Measurement of the Expansion and Contraction Effects of Vertical Yoked Prism

Steve Kocks

Advisor- Mark Kosciuszko O.D.

April 1986

INTRODUCTION

Vertical yoked prisms (VYP) are used by some practitioners as an alternative to the classical use of base in and base out prism in the successful treatment of convergence insufficiency and convergence excess. VYP are used as an associating device in which there are equal amounts of prism with the same base direction in front of each eye.[1] The theory of using vertical prism is based upon the displacement of the visual world caused by the optical properties of the prism in which the perceived object is projected toward the apex of the prism.[2] Therefore, a person wearing VYP base down would perceive the object as being projected upward while a person wearing VYP base up would perceive the object as being projected downward.

Adaptation to the expansion and contraction effects of VYP creates a behavioral modification affecting the relationship between eye movement and body orientation.[3] According to Kaplan, since the object is peceived to be projected upward with VYP base down, the object will also be perceived as being larger and further away.[4] The apparent change in size and position forces the patient to reorganize his visual and postural systems toward a broader and more open visual perception which corrects for the convergence excess.[5] On the other hand, the object that is perceived to be projected downward with VYP base up will also be perceived as being smaller and closer than the actual object.[6] This decrease

in size and distance enables the person to "tighten up" and reorganize his/her visual and postural systems to correct for convergence insufficiency.[7]

PURPOSE

The purpose of this project is to determine if the patients actually notice the SILO effects caused by the projection properties of the VYP and how the SILO effects correlate with the treatment of convergence insufficiency and convergence excess.

PROCEDURE

There were 25 subjects tested in which 15 were males and 10 were females. The distance visual acuities of all the subjects, as measured with Snellen letters, were $^{20}/_{20}$ O.D., $^{20}/_{20}$ O.S., and $^{20}/_{20}$ O.U. Near point of convergence of all subjects, which was measured using an accommodative target consisting of reduced Snellen letters, was to the nose. The lateral phoria at distance, as determined by an alternating cover test, was between 5 exophoria and 3 esophoria with no detectable vertical component for all subjects.

The target used was a black vertical line, 10cm by 1cm, on a white background which was located 10 feet from the

seated patient. The perceptual measuring device consisted of two aluminum dowels (9mm in diameter) mounted on a board in a V-shaped pattern (see Figure 1).

The vertical dimension of the line was objectively measured by having the subject slide his/her thumb and forefinger along the V separation until the distance between the dowels matched the perceived vertical dimension of the line. The sensitivity of measurement was to the nearest 0.5cm because of the limitation of measurement caused by the size of the subjects' thumbs and forefingers. The position of the thumb and forefinger on the dowels was recorded according to the calibration on the board and the separation between the two calibrated points was mechanically measured at a later time. Baseline measurement of the perceived size of the vertical line was recorded with no lenses in place, 2^{Δ} base up VYP, and 3^{Δ} base down VYP. The numerical values of the prisms used in this project were the same values as used by Kaplan in successfully treating his patients.[8] Ten measurements were taken with each lens presentation and the average was recorded. After the initial measurements, either 3^{Δ} base down VYP or 2^{Δ} base up VYP was trial framed and placed on the subject for one hour of adaptation. After the adaptation period, the perceived size of the vertical line was measured ten times and the average was recorded. The other base direction of VYP was then trial framed and placed on the subject for the hour adaptation period and the measurements were repeated as above. The measurements that were taken

with no prism at baseline, and with 2^{Δ} base up VYP and 3^{Δ} base down VYP after the one hour adaptation were used in the following calculations and results.

RESULTS

The mean and standard deviation of the three different lens presentations for each of the 25 subjects were computed and recorded in Table 1. With the 0.5cm sensitivity of measurement taken into account, 52% (13 of 25) of the subjects objectively perceived the vertical line to be smaller than baseline (no prism) with 2^{Δ} base up VYP. 44% (11 of 25) of the subjects objectively perceived the vertical line to be larger than baseline (no prism) with 3^{Δ} base down VYP (Table 2). 28% (7 of 25) of the subjects objectively perceived the vertical line to be both smaller with 2^{Δ} base up VYP and larger with 3^{Δ} base down VYP.

44% (11 of 25) of the subjects subjectively noticed the SILO effects created by the use of the VYP. 45% (5of 11) of these subjects objectively perceived the vertical line to be smaller with 2^{Δ} base up VYP and larger with 3^{Δ} base down VYP.

CONCLUSION

The results of this project were inconsistent with the proposed expansion effects with 3^{Δ} base down VYP and the contraction effects using 2^{Δ} base up VYP. The main inconsistency was that only 52% of the subjects noticed the proposed contraction effects and 44% of the subjects perceived the proposed expansion effects. It appeared to me that if the VYP actually caused a perceived contraction or expansion effect, then the objective and subjective measurements should have been much greater than the 50% chance that was measured in this project.

Therefore, the results of this project did not support the expansion and contraction theory of using VYP to correct for convergence insufficiency and convergence excess. It appears that the direction of the VYP may not be the causitive factor, but the spatial disruption which creates a reorientation of the visual system. This spatial disruption and reorientation enables the patient to interpret visual clues more efficiently.

Figure 1

PERCEPTUAL MEASURING DEVICE

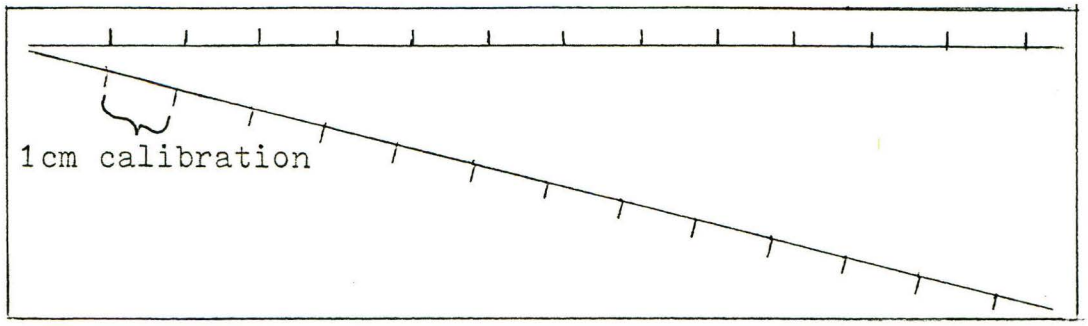

Table 1

PERCEIVED SIZE OF 10cm VERTICAL LINE

Subject No.	No Prism		2Δ Base Up		3Δ Base Down	
	Mean	S. Dev.	Mean	S. Dev.	Mean	S. Dev.
* 1	12.0cm	5.45	11.3cm	4.31	12.3cm	2.53
2	10.2	4.58	11.3	5.20	10.5	5.18
* 3	11.3	5.18	9.7	2.34	12.2	3.60
* 4	9.6	3.38	10.1	3.70	9.9	4.80
* 5	10.3	9.73	10.5	3.80	10.6	2.90
6	9.2	2.99	7.3	2.17	7.9	2.71
7	9.7	4.00	9.7	4.96	9.7	6.57
8	13.3	1.49	13.1	2.98	11.0	5.28
9	10.2	2.00	10.7	4.17	11.7	4.20
10	11.9	2.77	11.4	1.49	11.4	2.25
*11	10.8	6.48	9.0	3.67	12.4	10.70
*12	10.1	4.13	9.5	1.41	11.0	3.87
13	9.5	2.97	10.7	5.02	9.8	8.42
14	11.5	2.49	10.8	2.56	12.9	4.73
15	8.8	1.74	9.0	1.12	8.6	2.27
*16	8.9	2.64	8.4	2.10	9.6	1.63
*17	11.7	14.51	9.3	2.16	9.3	3.20
18	10.1	2.42	10.1	2.17	10.6	2.72
19	9.4	6.16	8.6	4.12	8.8	2.26
*20	10.3	2.23	10.3	1.86	11.2	2.28
*21	10.3	1.19	9.8	1.10	11.2	1.33
*22	10.4	1.29	9.8	2.30	11.4	1.41
23	8.9	2.45	8.1	2.00	8.9	2.27
24	9.9	2.26	10.2	1.32	9.5	1.87
25	8.6	1.14	9.1	0.82	9.2	2.42

* SILO subjectively noticed

Table 2

Percentage comparison of the peceived dimension of the vertical line with VYP to the baseline measurement without prism.

	% larger than perceived size with no prism	same size as with no prism (within 0.5cm)	% smaller than perceived size with no prism
2 $^{\Delta}$ BU VYP	20%	28%	52%
3 $^{\Delta}$ BD VYP	44%	36%	20%

REFERENCES

[1] Getman, Gerald. "Optometric Dialogues," Optometric Extension Program, April 1976, p. 34.

[2] Rock, Irvin. The Nature of Perceptual Adaptation, Basic Books Inc., Published New York and London, p. 107.

[3] Kaplan, Melvin. "Vertical Yoked Prisms," Optometric Extension Program, January 1979, p. 15.

[4] Kaplan, Melvin. "Vertical Yoked Prisms," Optometric Extension Program, October 1978, p. 3.

[5] Kaplan, Ibid. p. 7.

[6] Kaplan, Ibid. p. 3.

[7] Kaplan, Ibid. p. 3.

[8] Getman, Gerald. "Optometric Dialogues," Optometric Extension Program, May 1976, p. 41.