CROSSED CYLINDER ROCK:
A NEW TECHNIQUE
IN THE TRAINING OF THE ACCOMMODATIVE CONVERGENCE FUNCTION

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ABSTRACT

This paper reports on a clinical vision therapy technique to enhance the patient's ability to accommodate independently of convergence. The technique utilizes crossed cylinder lenses and a dissociating prism. The target is a crossed cylinder grid. The crossed cylinder lenses monitor the patient's accommodation and the dissociating prism monitors the patient's vergence by creating diplopia. The technique is based on biofeedback. The rationale and physical arrangement of the technique are discussed, as well as guidelines to insure patient success.

KEY WORDS

accommodative convergence, crossed cylinder, biofeedback, dissociating prism

In this paper I will report a training technique that is based on biofeedback. It enables the patient to gain control of stimulating and inhibiting accommodation independently of vergence and vice versa.

BIOFEEDBACK

Biofeedback is the monitoring of a bodily function in order to bring that function to the conscious awareness of the individual. It is this new awareness that enables the individual to alter the function. Numerous papers have been published on the use of biofeedback techniques to control physiological processes. One of the most familiar applications has been in the area of cardiac functioning. Shapiro et al[1] successfully used biofeedback to enable subjects to raise and lower blood pressure without altering heart rate. Shortly after this paper was published, another study by the same research group brought biofeedback into the clinical setting by successfully treating patients with essential hypertension.[2]

Biofeedback techniques have had various applications in other health-related areas. Kamiya et al[3] used the technique to monitor brain wave functioning. Its clinical application has been in preventing epileptic seizures. Applications range from the control of migraine headaches via body temperature to neuromuscular reeducation, which allows the patient to regain control over compromised neuromuscular systems--as with stroke victims. The most recent health care profession to utilize biofeedback techniques is otolaryngology where the distressing symptoms of temporomandibular joint dysfunction, such as tinnitus and bruxism, have been successfully alleviated.[4,5]

There have been reports on the successful application of biofeedback procedures to alter visual function. Birnbaum[6] has reviewed several of these studies. He reports on one study that demonstrated exceptional control by subjects of visual function.[7] These subjects were trained to make cyclotorsional eye movements of up to 30 degrees. When the biofeedback stimulus was removed, subjects retained the ability to voluntarily control cyclotorsion.

I propose that effective vision therapy procedures are a form of biofeedback. I view these techniques as "mirrors" which allow the patient to gain knowledge of his level of control of various visual skills. In fact, I judge the value of techniques by the relative quality of their "mirror-effect." The key element is to enhance the patient's conscious awareness of visual functioning. This is accomplished by requiring the patients to make judgments about their performance during therapy. Kraskin[8] discusses what he deems important characteristics for vision therapy procedures. He states that the technique must have a "problem to be solved" (i.e., conscious awareness) and serve as a "measuring device" (i.e., reflect performance back to the patient).

THE ACCOMMODATIVE-CONVERGENCE FUNCTION

In behavioral optometry, a bellwether of comfortable and efficient visual functioning at near is the measurement of the degree to which the patient can relax accommodation independently of conver-

gence (i.e., while convergence remains unchanged). This has been referred to as "plus acceptance."[9] Under stress, plus acceptance decreases and eventually can be lost (absorbed). The individual is then susceptible to maladaptation. Skeffington[9] wrote of the importance of plus acceptance and expressed it with a formula calculation known as the "near nets." When an individual demonstrates plus acceptance he shows that there is a neurological independence between the autonomic nervous system (accommodation) and the somatic nervous system (vergence). The degree of this independence is a measure of the integrity of the accommodative convergence synkinesis.

THE CROSSED CYLINDER ROCK TECHNIQUE

The technique is biofeedback in nature in that it brings to the patient's conscious awareness:

1. the relative amount and direction of accommodation
2. the relative amount and direction of vergence
3. the relative degree of accommodation independent of vergence
4. the relative degree of vergence independent of accommodation.

The technique is valuable because it trains the patient to control these functions in order to obtain a reasonable independence between accommodation and vergence.

The procedure requires a Correct-Eye-Scope[A] with a Van Orden Trainer.[A] (See Figure 1.)

This enables you to place the lenses in a well. A pair of crossed cylinders are required. These can be made from a trial case. In each lens well, create a crossed cylinder from two cylindrical lenses, +1.00 x 180 and -1.00 x 90 (see Figure 2).

The stimulus is a standard crossed cylinder target (a series of vertical and horizontal lines crossing at right angles). (See Figure 3.) The target should be on a transparent sheet. This can be accomplished by photocopying the standard target onto a transparency sheet used for overhead projectors. The transparent target enables the patient to look beyond the actual plane of the target in order to relax accommodation. The final component is a dissociating prism placed in the right eye well in addition to the crossed cylinder

Figure 1. Therapist with patient working on Crossed Cylinder Rock procedure. The illuminated box is the Correct-Eye-Scope and the arm is the Van Orden Trainer.

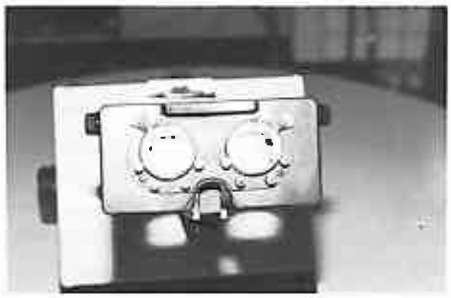

Figure 2. The lens wells of the Van Orden Trainer showing the crossed cylinder lenses in each well. Each crossed cylinder is created from two trial case cylinder lenses: +1.00 x 180 and -1.00 x 90.

already there. This is a base-down vertical prism of sufficient power to double the crossed cylinder target so that the two are completely separated. (See Figure 4.)

A prism in the range of 6Δ to 9Δ is used. The target should be 16 inches from the patient's eyes. With this arrangement, when the patient looks through the instrument at the target he should report the following:

1. two crossed cylinder targets, the top seen by the right eye and bottom seen by the left eye (the base-down dissociating prism is before the right eye).
2. the vertical or horizontal lines blacker, or equality of blackness between horizontal and vertical lines. This is dependent upon the patient's accommodative response.
3. the top target to the left, in line with, or to the right of the bottom target. This is dependent upon the patient's vergence response.

The initial instruction to the patient is "Do you feel that you can do something differently to change how things look?" Usually, the patient will readily report he can initiate a change. Then the significance of each of the possible permutations of the targets is clearly explained to the patient. First, if the patient's accom-

Figure 3. The crossed cylinder target. The target is a series of vertical and horizontal lines crossing orthogonally. The standard target is usually printed on cardboard. This target has been photocopied onto an acetate transparency to facilitate looking beyond.

Figure 4. The Van Orden Trainer showing the dissociating prism being placed before the right eye. The prism is 6 base-down.

modation is at the plane of the target, both the vertical and horizontal lines will be equally black. If accommodation is in front of the target, the vertical lines will be blacker. If accommodation is behind the target, the horizontal lines will be blacker. Second, if the patient's eyes are converged to the plane of the target, both crossed cylinder targets will be in vertical alignment. If convergence is closer than the plane of the target, the top target will appear to be to the right of the bottom target (homonymous diplopia for an eso posture), and if convergence is beyond the plane of the target, the top target will appear to be to the left of the bottom target (heteronymous diplopia for an exo posture).

The stage is now set for conscious awareness of accommodative control, vergence control, and the independence of the two. One goal is for the patient to flex accommodation (shift horizontal and vertical as blacker) without affecting the vergence system (without shifting the position of the top target relative to the bottom target). A second goal is for the patient to accomplish the reverse; flex the vergence system (move the top target to the right and left of the bottom target) without affecting the accommodative sys-

tem (without shifting horizontal or vertical lines blacker).

GAINING CONSCIOUS CONTROL

Generally, I have found that most patients gain control of accommodation with the Crossed Cylinder Rock method more quickly than standard plus/minus flipper training. They also have a better understanding of what they are trying to accomplish. The crossed cylinders allow the patient to be aware of both speed and direction of the accommodative response, while the flipper technique indicates only speed.

I have found that early myopes have a typical response: they over-accommodate at near and as a result see the vertical lines blacker than the horizontal. The value of the clear acetate target is that it allows the over-accommodating patient to look through and beyond it. When the myope is asked to look beyond the target as if "looking through a window," the horizontal lines become blacker. The myope is then told that in order for his vision to improve, he must be consciously aware of keeping his focus relaxed when working at the reading distance. The crossed cylinder technique demonstrates to these early myopes that their first response at near is to over-focus for the distance. I instruct them to apply the same feeling tone and mental set they experienced when using the crossed cylinder technique to make the horizontal lines blacker, to their habitual visual functioning at near.

If the patient cannot relax accommodation to make the horizontal blacker, he is indicating an inflexibility of accommodation. This requires an additional strategy. Physically take the crossed cylinder target in your hand and gradually move it toward the patient (see Figure 5).

As the target approaches the patient, a point is reached where the horizontal and vertical lines of the crossed cylinder target are equally black. This is the spatial plane of the patient's accommodation. At this moment have the patient move his head out of the instrument to view the target's actual location. You then explain that even though you asked him to focus back at the plane where the target initially was located, he focused at a closer distance, ie., the present target location. This gives the patient an indication of the error of his focusing ability, in the interest of gaining more conscious control. Then, while you continue to hold the target in the closer position, have the patient return to the instrument and again attempt to look beyond the target. At this position you will find most are able to make the horizontal blacker. As the patient gains better control, slowly move the target farther away until he ultimately can keep the horizontal blacker with the target in its original position.

Figure 5. The therapist has moved the crossed cylinder closer to the patient to locate the spatial plane where the patient reports equality of blackness between the vertical and horizontal lines. This marks the spatial plane of the patient's accommodative response.

Figure 6. The therapist has placed a new target between the patient and the crossed cylinder target. The new target is a thin black line drawn on a sheet of acetate. It gives the patient a concrete stimulus to attend to while he is attempting to stimulate accommodation and/or vergence.

The same principle can be applied to the eso patient. When the patient reports homonymous diplopia and cannot vertically align the targets, physically move the target closer until the patient reports alignment of the doubled targets. This marks the spatial locus of vergence. At this position, the patient will readily be able to look through the clear acetate target and thus create a heteronymous diplopia. Slowly move the target farther away, insuring that at each distance the patient can accomplish an exo posture by verging beyond the target. Ultimately move the target back to its original position.

Under-focusing and high exo patients need to learn to respectively accommodate and verge closer than the plane of the target. If they cannot do this readily on their own, you can encourage this by making another acetate target with a thin black vertical line. Place this target between the patient and the crossed cylinder target so that it provides a concrete visual stimulus (see Figure 6).

When asked to focus on the vertical line of the new target, the patient may perceive the vertical lines on the crossed cylinder target as blacker than previously, and the doubled targets in an homonymous orientation. If the vertical line on the new target does not provide a strong enough incentive, then draw other stimuli on the acetate in addition to the vertical line, such as letters, to provide a more highly discriminative demand.

I have found most exo patients over-accommodate in order to converge; vertical lines become blacker when the targets come into alignment. The Crossed Cylinder Rock Technique allows these patients to become keenly aware of this. They can then begin to internally discover new means of control in order to converge without over-accommodating. As soon as they accomplish this, they will have immediate reinforcement from the appearance of the targets; the targets will come into alignment without the vertical lines getting darker. The immediacy of reinforcement enhances the speed with which they can learn.

The key to improvement, as with all biofeedback techniques, is in making the patient aware of that which he is otherwise unaware. The reason why the Crossed Cylinder Rock Technique works is that it is like a ball on the edge of a hill. It requires only a little push and then its off and running on its own. Thus, the patient only needs to "move a little" to make the targets change in appearance (accommodation) and position (vergence). It transduces and then amplifies the patient's visual behavior. Little changes that usually go unnoticed are now noticed. The patient must then learn to associate what he is doing (how he is thinking, feeling, what he is attending to, where and how he is looking) with his visual behavior. It is this newly learned awareness that is then transferred to everyday seeing in order to ultimately change visual behavior for the better. To reinforce and facilitate this,

crossed cylinder lenses and targets can be given for home training. It is impractical to duplicate the entire physical arrangement, so the activity is done monocularly, for accommodative control only, when given as a home activity.

As more optometrists use the Crossed Cylinder Rock Technique, other applications and innovations will result.

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SOURCE

A. Available through VisionExtension, 2912 South Daimler St., Santa Ana, CA 92705.

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