

Article

Untreated Oculomotor Dysfunction

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ABSTRACT

Background. Oculomotor dysfunction (OMD) is one of many visual anomalies that can be successfully treated with optometric vision therapy (OVT). A widely used diagnostic indicator of OMD is a low score on the Developmental Eye Movement test (DEM) Ratio.

Methods. Thirty-six subjects with OMD per a DEM Ratio standard score of 92 or lower were retested with DEM one or more years later. None of the 36 participated in OVT.

Results. Upon retest, 26 subjects (72%) failed DEM ratio again. Ten improved to pass (standard score 93 or higher.) Thirteen (36%) improved by two standard errors of measurement or more and two individuals decreased by two standard errors of measurement or more.

Conclusion. Although spontaneous improvement and normalization is possible, untreated oculomotor dysfunction is more likely to persist over time than it is to self-correct. Active optometric vision therapy should be considered as a viable treatment option in these patients.

KEY WORDS

oculomotor dysfunction, saccade, optometric vision therapy, Developmental Eye Movement Test.

Oculomotor dysfunction (OMD, also known as Ocular Motility dysfunction¹) is characterized by a deficiency in one or more of the following visual skills:

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fixation maintenance, saccadic eye movements, and pursuit eye movements.² Maples connects OMD to a problem with higher levels of neurologic function and not extraocular muscle or cranial nerve abnormalities.³ Maples further states that OMD arises as a result of developmental delay or visual stress.³ A common clinical test for OMD is the Developmental Eye Movement Test (DEM).⁴ The DEM is recommended as an appropriate oculomotor test in a widely disseminated optometric clinical practice guideline.¹ It has been shown to be reliable when administered in an office setting as part of a optometric vision therapy assessment⁵ and it is administered frequently by surveyed optometric faculty members.⁶ OMD is one of several visual conditions for which optometric vision therapy (OVT) is prescribed.^{1,7} The goal of OVT is to develop oculomotor skills so that performance during a visual task improves, e.g. keeping ones place while reading. While there is ample evidence that OMD can be effectively treated with OVT,⁷⁻⁹ there is no extant research that addresses untreated OMD and whether or not it persists over time. The present study was initiated to provide a determination as to whether or not OMD persists over time when not treated.

METHODS

Subjects

A retrospective record review was conducted in the author's optometry practice to generate the 18 female and 18 male elementary school subjects for this study. All subjects presented with a chief concern of struggling in school, and were evaluated to determine if OVT should be prescribed. The DEM is routinely administered to patients if school difficulty and/or reading concerns are noted in the case history.

Selection Criteria

Patient records were chosen from the entire set of records of patients who were assessed for OVT between January 1st 1992 and December 1st 2004. Patient

Table 1.
Sample size at each grade level

Grade	N	Grade	N
1st	1	5th	5
2nd	11	6th	2
3rd	6	7th	4
4th	5	8th	2

N=36, 18 Female and 18 Male

Table 2.
Descriptive Statistics for change in DEM standard scores upon retest

Test	Range of Ratio Scores	Mean Score	Median Score	Fail	Pass
First DEM	58-91	77.78 (+/-8.2)	77.00	36	0
Second DEM	52-106	84.75 (+/-13.3)	85.50	26	10

SCORE, Standard Score FAIL, Standard Score of 92 or lower

Table 3.
Statistical Analysis of Test and Retest Scores

Mean Change	95% Confidence Intervals	T	P
6.97 (13.39)	2.44, 11.50	3.12	0.004

examination findings were utilized for this study per the following criteria:

1. The patient was in grade one through eight upon presenting for the OVT evaluation.
2. A diagnosis of OMD was made at the initial OVT evaluation. In all cases, a low score on the DEM Ratio was one of the test results leading to a diagnosis of OMD. Specifically, a DEM Ratio raw score that converted to a standard score of 92 or lower was considered a fail and indicative of OMD. A standard score of 92, which converts to the 30th percentile, was chosen as the upper limit of fail based on the recommendation of Solan and Suchoff.¹⁰ (The DEM Examiner's Booklet does not provide a pass/fail cut off.⁴) The DEM was administered and the Ratio Score calculated per the protocols in the DEM Examiner's Booklet. Ratio raw scores were converted to standard scores using the grade tables in the Examiner's Booklet.
3. The patient did *not* participate in OVT, even though it was recommended they do so.
4. The patient returned one or more years later for another evaluation.
5. The DEM was administered again at the return evaluation. A repeat administration of the DEM is routinely done for patient's who had failed it previously.

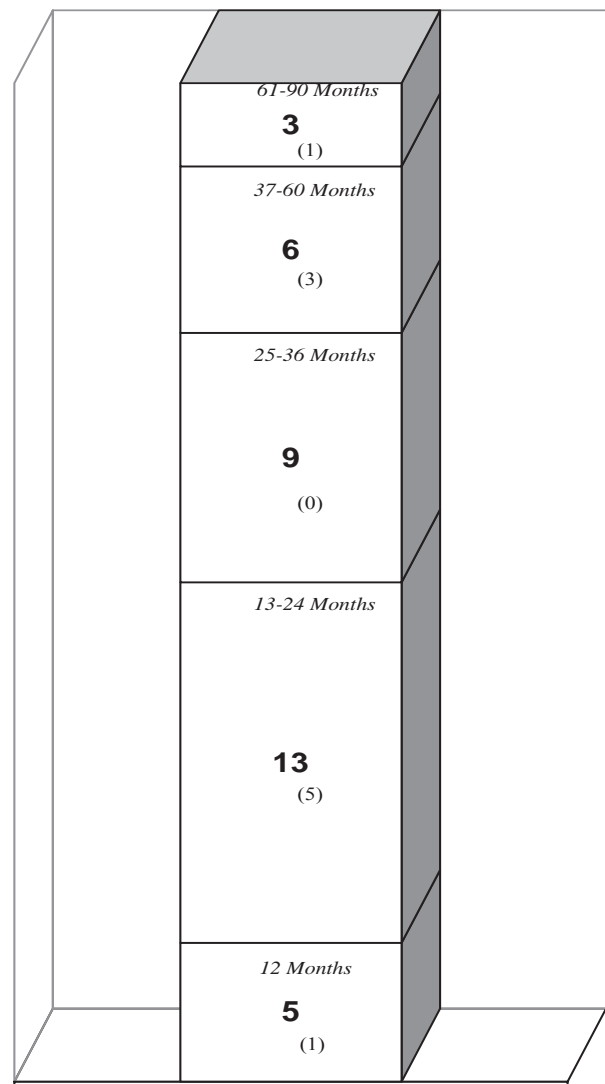


Figure 1. Number of subjects per each re-test interval. Value in parentheses is the number of subjects whose DEM Ratio score improved to pass on re-test.

RESULTS

The record review produced 18 female and 18 male subjects who met the selection criteria. The grade level of the 36 subjects at the first DEM administration is shown in Table 1. Figure 1 shows that half of the group was re-tested one to two years later. The remainder was retested 25 months to almost 8 years after the original diagnosis of OMD.

Table 2. shows a trend toward elevation of the DEM Ratio standard score upon retest. The group mean improved by seven standard score points and 28% of the subjects improved from fail to pass. The test and retest standard scores were analyzed with a one sample T test to determine if the change in score differed from zero. Table 3 shows that the scores did not significantly (P=.004) change.

Another way to analyze the change in score upon retest is to quantify the change in terms of standard error of measurement (SEM). SEM is a reasonable estimate of

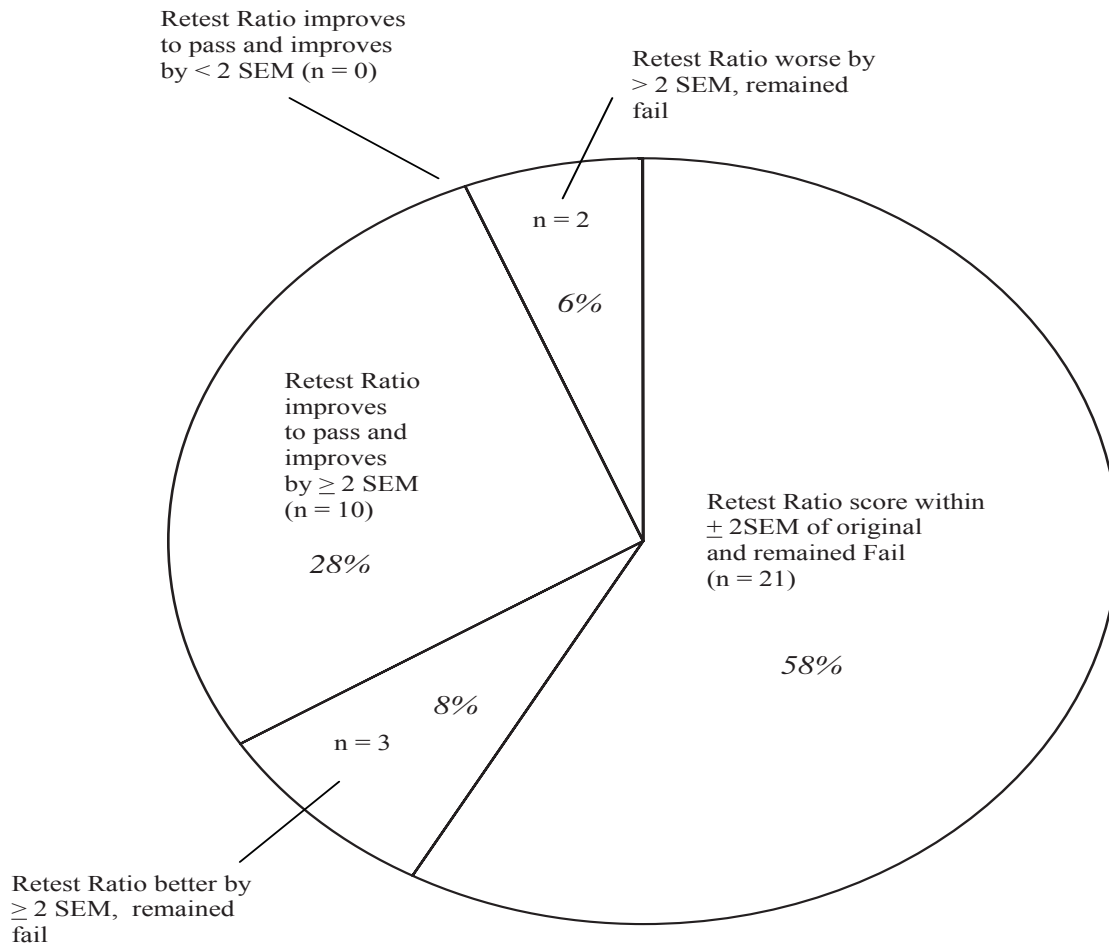


Figure 2. Descriptive outcome of change in DEM Ratio pass/fail status and standard error of measurement (SEM)

the range of fluctuation to be expected in an individual's test score.¹⁰ SEM is calculated using the equation $SEM = s\sqrt{1-r}$, where s = the standard deviation of the test and r is the correlation coefficient. Solan and Suchoff recommend that 2 SEM be used to assess a change in score as within the expected range of fluctuation or a true change.¹⁰ Using an r of 0.76 from a reliability study of office based subjects⁵ and the s (8.2) from this study, $2\ SEM = 8.0$ standard score points. Using an r of .27 from another study¹¹, $2\ SEM$ is 14.0. Averaging the 2 values yields a $2\ SEM$ value of 11. Figure 2 shows that 13 subjects improved by 2 SEM or more. There were 2 subjects whose Ratio score declined by $\geq 2\ SEM$.

The difference in Ratio standard score between the two administrations was analyzed for the influence of time interval. Figure 1 shows that six of the ten subjects who improved to normal had test/retest interval of one to two years. The other four improve-to-normal subjects had a test/retest interval of more than three years. A Pearson correlation of time interval and differences in Ratio standard was low (-0.1) and insignificant ($P = 0.60$).

DISCUSSION

OMD is a visual skill problem that is assumed to be related to difficulty keeping place while reading and other symptoms.¹ The DEM is a frequently used test for OMD. OVT is an accepted treatment for ameliorating these problems. An unanswered clinical question is the status of untreated OMD one or more years after diagnosis. The results of this study indicate that OMD per DEM ratio does not improve significantly when group performance is analyzed. There are individual exceptions who do improve from below expected to above. There are also some patients who become worse. Thus the best answer to the question, "Will OMD resolve without treatment?" is "Probably not."

The results of this study should be considered in the context of reliability. It is possible that some subjects showed change because of test score fluctuation – not better or worse oculomotor skill. A previous reliability study showed that 5% of school children with OMD will rise from fail DEM Ratio to pass DEM Ratio when retested 2-4 weeks later.⁵

This study exceeded the 5% improvement expected because of imperfect reliability. This result indicates

that there were subjects who genuinely achieved better oculomotor skills over time.

A possible limitation of this study is the single criterion (DEM Ratio) used to diagnose OMD. Many clinicians use a broader approach to diagnose OMD, which may include observational eye movement tests (NSUCO Saccade NSUCO Pursuit, etc.), Visagraph/Readalyzer results and a review of symptoms. The status of untreated OMD using an expanded diagnostic methodology may yield additional results supportive and/or conflicting with these findings. Other limitations of this study are the lack of a second examiner to administer the retest and the utilization of a retrospective study design. A retrospective study, however, permitted the long intervals between test and retest. There would be ethical considerations in a prospective study in which treatment for OMD was deliberately withheld for a period of one or more years.

CONCLUSION

Among school children with a low score on the DEM Ratio, 72% will continue to perform poorly over time if OVT is not initiated. This result indicates that the functional visual skill problem of OMD does not self-correct for the majority of affected individuals. For the minority of individuals with OMD who normalize without OVT, prompt treatment with the appropriate

therapy may shorten the time period OMD and its consequences are present.

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