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## EFFECTIVENESS OF OPTOMETRIC THERAPY FOR STRABISMUS IN A PRIVATE PRACTICE\*

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### ABSTRACT

This study is a compilation of analytical data on effective optometric treatment of strabismus patients. Available optometric knowledge and therapy can contribute to the successful handling of a great number of strabismic patients. More research in the psychophysiological aspects of strabismic behavior is needed, as is a resurgence of optometric practitioners specializing in the handling of strabismic patients.

The paucity of published results of optometric orthoptic visual training has prompted the writing of this article. Ludlam's comprehensive study of 149 strabismics<sup>1</sup> in 1961 detailed the results of orthoptic procedure, and is an outstanding piece of work. A subsequent follow-up study of Ludlam's original sample<sup>2</sup>, was reported in 1965. Seventy-six per cent of the strabismus patients given orthoptic therapy at the Optometric Center of New York between 1956 and 1960 achieved successful correction of their strabismus. This is a truly remarkable result, reflecting the excellent work done under clinical conditions. The present study is an analysis of the results achieved under the optimum conditions of private practice.

It is not the purpose of this article to duplicate the complexity of the Ludlam Study. Rather, it is our desire and intent to add our clinical experiences as an adjunct to that study. Hopefully we may induce more of our colleagues to delve into the study and practice of optometric therapy for strabismus.

Those who ascribe to a functional rationale, rather than the classical physical normative philosophy for correction of visual anomalies can not decry the value of classical orthoptic procedure. However, they should not become contained by its limitations. These limitations produced very nominal success in the past, enough to discourage many capable optometrists from entering into the specialty of visual training. The contemporary renaissance of visual training must be mediated with classical orthoptic procedure: from this will emerge a comprehensive optometric therapy for strabismus and other visual problems.

When we initiated this study we reviewed 100 consecutive cases of the

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past two years. We selected 55 completed cases out of the 100 reviewed. Forty-five patients were not selected for the following reasons:

1. Twenty-seven were still undergoing treatment.
2. Ten were accommodative esotropes who were corrected with spectacles.
3. Five were anomalous projectors.
4. Three attended no more than one month of training and either left the program of their own volition, or were discharged by us because of poor motivation or attendance.

The 55 patients included in this study had to fulfill the following criteria before entering the training program:

1. The patient had to manifest a strabismus deviation that was constant, intermittent, or periodic.
2. The manifest deviation could not be corrected with lenses. Complete accommodative tropias were not included in this study.
3. Patients who underwent prior surgical treatment for strabismus were not included.
4. Patients must not show any evidence of ocular motor paresis or paralysis.
5. Patients who indicated compensatory anomalous retinal correspondence (A.R.C.)<sup>a</sup> were excluded from this study.
6. The patient necessarily had to complete the entire course of therapy in our office.

Eighteen patients of the 55 had been told by ophthalmologists that surgery was suggested to correct the strabismus while 37 did not get a diagnosis for surgical correction.

Of this 37 patients, 21 were only seen by our office staff and never received other professional opinions.

The basis for our judgment of success in the treatment of strabismus and the consequential classification of results were based upon the stringent criteria established by Flom<sup>2</sup> and further amended by Ludlam<sup>1</sup>. A summary of the criteria for successful functional and cosmetic results follows:

"Cure" of strabismus, as adopted at the beginning of the University of California Optometry School study, were as follows: Clear, comfortable single binocular vision must be present at all distances up to the near point of convergence, which is normal itself; there must be stereopsis and normal ranges of fusion; and occasional turning of the eyes may occur (up to one per cent of the time) providing diplopia is experienced whenever this happens; correction lenses and small amounts of prism (up to five prism diopters) may be worn if necessary<sup>b</sup>.

<sup>a</sup>The Ludlam study included some patients with anomalous retinal correspondence.

<sup>b</sup>The Ludlam amendment to the aforementioned criteria is a required satisfactory binocular motility in all positions of gaze.

A second set of criteria was adopted for the category of "almost cured." In this category a patient may lack stereopsis, may exhibit strabismus with diplopia up to five per cent of the time and may need larger amounts of prism to maintain comfortable binocular vision. In all other respects the patient must meet the criteria for "functional cure."

Categories of "moderate improvement" and "slight improvement" were adopted for those patients for whom the main improvement was, respectively, in more than one, or only in one of the defects associated with the strabismus. The category of "no improvement" was adopted for those patients for whom there was no improvement in the strabismus or its associated defects.

All of our patients received the following diagnostic work-up prior to entering into a training program:

1. Refractive analysis.
2. Optometric visual training work-up.

The purpose of the optometric visual training work-up was to determine the quantity and the quality of the patient's visual behavior. The work-up consisted of the following:

1. Monocular and binocular pursuit and saccadic ability.
2. Objective and subjective angle of squint in space determined by loose prisms and monocular cover test with the patient's correction lenses in place.
3. Objective and subjective angles of squint determined with a Clement-Clarke major amblyoscope.
4. Determination of the reduced visual acuity caused by existing amblyopia.
5. Determination of the centricity of fixation and projection with a visuscope.
6. Determination of correspondence with the Bielschowsky after-image test.
7. Determination of the point of binocular centration.
8. Peripheral and central stereopsis.
9. Fusional ranges.
10. Quality of fusion—presence of suppression.
11. Amplitude and facility of accommodation.
12. Foundational motor skills
  - a. Gross motor
  - b. Fine motor
  - c. Oculor motor

Tables 1 through 9 are summaries and statistical analyses of the 55 strabismus patients.

TABLE 1  
ANALYSIS OF MAGNITUDE OF DEVIATION IN ESOTROPIA AND EXOTROPIA

Total cases .....	55
Exotropia 5-15 prism diopters .....	11
Exotropia 16-30 prism diopters .....	14
Exotropia 31+ prism diopters .....	1
Esotropia 5-15 prism diopters .....	16
Esotropia 16-30 prism diopters .....	8
Esotropia 31+ prism diopters .....	5

In our study 18.18% of the patients were amblyopic. (See Table 5.) Eight esotropes (80%) and two exotropes (20%) manifested amblyopia. Our criteria for amblyopic acuity is determined by those patients who elicited 20/40 whole line acuity or worse with the amblyopic eye providing that there was a two line acuity difference between the eyes. (As defined by the Laboratory of Amblyopia at the Optometric Center of New York.)

Those patients who achieved most successful conclusions from our therapy were intermittent or periodic tropia problems, whereas, those few failures were

TABLE 2  
DIRECTION OF DEVIATION WITH RESPECT TO AGE AND MAGNITUDE  
EXOTROPIA

Age	5-15	16-30	31+
5-9	6	7	0
10-14	3	6	0
15-19	2	1	0
20+	0	0	1

  

Age	5-15	16-30	31+
5-9	11	2	3
10-14	2	4	2
15-19	2	2	0
20+	1	0	0

TABLE 3  
RELATIVE STABILITY OF DEVIATION

	Periodic	Intermittent	Constant
Exotropia .....	1	21	4
Esotropia .....	1	2	23
Hyper exotropia .....	0	0	0
Hyper esotropia .....	0	0	3

TABLE 4  
DIRECTION OF DEVIATION WITH RESPECT TO AGE AND FAILURE TO  
ACHIEVE SUCCESS

Age	Total	Exo	Eso	Failure
5-9	29	13	16	3
10-14	17	9	8	2
15-19	7	3	4	1
20+	2	1	1	0

TABLE 5  
RESULTS OF THOSE TROPIAS MANIFESTING AMBLYOPIA

Turn	V.A.		Duration of Training (Months)	V.A. at Dismissal—	
	Whole Line	Single Letter		Whole Line	Single Letter
Rt. Esotropia	20/100	20/80-3	11	20/30	20/25
Lt. Esotropia	20/40	20/40	8	20/30	20/25
Rt. Esotropia	20/50	20/40-3	8	20/30	20/20
Lt. Esotropia	20/50	not done	11	20/20	20/20
Lt. Esotropia	20/80	20/50	8	20/30	20/25-3
Periodic Exotropia	20/40-2	20/40	7	20/20	20/20
Rt. Esotropia	20/40	20/40	4	20/30	20/30
Lt. Esotropia	20/200	20/200	10	20/40	20/30
Rt. Esotropia	20/50	20/20	11	20/20	20/20

constant tropias. (See Table 6.) A statistical analysis of the data in Table 6, using the Z factor<sup>c</sup> which was calculated to be 1.83, demonstrates that the aforementioned conclusions could happen only in five out of 100 cases by chance.

The study revealed (Table 7) that slightly better results were achieved with unilateral esotropia, but this was not significant on 0.05% level ( $Z = 1.42$ ). Therefore, no specific relative conclusion could be demonstrated.

It was found that the esotropes were not as successful (76% cure—six failures) as compared to the exotropes (100% cure) in this study. (See Table

<sup>c</sup>Z value is the test of significance of the difference of % of success<sup>4</sup>.

TABLE 6  
AN ANALYSIS OF THE RELATIVE STABILITY OF DEVIATION AND PERCENTAGE OF SUCCESS AND FAILURE

	Floam	Almost	Cosmetic	Failure
Constant .....	18	5	1	6
Intermittent .....	22	1	0	0
Periodic .....	2	0	0	0

TABLE 7  
COMPARING STABILITY OF DEVIATION TO SUCCESS OR FAILURE

	Total	Floam	Almost	Cosmetic	Failure
Unilateral	15	10	3	0	2
Eso					
Unilateral	4	4	0	0	0
Exo					
Alternating	14	7	2	1	4
Eso					
Alternating	22	21	1	0	0
Exo					

TABLE 8  
TYPE AND DIRECTION OF DEVIATION IN RELATION TO RESULT

	Total	Floam	Almost	Cosmetic	Failure
ESO	26	15	5	0	6
EXO	26	25	1	0	0
Hyper	3	2	0	1	0
Eso					
Hyper	0	0	0	0	0
Exo					

TABLE 9

Researchers	Year	a P <sub>1</sub>	b N <sub>1</sub>	c P <sub>2</sub>	d N <sub>2</sub>	Year	e Z
Hicks & Hasford	1935	16%	32	87%	55	1968	6.6
Feldman	1935	29%	87	87%	55	1968	6.79
Law	1938	30%	91	87%	55	1968	6.65
Burri	1940	22%	115	87%	55	1968	7.64
Nugent	1940	50%	81	87%	55	1968	4.49
Geller	1945	37%	63	87%	55	1968	5.55
Delus	1949	33%	63	87%	55	1968	5.96
Castanera	1951	33%	160	87%	55	1968	3.02
Douglas	1952	22%	203	87%	55	1968	8.89
Jonkers	1954	35%	91	87%	55	1968	6.67
Ludlam	1961	76%	149	87%	55	1968	1.73

a P<sub>1</sub> = % of success in other studies.

b N<sub>1</sub> = Number of patients in other studies.

c P<sub>2</sub> = % of success in author's studies

d N<sub>2</sub> = Number of patients in author's study.

e Z = Defined previously.

8.) This result analyzed on statistical basis did meet the 0.01 level of significance which demonstrates that the aforementioned results would happen only in one out of 100 cases by chance.

Utilizing Ludlam's review of the literature with respect to strabismus research, a comparison of the percentages of success reported by previous researchers was related to the percentage of success of this study. (See Table 9.) All but one of the values were above 2.33 which is greater than the 0.01 level of

confidence. A specific comparison of Ludlam's findings (76%) to the findings of this study (87%) resulted in a Z value of 1.75. This comparative result rests on a 0.05 level of confidence.

The over-all success of 87.1% of strabismic correction by using the Flom and Ludlam criteria certainly corroborates the Ludlam study. We attribute the greater percentage of success in our study to clinical conditions which were nearly optimal. The younger children in the study achieved greater success. Although those two patients over 20 years of age were successful, we feel that there were not enough patients in this category to give a true percentage of success. Periodic and intermittent tropias achieved maximum success, whereas constant tropias achieved 76.5% success. Exotropes were easier to correct, whereas esotropes took longer to work with and achieved a lesser percentage of successful functional cures (74.5%). Those patients with large deviations (greater than 30Δ) were not as successful as those patients with lesser deviations.

#### DISCUSSION

Although our study demonstrated that orthoptics is a warranted and badly needed therapy for concomitant strabismus, many areas of this problem need more research, study, and technique development. Priority must be given to the development of more comprehensive techniques to retard the onset of amblyopia and anomalous projection in strabismics under six years of age. Our techniques that exist today are valid, but they are few and lack standardization. Therefore it is necessary to develop a larger variety of techniques for these youngsters.

This priority is an immediate necessity in order to "buy time" for those pre-school youngsters who are not capable, because of their immaturity, to participate actively in optometric therapy. Perhaps with further learning and study about development of strabismic behavior we will be able to develop techniques of training and more comprehensive programs of therapy for handling children under six years of age. We feel that research in this area will reduce the time needed to correct the strabismic patient.

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