was recorded before the No. 12 (vertical phoria and ductions) to note the phoric value before the No. 12 was taken.

2. The No. 13B taken after the No. 12 reflected any variation present due to:
   
a. Effect of the vertical phoria and ductions.

   b. Normal variation due to repetition of a phoria.

3. The No. 13B was repeated with the near PD to determine the amount of prism measured that is due to the induced prism with the lenses in place. The amount of prism induced by the lenses was subtracted from column No. 3 in the table of data to give the adjusted No. 13B value, column No. 3'.
In the analysis of our data the differences in the following phorias are based on several assumptions.

I. Columns 1 and 2 (see data sheet) measures:
   A. The variation due to the vertical phoria.
   B. The variation due to the repetition of a phoria.
   C. The variation due to the induced prism of the lenses.

II. The difference in phorias, columns 2 and 3', measures:
   A. The variation due to the vertical phoria.
   B. The variation due to the repetition of a phoria.

III. The difference in phorias, columns 1 and 3', measures the normal variation of a phoria as a function of time when a phoria is repeated.
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<td>6x0</td>
<td>12x0</td>
<td>14x0</td>
<td>-1.8</td>
<td>12.2x0</td>
<td>+6</td>
<td>+2</td>
<td>+0.2</td>
<td>+6.2</td>
<td>36</td>
<td>0</td>
<td>38.4</td>
<td></td>
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</tr>
<tr>
<td>68.</td>
<td>-0.25</td>
<td>7x0</td>
<td>1x0</td>
<td>3x0</td>
<td>-0.1</td>
<td>3.9x0</td>
<td>-6</td>
<td>+3</td>
<td>+2.9</td>
<td>-3.1</td>
<td>36</td>
<td>8.4</td>
<td>9.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>69.</td>
<td>+0.50</td>
<td>7x0</td>
<td>4x0</td>
<td>3x0</td>
<td>+0.2</td>
<td>3.2x0</td>
<td>-3</td>
<td>-1</td>
<td>-0.8</td>
<td>-3.8</td>
<td>9</td>
<td>6</td>
<td>14.4</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>70.</td>
<td>-0.50</td>
<td>1/2s0</td>
<td>4s0</td>
<td>2s0</td>
<td>+0.2</td>
<td>2.2s0</td>
<td>-3 1/2</td>
<td>+2</td>
<td>+1.8</td>
<td>-1.7</td>
<td>12.2</td>
<td>3.2</td>
<td>2.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71.</td>
<td>PL</td>
<td>9x0</td>
<td>6x0</td>
<td>12x0</td>
<td>--</td>
<td>--</td>
<td>-1</td>
<td>+4</td>
<td>+4</td>
<td>+3</td>
<td>1</td>
<td>16</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>72.</td>
<td>PL</td>
<td>12x0</td>
<td>12x0</td>
<td>11x0</td>
<td>--</td>
<td>--</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>73.</td>
<td>PL</td>
<td>3x0</td>
<td>1x0</td>
<td>1/2x0</td>
<td>--</td>
<td>--</td>
<td>-2</td>
<td>-1/2</td>
<td>-0.5</td>
<td>-2.5</td>
<td>4</td>
<td>2</td>
<td>6.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>74.</td>
<td>PL</td>
<td>5x0</td>
<td>2x0</td>
<td>--</td>
<td>--</td>
<td>+5</td>
<td>-3</td>
<td>-3</td>
<td>+2</td>
<td>25</td>
<td>9</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>75.</td>
<td>PL</td>
<td>3x0</td>
<td>8x0</td>
<td>6x0</td>
<td>--</td>
<td>+0.5</td>
<td>-2</td>
<td>-2</td>
<td>+3</td>
<td>25</td>
<td>4</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ANALYSIS OF DATA

FORMULAS USED FOR STATISTICAL ANALYSIS OF THE DATA

1. Standard Deviation:
   \[ \bar{E}_x^2 = \bar{E}_x^2 - \frac{(\bar{E}x)^2}{n} \]

   * See note below

2. Standard Deviation of the Difference:
   \[ S_x = \sqrt{\frac{\bar{E}x^2}{n - 1}} \]

3. Estimate of Standard Deviation of the Means:
   \[ S_{\bar{x}} = \sqrt{\frac{S_x}{n}} \]

4. Standard Deviation of the Difference of the Means:
   \[ S_{\bar{D}} = \sqrt{(S_{\bar{x}})^2 + (S_{\bar{y}})^2} \]

5. Mean Value:
   \[ \bar{x} = \frac{E_x}{n} \]

6. Difference of the Means:
   \[ \bar{D} = \bar{x} - \bar{y} \]

7. "T" Score for Determinate Value of Significance:
   \[ t_{(x,y)} = \frac{D}{\frac{S_{\bar{D}}}{\bar{D}}} \]

*E = Sum indicator symbol ( )
CALCULATIONS

\[
E \bar{x} = 29.5 \text{ (Column 1-2)} \quad \text{Note: } E = \text{Sum of Values}
\]

\[
E \bar{y} = 29.5 \text{ (Column 2-3')}
\]

\[
E \bar{z} = 58.1 \text{ (Column 1-3')}
\]

\[
\bar{X} = \frac{E \bar{x}}{75} = \frac{29.5}{75} = .3935
\]

\[
\bar{Y} = \frac{E \bar{y}}{75} = \frac{29.5}{75} = .3935
\]

\[
\bar{Z} = \frac{E \bar{z}}{75} = \frac{58.1}{75} = .775
\]

I. \(x, y, \text{ and } z\) Means:

<table>
<thead>
<tr>
<th>(x) Mean (\pm 1 - 2)</th>
<th>(E) Minus Values</th>
<th>(E) Plus Values</th>
<th>Mean</th>
<th>(E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-72.0)</td>
<td>(+101.5)</td>
<td>(+.393)</td>
<td>(+29.5)</td>
<td></td>
</tr>
</tbody>
</table>

| \(y\) Mean \(\pm 2 - 3'\) | \(-43.8\)          | \(+73.3\)          | \(+.393\) | \(+29.5\) |

| \(z\) Mean \(\pm 1 - 3'\) | \(-64.3\)          | \(+122.4\)         | \(+.775\) | \(+58.1\) |

II. Standard Deviation, Experimental:

A. For Column 1 - 2: (From tables, pp. 6 - 10)

\[
EX^2 = E(1-2)^2 = 714.4
\]

\[
(EX)^2 = (E1-2)^2 = 870.25
\]

\[
Ex^2 = Ex^2 - \frac{(EX)^2}{n} = 714.4 - \frac{870.25}{75} = 702.8
\]

\[
S_x = \sqrt{\frac{Ex^2}{n-1}} = \sqrt{\frac{702.8}{74}} = \sqrt{9.497}
\]

\[
S_x = \frac{Sx}{\sqrt{n}} = \frac{9.497}{\sqrt{75}} = 3.08 \quad 0.66 = 0.356
\]
B. For Column 2-3': (From tables, pp. 6 - 10)

\[ EY^2 = E(2-3') = 307.4 \]

\[ (EY)^2 = (E2-3')^2 = 870.25 \]

\[ Ey^2 = \frac{EY^2 - (EY)^2}{n} = \frac{307.4 - 870.25}{75} = 295.8 \]

\[ Sy = \sqrt{\frac{Ey^2}{n-1}} = \sqrt{\frac{295.8}{75}} = \sqrt{4.04} = 2.01 \]

\[ S_{\bar{y}} = Sy = \frac{2.01}{\sqrt{75}} = \frac{2.01}{8.66} = .232 \]

C. For Column 1-3': (From tables, pp. 6 - 10)

\[ EZ^2 = E(1-3')^2 = 759.9 \]

\[ (EZ)^2 = (E1-3')^2 = .3376 \]

\[ Ez^2 = \frac{EZ^2 - (EZ)^2}{n} = \frac{759.9 - .3376}{75} = 759.9 - .45 = 714.9 \]

\[ Sz = \sqrt{\frac{Zz^2}{n-1}} = \sqrt{\frac{714.9}{74}} = \sqrt{9.66} \]

\[ S_{\bar{z}} = \frac{Sz}{\sqrt{n}} = \frac{9.66}{\sqrt{75}} = \frac{3.11}{8.66} = .359 \]

D. Standard Deviation of Difference of The Means: \( S_{D} \)

\[ S_{D}(\bar{X} - \bar{Y}) = \sqrt{(S_{\bar{X}})^2 + (S_{\bar{Y}})^2} = \sqrt{(.356)^2 + (.232)^2} \]

\[ = \sqrt{.127 + .0539} = \sqrt{.181} = .425 \]
\[
\frac{S}{D}(\bar{X} - \bar{Z}) = \sqrt{(S_X)^2 + (S_Z)^2} = \sqrt{(0.356)^2 + (0.359)^2} = \sqrt{0.127 + 0.1288} = \sqrt{0.2558} = 0.506
\]

\[
\frac{S}{D}(\bar{X} - \bar{Z}) = \sqrt{(S_X)^2 + (S_Y)^2} = \sqrt{(0.359)^2 + (0.232)^2} = \sqrt{0.1288 + 0.0514} = \sqrt{0.1802} = 0.425
\]

III. Difference of the Means:

\[
\bar{D}_{XY} = \bar{Y} - \bar{X} = 0.3935 - 0.3935 = 0
\]

\[
\bar{D}_{XZ} = \bar{Z} - \bar{X} = 0.775 - 0.3935 = 0.3815
\]

\[
\bar{D}_{YZ} = \bar{Z} - \bar{Y} = 0.775 - 0.3935 = 0.3815
\]

IV. "T" Scores -- Correlation Coefficient

\[
t_{XY} = \frac{\bar{D}}{S_D} = \frac{0}{0.425} = 0
\]

\[
t_{XZ} = \frac{\bar{D}}{S_D} = \frac{0.3815}{0.506} = 0.757
\]

\[
t_{YZ} = \frac{\bar{D}}{S_D} = \frac{0.3815}{0.425} = 0.902
\]
### COMPARISON OF "t" CORRELATION COEFFICIENTS

<table>
<thead>
<tr>
<th>Element</th>
<th>Calculated &quot;t&quot; Score</th>
<th>&quot;t&quot; Significance Levels With 74 Degrees of Freedom</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>.05</td>
</tr>
<tr>
<td>$t_{XY}$</td>
<td>0</td>
<td>1.994</td>
</tr>
<tr>
<td>$t_{XZ}$</td>
<td>.757</td>
<td>1.994</td>
</tr>
<tr>
<td>$t_{YZ}$</td>
<td>.902</td>
<td>1.994</td>
</tr>
</tbody>
</table>
DISCUSSION OF ANALYSIS

A. Statistical Method

The statistical question is, what is the probability of obtaining an average change of .394 prism diopters on the No. 13B lateral phoria on the basis of the null hypothesis that the vertical phoria produces no effect? The assumption is made that the values are drawn from a distribution which is genuinely normal. This is based on the theorem that -- "The means of a number of random variables tended toward normality in distribution as the number of variables increased." In relation to the above question, the implied null hypothesis is to the effect that the vertical phoria and ductions do not affect the lateral phoria at near and that any difference obtained under the two conditions is a matter of chance.

The basic method is in all cases the same for determining the significance of means and differences between means. We uniformly compute the difference in standard deviation units of a given mean or difference from some particular value implied by the null hypothesis, and find the probability of obtaining as great a value of "t" from Student's "t" distribution table.

An effort was made to determine whether the means of .393 and .775 deviates significantly from the particular value, $\sigma$, implied by the null hypothesis. The number of cases, $n$, is found as a parameter of the distribution. That $n$ occurs as a parameter means that the dis-
tribution will vary according to the number of cases. Particular
probability values, therefore, will depend upon the number of
cases making up the mean whose significance we are testing.
Our conventional statistical judgments are of three kinds: (1)
The results are not significant if the probability of obtaining
results as extreme on the basis of the null hypothesis is greater
than .05. (2) The results are significant at the 5% level if the
probability of obtaining as discrepant results is less than .05 but
greater than .01. (3) The results are significant at the 1% level
if the probability of obtaining results as discrepant is less than .01.
The number of degrees of freedom in the use we are considering is
always 1 less than the number of cases.

The probability values shown in the table of "t" approximate
closer and closer the probability values found from the table of the
normal distribution as the number of cases is increased. For values
of 60 or more the approximation is fairly good. This is an illustration
that the means of a number of random variables tend toward normality
in distribution as the number of variables increase. In determining
whether two means differ significantly, the means will usually be
some fractional value, as will the individual deviations, with attend-
ant labor in squaring each one. This labor may be shortcut by use of
a simple mathematical identity:

\[ \frac{\text{Ex}^2}{N} = \text{Ex}^2 - \left(\frac{\text{Ex}}{N}\right)^2 \]
A method was outlined for determining the significance of the difference between two means where both are based upon the same number of cases. The null hypothesis is to the effect that the taking of vertical phorias and ductions immediately prior to the taking of near lateral phorias produces no effect upon the lateral phoria. If we can find the standard deviation of this mean difference, then we can discover the probability of finding a difference as great as this by chance. We can obtain the standard deviations of the raw scores control and experimental groups.

\[ S_x = \sqrt{\frac{E_x}{n-1}} \quad S_y = \sqrt{\frac{E_y}{n-1}} \]

From these values we can obtain the standard deviation of the means of the two groups by use of the theorem: "The standard deviation of the means of samples of "n" cases drawn from a normal population with a standard deviation of \( \sigma \) is \( \sigma / \sqrt{n} \)." For example, we have: \( S_{\bar{x}} = S_x / \sqrt{n} \) and \( S_{\bar{y}} = S_y / \sqrt{n} \).

The standard deviation of the sum or difference of a number of normally distributed independent variables is equal to the square root of the sum of the squares of their standard deviations. The equation for the standard deviation of the difference between the means becomes:

\[ S_{\bar{D}} = \sqrt{S_x^2 + S_y^2} \]

The result is a mean difference and the standard deviation of this mean difference. The difference between the means \( \bar{D} \) is
given by the following identity: \( \overline{D} = \overline{Y} - \overline{X} \). The mean difference is .3814 units away from our predicted value of zero. In terms of the standard deviation of this mean difference it is \( t = \frac{\overline{D}}{S_D} = \frac{.3814}{.433} = .8825 \) standard deviation units away from zero. The probability of obtaining a change in lateral phoria as great as this by chance is then, from Student's "t" distribution, 1.994 at the 5% level and 2.648 at the 1% significance level. The probability values shown in the table are based upon the null hypothesis that no change in either direction is to be expected. Our probability values, then are already doubled, and this point is of no concern unless there is a need to test a null hypothesis specifically to the effect that no increase is caused by the vertical ductions. And in such a case, the table values are simply halved.

The distance in standard deviation units of a given mean or difference from some particular value implied by the null hypothesis is computed. Then the probability of obtaining as great a value of "t" from Student's "t" distribution is determined. Measurement data form a continuous distribution and were assumed to be normal. The true discrete frequency function may approximate the normal distribution sufficiently closely that no serious error is introduced using a technique based upon the assumption of normality.
<table>
<thead>
<tr>
<th>No.</th>
<th>Lateral Phoria</th>
<th>Age</th>
<th>Sex</th>
<th>Time</th>
<th>R. E.</th>
<th>Amp.</th>
<th>Hyper Phoria</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>14xo</td>
<td>17</td>
<td>F</td>
<td>3 p.m.</td>
<td>-1.25</td>
<td>Pre. Pres.</td>
<td>0</td>
</tr>
<tr>
<td>29</td>
<td>1/2xo</td>
<td>23</td>
<td>M</td>
<td>9 a.m.</td>
<td>PL</td>
<td>Pre. Pres.</td>
<td>0</td>
</tr>
<tr>
<td>44</td>
<td>1/2xo</td>
<td>24</td>
<td>M</td>
<td>12 p.m.</td>
<td>-2.00</td>
<td>Pre. Pres.</td>
<td>1 L. H.</td>
</tr>
<tr>
<td>40</td>
<td>2xo</td>
<td>40</td>
<td>F</td>
<td>9 a.m.</td>
<td>PL</td>
<td>Pre. Pres.</td>
<td>0</td>
</tr>
<tr>
<td>47</td>
<td>4xo</td>
<td>23</td>
<td>M</td>
<td>2 p.m.</td>
<td>-3.00</td>
<td>Pre. Pres.</td>
<td>0</td>
</tr>
<tr>
<td>52</td>
<td>2so</td>
<td>18</td>
<td>M</td>
<td>11 a.m.</td>
<td>+1.25</td>
<td>Pre. Pres.</td>
<td>2 R. H.</td>
</tr>
<tr>
<td>60</td>
<td>12xo</td>
<td>18</td>
<td>M</td>
<td>1 p.m.</td>
<td>+.75</td>
<td>Pre. Pres.</td>
<td>1/2 P.H.</td>
</tr>
<tr>
<td>67</td>
<td>6xo</td>
<td>25</td>
<td>M</td>
<td>12:05 p.m.</td>
<td>-4.50</td>
<td>Pre. Pres.</td>
<td>0</td>
</tr>
<tr>
<td>68</td>
<td>7xo</td>
<td>18</td>
<td>M</td>
<td>1 p.m.</td>
<td>-.25</td>
<td>Pre. Pres.</td>
<td>0</td>
</tr>
<tr>
<td>74</td>
<td>Ø</td>
<td>65</td>
<td>M</td>
<td></td>
<td>PL</td>
<td>Presbyope</td>
<td>0</td>
</tr>
</tbody>
</table>

B. Findings That Seemed Incongruous to General Pattern

The cases illustrated in the chart above displayed an exophoric or esophoric phoric shift of greater than four prism diopters. No definite trends were noted that would indicate a cause-effect relationship. The factor considered in order to determine if a relationship existed was high variation of lateral phorias over Exo or Eso, age, sex, time, refractive status, amplitude, vertical phoria value and vertical ductions.
GRAPHICAL RESULTS

The results are shown graphically for each subject in six relationships. Values used were rounded off to the nearest prism diopter. Plus values indicating an exo shift and minus values an eso shift.

The 1-2 graph illustrates the difference in near lateral phorias taken before vertical phoria and ductions and after. A nearly symmetrical distribution with a tailing off in both directions from zero is noted.

The 2-3' graph represents the difference in phorias taken after the vertical phoria and ductions and a second lateral phoria adjusted for induced prism when changed to the near PD. An even peaking on either side of zero with a tailing off in both directions slightly right skewed is indicated.

The 1-3' graph is a plot of the difference in phorias before the vertical phoria and duction and the adjusted lateral phoria changed to the near PD after. The majority is found on both sides of zero with a right skewed distribution.

The 1-2, 1-3' graph seems to have a positive correlation in that plus values of 1-3' are expected to be associated with plus values of 1-2 and similarly with minus values.

The 1-2, 2-3' graph and 2-3', 1-3' graph both cluster about zero with very little indication of correlation.
SCATTERGRAM RELATING COLUMNS (1-2) and (1-3) IN TABLE OF DATA
Scattergram relating columns (1-2) and (2-3) in Table
BAR GRAPH OF COLUMN (1-2) IN TABLE OF DATA SHOWING RESULTANT DIFFERENCE IN #13B PHORIA TAKEN BEFORE #12 VERTICAL PHORIA AT FAR PD COMPARED TO #13B TAKEN AFTER #12 PHORIA, STILL WITH FAR PD.
BAR GRAPH OF COLUMN (1-3') IN TABLE OF DATA SHOWING RESULTANT OF #13B TAKEN BEFORE #12 AT FAR PD COMBINED WITH #13B INCORPORATING CALCULATED PRISM ADJUSTMENT FOR CHANGE FROM FAR PD TO NEAR PD.
BAR GRAPH OF COLUMN (2-3') IN TABLE OF DATA SHOWING RESULTANT OF #13B TAKEN AFTER #12 VERTICAL PHORIA AT FAR PD COMBINED WITH #13B INCORPORATING CALCULATED PRISM ADJUSTMENT FOR CHANGE IN PD FROM FAR TO NEAR.
STATEMENT OF RESULTS

1. At the 5% level of significance there is no statistically significant variation in taking \#12 vertical phoria and ductions before or after the near lateral phorias.

2. The "t" scores computed from the data obtained were not significant at the 5% level or the 1% level when calculated with 74 degrees of freedom.

3. The greatest variation in the "t" scores is .7425 which is 1.25 less than the significance level at 5% and 1.90 less than the significance level at 1%.
CONCLUSION

In order to investigate the possible existence of a functional relationship between vertical ductions and the near lateral phoria finding, the design of this study was carefully worked out to exclude any extraneous effects. Levels of illumination and target distance were carefully measured along with the present conditions of the prism settings. Phraseology and clinical techniques were made to resemble as nearly as possible the actual conditions in the standard analytical exam in order to obtain results that could be useful in determining the adequacy of the sequence used in the standard clinical examination procedure.

The results of this study showed that there was no statistical reason to believe that the near lateral phoria tests in the standard sequence or out of standard sequence in the analytical routine will vary significantly at the .05 level of significance.

There was no evidence to uphold the conclusion that a residual muscular contraction will in some way consistently influence the near phoria findings after vertical phorias and ductions are taken.

Any influence found on the near lateral phoria findings was found to be statistically and clinically insignificant and would not appear to alter the validity of near lateral phorias taken in the standard clinical sequence.