CASUAL FIXATION DISPARITY TESTING: DIRECT COMPARISON OF THE SALADIN NEAR POINT CARD WITH AND WITHOUT FUSION CONTOURS.

by

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ABSTRACT

Background: The purpose of this study was to investigate whether the multiple fusion contours found on the Saladin Near Point Balance Card (SNPC) have an effect on the patients horizontal fixation disparity curve. *Methods:* Readings were taken from 32 young adults with best corrected near visual acuity in place resulting in 20/20 vision. A modified Thorington was used to rule out any dissociated phoria. Casual fixation disparity (FD) measurements were taken through forced vergence demands of 0, 4BI, and 4BO prism diopters simultaneously from an original SNPC and one designed to hide all distractions. *Results:* Eso fixation disparity was more evident without the multiple fusion contours when measured with 4BI prism than compared to the original SNPC. 0 and 4BO measurements revealed similar exo FD reading with both cards. *Conclusion:* The data suggests that the vergence system is less able to withstand eso prismatic stress when the multiple fusion contours are absent. Due to the flat spot in the fixation disparity curve measurements with > 4BO prism may be needed to put the system under stress to determine if the vergence system will be able to handle the stress in the exo direction.

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Introduction:

Fixation disparity (FD) is a slight misalignment of the visual axes (measured in minutes of arc) while still maintaining single binocular vision. Exact corresponding retinal points are not stimulated but fusion still occurs due to the images falling within Panum's fusional area. FD measurements can indicate stress on the fusional vergence system, can be associated with heterophoria and asthenopia, and can aid in prescribing prism.

The near fixation disparity can be measured with a number of devices, such as the Sheedy Disparometer, the Bernell unit, the Mallet unit, the Wesson Card, and the Saladin Near Point Balance Card (Saladin Card). The Sheedy Disparometer has been the instrument most commonly used to measure FD in clinical situations, but is considered to be more time consuming than the Saladin Card[1]. The Saladin Card can be used to measure both associated and dissociated phorias, therefore is clinically more efficient, and generally yields more repeatable measurement than the disparometer[2]. The purpose of this study was to investigate whether the multiple fusion contours found on the Saladin card have an effect on the patient's horizontal fixation disparity, resulting in a skewed fixation disparity curve.

Methods:

Horizontal FD readings were taken from 32 young adults, ranging in age from 19 to 38, with best corrected near visual acuity in place resulting in 20/20 vision. A Modified Thorington phoria test was given (at 40 centimeters) in straight-ahead position and reading gaze to rule out any dissociated phoria. The subject was then presented

simultaneously with a normal Saladin Card and one designed to hide all unneeded fusion contours. A single white opaque piece of construction paper was used to cover all other tests on the Saladin Card, leaving only the horizontal FD nonius lines and the Dorch words immediately above the apertures visible to ensure that all unnecessary fusion contours were removed. The subject held the cards at 40 centimeters in straight-ahead gaze and wore polarized lenses to view the vernier polarized nonius lines on both cards. The subject was advised to keep the words surrounding the polarized circles clear. A penlight was held behind the card to illuminate each circle until the subject identified the one that contained perfectly aligned vertical nonius lines. FD results were recorded from both cards as measured through forced vergence demands of 0, 4BI, and 4BO prism diopters.

Results:

Compared to the measurements taken with the original SNPC, the adjusted SNPC fixation disparity measurements were on average more eso when measured through 4BI prism (Average +0.71, Standard Deviation 2.04). While the 0 and 4BO measurements on both cards resulted in similar exo FD measurements, which can be seen in table 1.

	SNPC with Usual Fusion Contours			SNPC with Minimal Fusion Contours		
Prism	4BI	Ortho	4BO	4BI	Ortho	4BO
Mean*	+0.06	-1.26	-2.96	+0.71	-1.00	-3.00
Standard Deviation	2.45	3.38	2.68	2.04	2.16	3.26

Table 1. (* plus equals eso and minus equals exo)

Pearson correlation coefficients, r, were calculated for FD measurements comparing the original and modified cards through, 0, 4BI, and 4BO prism diopters. The data suggests reasonable correlation with r = +0.51, r = +0.76, and r = +0.76 respectively. Scatter plots detailing this information can be found in figures 1-3. A Pearson r was also

calculated for the phoria in straight-ahead and reading gaze to rule out any dissociated phoria that could affect testing results. This Pearson correlation coefficient of $r = +0.94$ suggests the phorias measured in different gazes are likely to be significantly related.

A correlation of $r = +0.33$ was found when the BI – BO change was compared. The 4 BI fixation disparity amount was subtracted from the 4 BO amount, thereby yielding a measure of the slope of the fixation disparity curve.

A paired Student's t test analysis resulted in the 4BI measurements being statistically significant with $\alpha = 0.04$ (> 95% confidence level). We are unable to conclude that there is a statistical difference using the 0 or 4BO prism diopters; these comparisons resulted in t test significance levels of $\alpha = 0.63$ and $\alpha = 1.00$ respectively. A paired t test of the BI – BO change resulted in a significance level of $\alpha = +0.27$.

Discussion:

This study was done to investigate the effects of the multiple fusion contours located on the face of the SNPC as measured casually in a clinical setting. It is important to point out that casual measurements were taken to simulate data collected in a clinical setting. Only one reading was taken under each prism stimulus.

The SNPC was modified by limiting the number of peripheral fusion contours, thus leaving the most central fusion lock (the circle forming the aperture surrounding the nonius lines) and only a few contours surrounding that polarized circle. This limits the fusional disparity stimuli to central retinal areas and to extreme peripheral areas outside of the card. Prior research by Kertesz[3] reported the effects of central and peripheral fusion lock/contour locations. He found that interactions must occur with neighboring

retinal areas in order for peripheral Panum's areas to bring the disparity to more central retinal areas[3]. Ukwade (Optom Vis Sci 2000) also showed that smaller FD measurements were obtained when using a target, such as the original SNPC, which contains both the necessary inner and also myriad peripheral fusion contours[2].

In additional to location, the size of the contours (spatial frequency) also appears to effect fixation disparity. Experiments show that the size of fusion contours effects forced vergence fixation disparity measurments in symptomatic patients but does not seem to effect that same measurement in asymptomatic patients[5]. The polarized areas on the SNPC are about 11mm in diameter and the capitalized Dorch words directly surrounding the polarized circles are 20/50 Snellen equivalent[4]. An investigation of the effect of changing these parameters is outside the scope of this study.

This study focused on asymptomatic patients. The study did show an increase in eso fixation disparity through forced vergence testing with 4BI when the SNPC was modified to have a reduced number of fusion contours. This suggests that the vergence system was less able to handle additional BI prismatic stress when fusion contours were limited. This increase of FD was not seen through forced vergence testing with 0 and 4BO prism diopters. However, the ability of a vergence system to accept greater amounts of BO prism (as shown by the flat spot on a FD curve) may suggest that our test did not induce enough exo stress on the system to investigate the effects of blocking out many of the fusion contours. Further investigation is needed to determine what would happen with greater amounts of BO prism.

Conclusion:

Under casual testing, we find that the multiple fusion contours found on the SNPC do have an effect on fixation disparity. The vergence system is less able to withstand BI prismatic stress, eso fixation disparity direction, when the number and presumably strength of the fusion contours is reduced. Measurements with > 4BO prism are needed to determine if the vergence system will be able to handle the stress in the exo direction.

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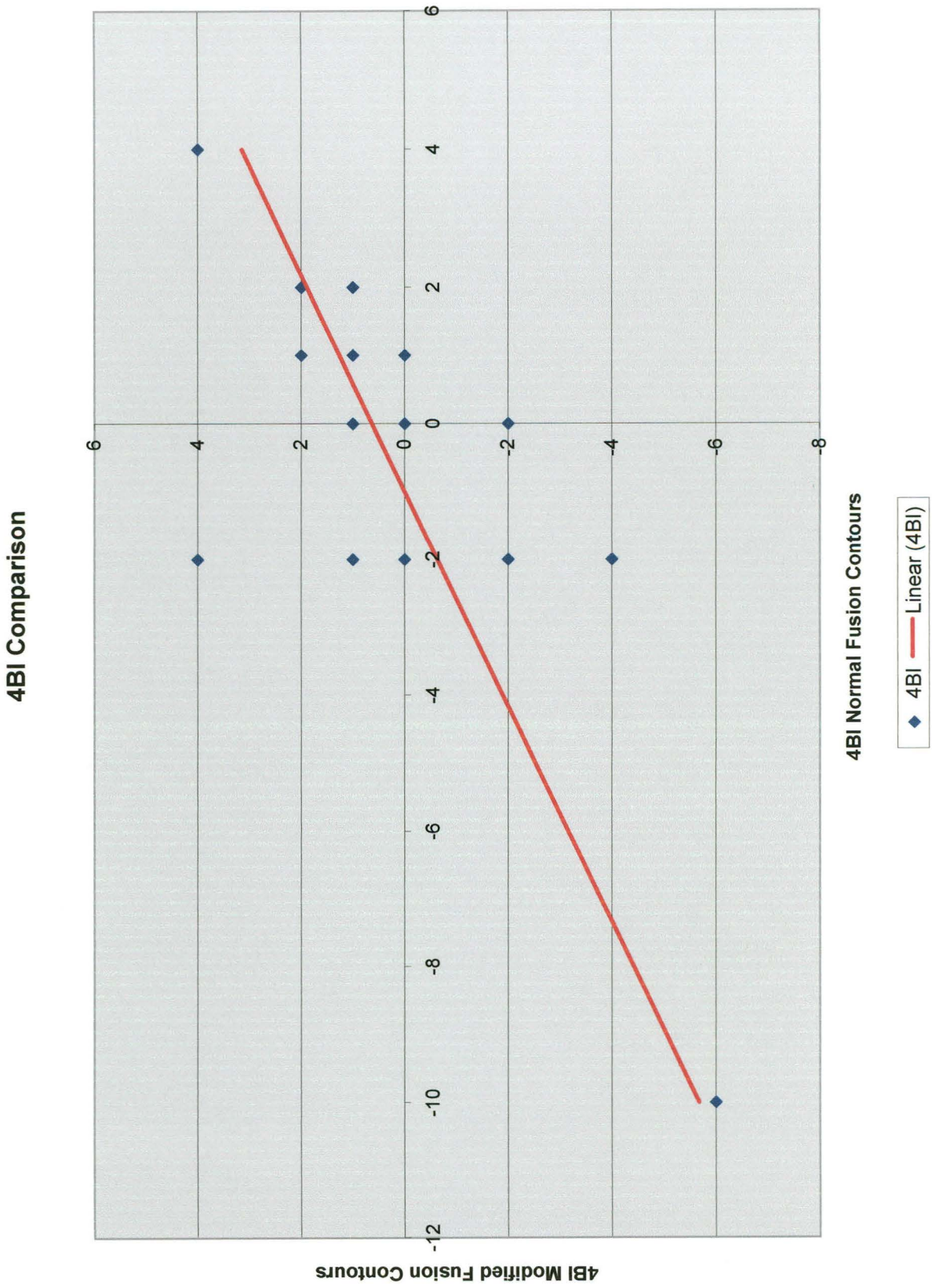
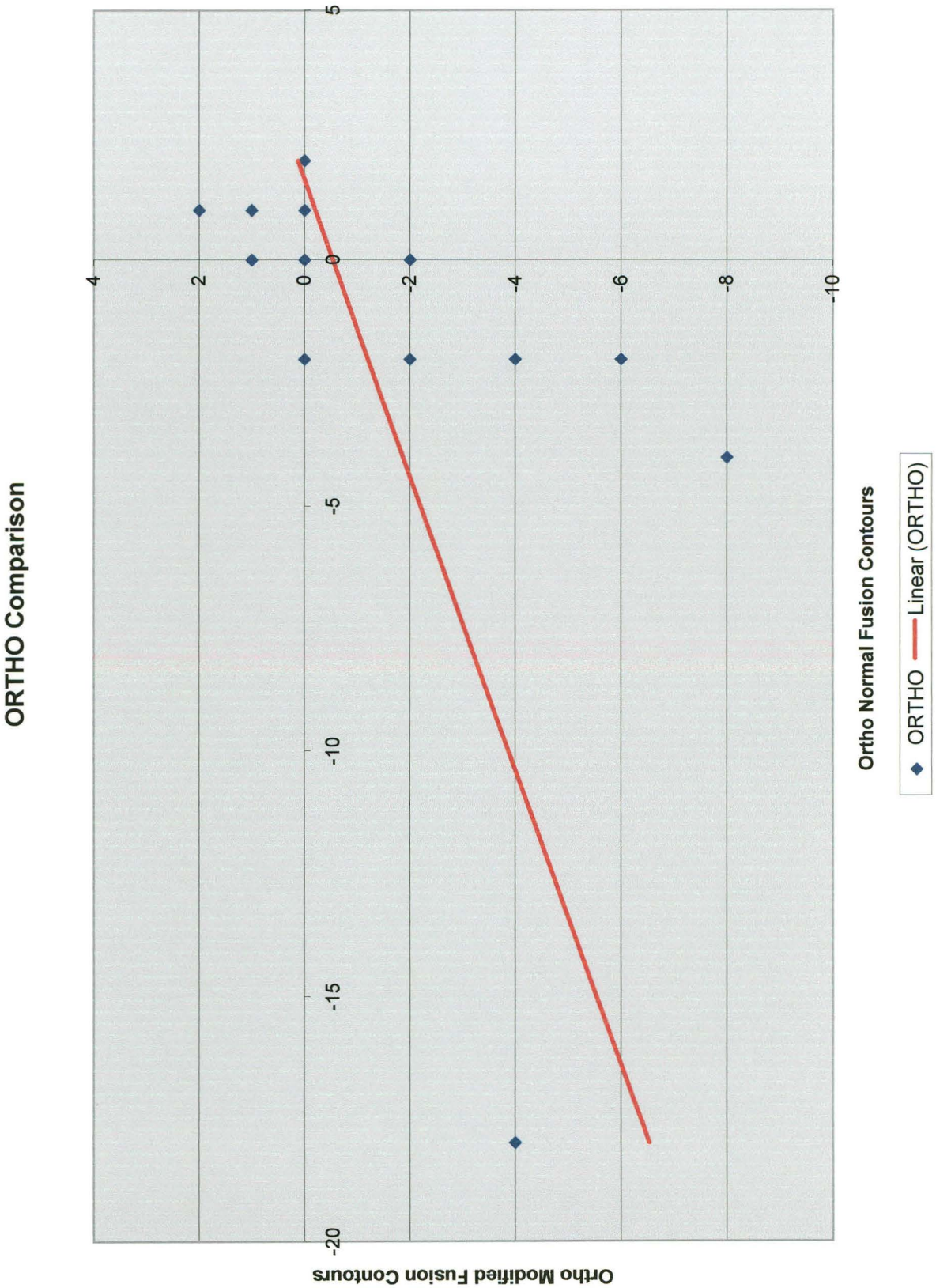
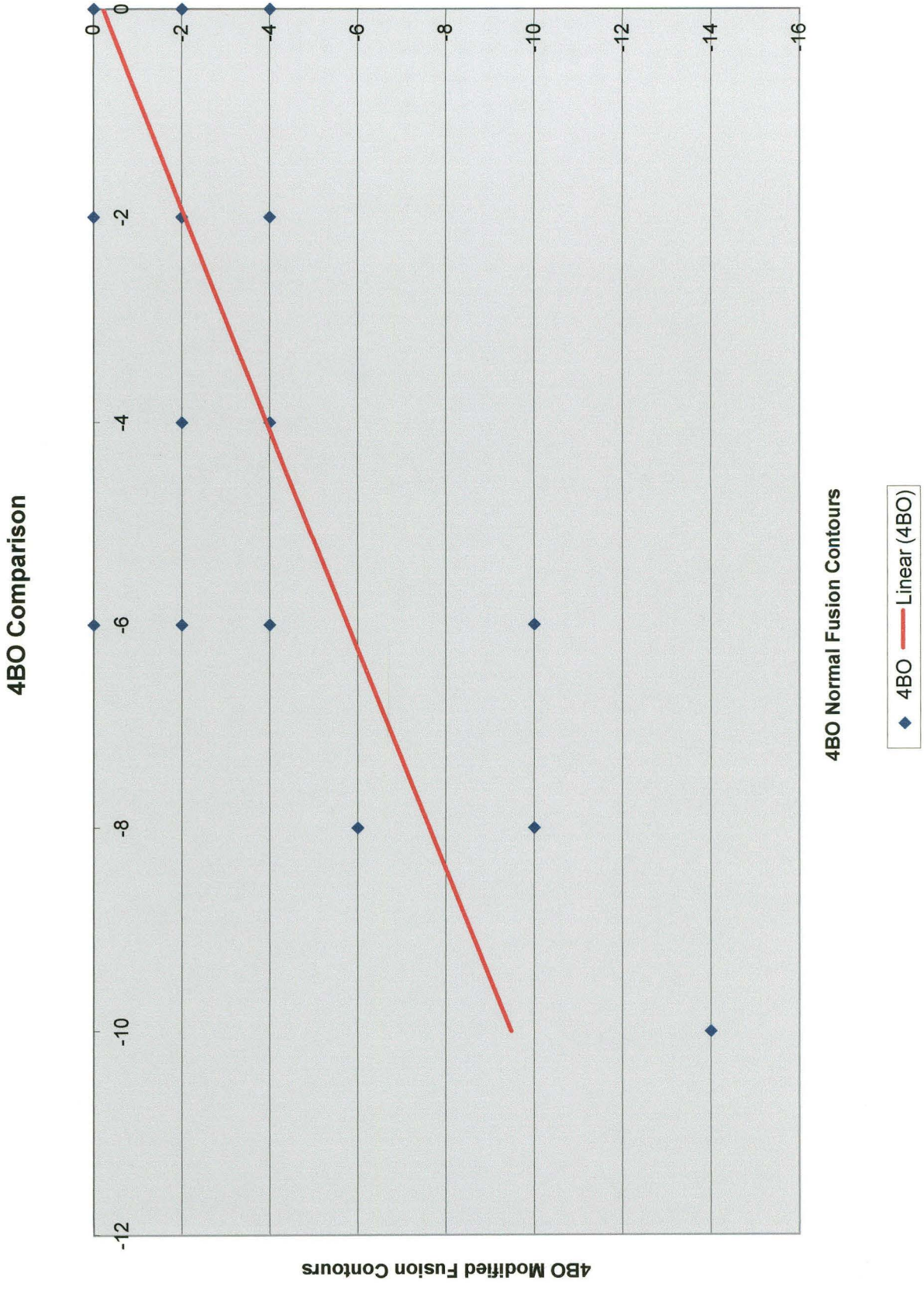
5. Saladin, JJ, Carr, LW, Fusion Lock Diameter and the Forced Vergence Fixation Disparity Curve. *Am. J. of Opt & Phys. Optics* 1983;60:933-943.


4BI Comparison
4BI Modified Fusion Contours
4BI Normal Fusion Contours
4BI
Linear (4BI)
6
4
2
0
-2
-4
-6
-8
-10
-12


ORTHO Comparison
Ortho Modified Fusion Contours
Ortho Normal Fusion Contours
ORTHO
Linear (ORTHO)
5
0
-5
-10
-15
-20
4
2
0
-2
-4
-6
-8
-10


4BO Comparison
4BO Modified Fusion Contours
4BO Normal Fusion Contours
0
-2
-4
-6
-8
-10
-12
-14
-16
4BO
Linear (4BO)