

Correlation of Binocular Vision test Results with Synaptophore Evaluation

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Abstract

THREE hundred and seventy five cases in the age group 17 to 30 years were examined for their binocular vision and convergence by the Bishop Harman Diaphragm Test and Maddox Rod Test. 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 decompensated heterophoria. To prevent wastage of trained pilots, a large number of tests are employed to exclude heterophoria. The most reliable method available today is synaptophore evaluation. This not only gives the idea about the grade of binocular vision but also the amplitude of fusion and stereopsis. The current standards for flying duties do not cater for synaptophore evaluation. No study has been carried out to establish a correlation between various other binocular vision tests and the synaptophore. The present study was undertaken to establish this correlation and also to determine the average amplitude of fusion and stereopsis in Indian subjects.

Material & Methods

A total of 375 cases from AFCME in the age group 17-30 years were studied. Elder patients were excluded to avoid poor accommodation cases. On the

first day, the cases were examined for different ocular muscle balance tests, which included the Maddox rod, Convergence—both objective and subjective 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.

Results

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

TABLE I

Objective convergence (cms)	Subjective convergence (cms)	Convergence limits of fusion (degrees)		Convergence limit of stereopsis (degrees)	
		Average	Range	Average	Range
6.5-8.0	9-13	13	8-18	21	12-40
6.5-9.0	14-18	16	8-38	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

The average amplitude of fusion varied between 13° to 16° and that of stereopsis between 21° to 24° for subjective convergence varying between 9 to 23 cms. For subjective convergence values above 23 cms, a significant fall in the amplitude of fusion and stereopsis is seen.

Table II gives the values of fusion and stereopsis

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comparing them with the difference between objective and subjective convergence values.

TABLE II

O. C. & S.C. (cms)	OC & SC difference (cms)	Amplitude of fusion (degrees)		Amplitude of stereopsis (degrees)		
		Average	Range	Average	Range	
<9	<18	6.1-8.0	21	8-43	29	16-48
		8.1-10.0	19	10-45	29	13-50
		10.1-12.0	20	7-45	31	15-47
>9	>18	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

It is seen that the average amplitude of fusion and stereopsis remain the same for a difference upto 16 cms when the objective convergence is less than 9 cms, beyond which there is a significant reduction in the amplitude of fusion and stereopsis.

The relationship between Maddox Rod and Synaptophore were studied and the findings are given in table III.

TABLE III

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	16-40
Esophoria	19	11-35	27	12-38
Exophoria upto 10 ΔD	16	10-40	23	9-40
Exophoria > 10 ΔD	12	8-35	20	8-40

It is seen from the above table that in the case of exophoric response above 10 ΔD at 33 cms, the average amplitudes both of fusion and stereopsis, tend to be lower than those in the cases of other responses. This confirms the established fact that people having exophoria of more than 10 ΔD cannot be considered as normal. However, upto Exophoria of 10 ΔD, no statistically significant difference was found.

The relationship between Bishop Harman Diaph-

ragm (BHD) test and Synaptophore evaluation are given in table IV.

TABLE IV

Response on B. H. D. test	Convergence limits of fusion (degrees)		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

It is seen from table IV 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 do not show any difference.

Discussion

The analysis of the above results shows that the subjective convergence upto 24cms is usually associated with good amplitude of fusion and stereopsis provided the objective convergence is below 10 cms. 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 ΔD when done at 33 cms, though we accept exophoria of 16 ΔD for the near as normal. Beyond 10 ΔD exophoria for near there is an appreciable fall in faculty of fusion and stereopsis but this is statistically insignificant upto 18 ΔD, beyond which it becomes significant. This confirms the common finding that usually convergence insufficiency is associated with high degree of exophoria but it is also detected as an isolated clinical entity (Lyle & Wybar)².

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 ΔD; between bar response of 3-5, 20% have exophoria more than 10 ΔD and the bar response between 6-18, 25% have exophoria of more than 10 ΔD. Hence no correlation was established between the two tests. Even in the crowding response upto 3, 15% of the cases had exophoria of more 10 ΔD and only in the cases of unocular response was the exophoria of more than 18 ΔD-an 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 state 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 test will fall into the category of poor convergence. It is difficult to explain the cause of poor convergence in these 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.

However, 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 abnormal 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 suppression. Hence it is of importance that both the tests should be carried out to assess the real state of binocular vision.

Conclusion

The tests for subjective convergence and synaptophore evaluation correlate well upto a convergence value of 23 cms.

The amplitude of fusion & Stereopsis remains good for objective convergence upto 10 cms beyond which there is a marked fall.

Exphoria upto 18 Δ D is associated with good amplitude of fusion and stereopsis.

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