

Correlation of Binocular Vision Test Results with Synaptophore Evaluation

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Abstract

TWO hundred and seventy three cases between the age of 17 to 30 years were examined for their binocular vision and convergence by the tests normally carried out during medical evaluation. These findings were compared with those obtained from synaptophore.

The results correlated well for the objective convergence and higher degrees of convergence insufficiency. However, the same did not hold good for the borderline values of subjective convergence and Maddox Rod test carried out at 33 cms.

Introduction

The importance of good ocular muscle balance in relation to flying duties has been adequately stressed in literature. There have been instances where trained aircrew have been removed from flying duties because of decompensatory heterophoria. To prevent wastage, a large number of tests are employed. However, one of the most reliable methods (Major amblyoscope) available today is the synaptophore evaluation. This, not only gives the idea about the grade of binocular vision but also +ve and -ve amplitude of fusion and stereopsis. The current standards for flying duties do not cater for synaptophore evaluation. Moreover no study has been carried out to establish

the correlation between the various tests and synaptophore. The present study was undertaken with a view to find out this and also to determine the average amplitude of fusion and stereopsis in Indian subjects.

Material and Method

The cases were selected from the Air Force Central Medical Establishment. Only the cases between 17 and 30 years of age were selected so as to exclude persons with poorer accommodations. On the first day, the cases were examined for different ocular muscle balance tests, which included the Maddox Rod and Bishop-Harman Diaphragm test.

Next day the cases were tested on synaptophore and the amplitude of fusion and stereopsis both of divergence and convergence were noted. The results obtained with different muscle balance tests were evaluated and compared to establish a relationship. A total number of 375 cases was examined.

Results

Table I gives the relationship between the subjective convergence and amplitude of fusion and stereopsis.

TABLE I

Subjective convergence (Cms)	Subjective convergence (Cms)	Convergence limits of fusion (in °)		Convergence limit of stereopsis (in °)	
		Average	Range	Average	Range
6.5—8.0	9—13	13	8—18	21	12—40
6.5—9.0	14—18	16	9—38	24	7—37
8.0—10.0	19—23	16	10—40	23	8—38
10.0 above	24—28	10	7—17	12	8—23

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The average amplitude of fusion varied between 13 and 16° and that of stereopsis between 21 and 24° for subjective convergence, varying between 9 and 23 cms. For subjective convergence values above 23 cms

a significant fall in the amplitude of fusion or stereopsis is seen.

Comparison is made between the different objective and subjective converge results and the findings are given in Table II.

TABLE II

Obj. C upto (cms)	S.C. upto (cms)	C & SC difference (cms)	Amplitude of fusion (degrees)		Amplitude of stereopsis (degrees)	
			Average	Range	Average	Range
8	18	6.1—8.0	21	8—43	29	16—48
8	18	8.1—10.0	19	10—45	29	13—50
8	18	10.1—12.0	20	7—45	31	15—47
10 above	20	12.1—14.0	21	8—41	29	12—48
"	"	14.1—15.0	20	16—25	28	21—35
"	"	16.1—18.0	13	10—20	20	11—30

TABLE III

Relationship between Maddox Rod and Synaptophore

Response on Maddox Rod Test at 33 cms.	Convergence limits of fusion (degrees)		Convergence limits of stereopsis (degrees)	
	Average	Range	Average	Range
Orthophoria	17	8 — 38	28	16 — 48
Esophoria	19	11 — 35	27	12 — 38
Exophoria 10 Δ D	16	10 — 40	23	9 — 40
Exophoria > 10 Δ D	12	8 — 35	20	8 — 40

It is seen from table III that in the case of exophoric response above 10Δ D at 33 cms, the average amplitudes both of fusion and stereopsis, tend to be lower than those in cases of other res-

ponses. This confirms the established fact that people having exophoria of more than 10Δ D cannot be considered as normal. However, upto exophoria 10Δ D no statistically significant difference was found.

TABLE IV

Relationship between Bishop—Harman Diaphragm (B.H.D.) test and Synaptophore

Response on BHD test	Convergence limits of fusion (in°)		Convergence limits of stereopsis (degrees)	
	Average	Range	Average	Range
Unocular 10	10	6—15	11	6—15
Bar 0-5	16	6—40	23	6—40
Bar 5-9	15	6—30	22	6—40
Crowding	18	6—35	24	11—40

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It is seen from the table that in the cases of unocular response the average amplitudes of both fusion and stereopsis remain low. However, with bar and crowding response the average fusion and stereopsis did not show any difference.

Discussion

The analysis of the above results shows that the objective convergence upto 24 cms is usually associated with good amplitude of fusion and stereopsis provided the objective convergence is below 10 cm. Beyond that there is an appreciable fall in the ability of fusion and stereopsis. The same holds good for the Maddox Rod findings upto exophoria of 10 Δ D when done at 33 cms, though we accept exophoria of 5 Δ D for the near as normal. Beyond 10 Δ D exophoria for near there is an appreciable fall in the ability of fusion and stereopsis but this is statistically insignificant upto 18 Δ D, beyond which it becomes significant. This conforms to the common findings that usually convergence insufficiency is associated with high degree of exophoria but it is also detected as an isolated clinical entity².

In case of Bishop-Harman test the acceptable limits are Bar or Crowding response at 5 for Air Force and 4 for Navy. However, the present study indicates that for bar response upto 2 about 10% have exophoria of more than 10 Δ D, between bar response of 3-5, 3% have exophoria more than 10 Δ D. With the bar response between 6-18, 25% have exophoria of more than 10 Δ D. Hence no correlation was established between the two tests. Even in the crowding response upto 3, 15% of the cases had exophoria of more than 10 Δ D and only in the cases of unocular response was the exophoria of more than 18 Δ D a universal finding.

Another finding which demands attention is the amplitude of fusion and stereopsis in cases with good ocular muscle balance. It ranged from 8-40° for fusion and 13 to 50° for stereopsis. According to Lyle & Wybar² most people can maintain fusion

for at least 25° of convergence and Duke-Elder¹ states that any faculty of fusion below 30° should be taken as convergence insufficiency. If this criterion is to be applied to the present study about 30% of the cases with normal muscle balance with other tests will fall into the category of poor convergence. It is difficult to explain the cause of poor convergence in those cases, when tested with the synaptophore. However, it was a universal finding that it took sometime for the subject to bring his eyes together and the findings were much better if the case was given adequate trial and explanation. It is felt that prism vergence test will be a more appropriate method to measure the convergence of a subject and the findings with prism vergence could be compared with those obtained with synaptophore.

Moreover, by testing a person only on Maddox Rod does not necessarily imply that he has good binocular vision. He may fulfill the requirement of the test, by rapid alternation, or he may have normal retinal correspondence. Contrary to this a person may have normal binocular vision when tested with synaptophore, but he may be unable to see the red line and spotlight coincidentally in any position due to ocular neglect or suppression². Hence it is of importance that both the tests should be carried out to assess the real state of binocular vision.

Acknowledgement

I wish to thank Gp Capt J. S. Sant, Officer Commanding, AF CME for the encouragement given to me to undertake the project and to Wg Cdr C. Subramanian, for constructive criticism and guidance in completing the study.

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