Article • Learning Efficacy in Undergraduate Optometry Students of Binocular Vision Evaluation Techniques: A Pilot Study

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ABSTRACT

Background: This pilot study was designed to evaluate the learning efficacy in undergraduate optometry students of binocular vision evaluation techniques.

Method: Twenty students from the third-year Bachelors of Optometry program were selected. They were introduced to binocular vision procedures for the first time in the curriculum. Three procedures were selected: cover test, near point of accommodation, and near point of convergence. Initially, theory lectures for the procedures were given, which were then followed by two practical hands-on sessions of 2 hours each. Students were asked to perform the procedures on subjects. A questionnaire was constructed and face validated. A score of 1 to 10 was given to students after examining 5 subjects, 10 subjects, 15 subjects, 20 subjects, and 25 subjects.

Results: Data was analysed with Microsoft excel version 2016 and ANOVA testing was performed to determine variance. After performing the cover test on 25 subjects, students' scores ranged from 8 to 10, with a mean score of 9.56 ± 0.745. For near point of accommodation, the mean score of students after examining 25 subjects was 9.65 ± 0.745, with a range of 8 to 10. The mean score of twenty students performing near point of convergence after examining 25 subjects was 10. ANOVA testing showed that there was no statistically significant difference between the scores for the procedure. It was also found that, for all the three procedures, at least 70% was obtained by all students after examining 20 subjects.

Conclusion: Statistically, there was no significant difference found between three groups. It can be concluded that practice on a minimum of 20 subjects is needed for students to learn the binocular vision evaluation techniques.

Keywords: binocular vision evaluation techniques, cover test, learning efficacy, near point of accommodation, near point of convergence

Introduction

Binocular vision anomalies are common eye problems encountered in young adults, which eventually can affect quality of life.[1] Accommodative and non-strabismic anomalies of binocular vision are reported to be highly prevalent among school children. Convergence insufficiency has higher prevalence than other binocular anomalies.[1-4] Evaluating binocular vision anomalies is important for eye heath.[1] Thus, tests for binocular vision evaluation must be an inherent part of vision evaluation. Optometrists must be taught to perform specific tests to evaluate binocular vision anomalies.[5] As the learning capacity of each student may be different, hours of exposure to learn the task may be different. However, systematic study may show the necessary trend of required exposure. There may also be differences in the estimated exposure required for the same group of students with different teachers. Typically, optometry students get theoretical and practical exposure to binocular vision and orthoptics during the third year of their studies. In India, different optometry colleges are linked to different eye hospitals or private clinics. The hospital with

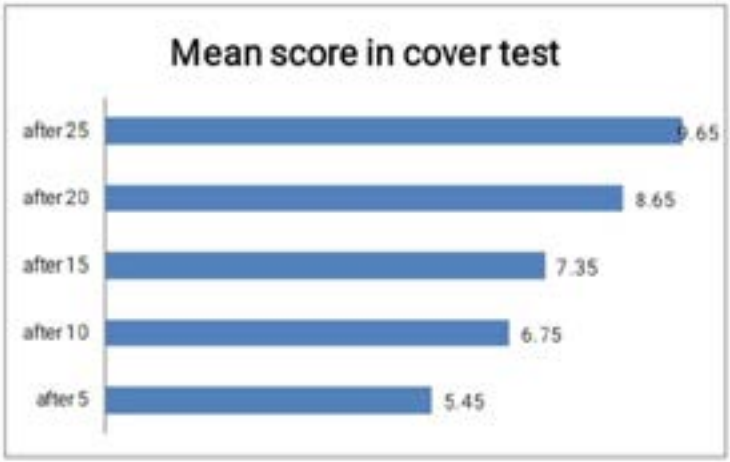

Figure 1. Mean score of students after performing cover test on 5, 10, 15, 20, and 25 subjects

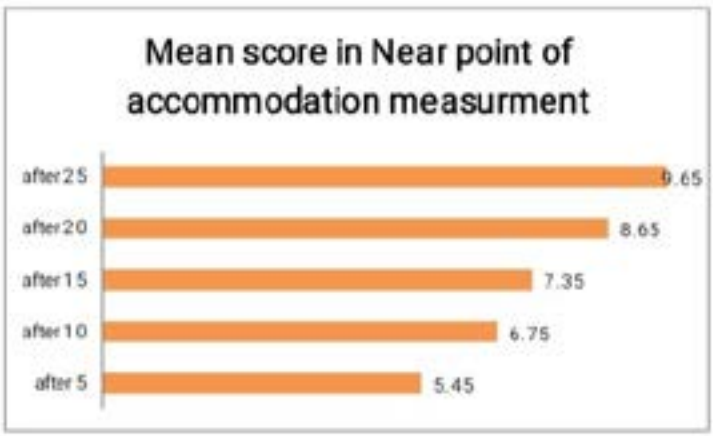

Figure 2. Mean score of students after measuring near point of accommodation of 5, 10, 15, 20, and 25 subjects

which the optometry students are linked is the place where they can practice their learning. According to the type of hospital linked, students get different exposure in the area of binocular vision. The present study was structured to find out how undergraduate students learn and practice binocular vision evaluation techniques efficiently.

Methods

Twenty third-year students were randomly selected as they were introduced to binocular vision and orthoptics for the first time. Three procedures were selected randomly: 1) cover test, 2) near point of accommodation, and 3) push-up method for near point of convergence. To assess the accommodative amplitude and vergence amplitude, the push-up method was selected as it can be easily performed with the help of a Gulden stick and a scale, as well as an RAF ruler.[6-8] Initially, the material was presented in theoretical lecture form, followed by group discussions and hands-on sessions. After the teaching sessions, students were asked to perform the procedures and

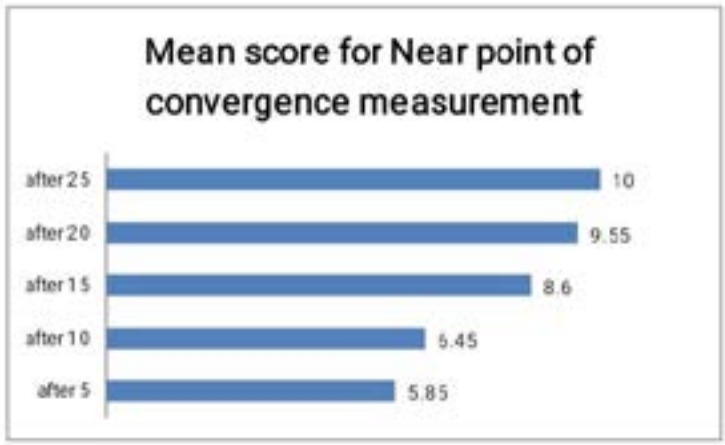

Figure 3. Mean score of students after measuring near point of convergence of 5, 10, 15, 20, and 25 subjects

interpret the findings. A questionnaire and grading protocol (see Appendix) were made and face validated, regarding how efficiently each student performed the procedure. Face validation involves experts looking at the items in the questionnaire and agreeing that they are valid measures of concepts.[9] A score of 1-10 was given to each student after examining 5 subjects, 10 subjects, 15 subjects, 20 subjects, and 25 subjects. Grading was done according to the score obtained, and data were analysed using Microsoft excel version 2016. ANOVA testing was used to determine variance.

Results

The three evaluation procedures performed were considered to be three groups:

(1) Cover test
(2) Near point of accommodation (NPA)
(3) Near point of convergence (NPC)

The score of students on cover test after doing the evaluation procedure on 5 patients was found in the range of 5 to 8, with a mean score of 5.45. Mean scores after performing cover test on 10, 15, and 20 patients were found to be 6.75, 7.35, and 8.65, respectively. After performing cover test on 25 patients, scores were found in the range of 8 to 10, with a mean score of 9.65 (Figure 1).

The score of students on near point of accommodation after 5 patients was found in the range of 5 to 8, with a mean score of 5.45. Mean scores after performing near point of accommodation on 10, 15, and 20 patients were found to be 6.75, 7.35, and 8.65, respectively. Scores were found in the range of 8 to 10, with a mean score of 9.65, after performing NPA on 25 patients (Figure 2).

The score of students on near point of convergence after 5 patients was found in the range of 5 to 7, with a

Table 1. ANOVA Test for Comparison of Mean Score of Students on Cover Test, NPA, and NPC

Summary							
Groups	Count	Sum	Average	Variance			
Group 1	20	151.8	7.59	0.97463158			
Group 2	20	151.8	7.59	0.97463158			
Group 3	20	161.8	8.09	0.38094737			
ANOVA							
Source of variation	SS	df	MS	F	P-value	F crit	
Between Groups		2	1.666666667	2.1457287	0.12633823	3.158844272	
Within Groups		57	0.776736841				
Total	47.6073333	9					

mean score of 5.85. Mean scores after performing near point of convergence on 10, 15, and 20 patients were found to be 6.45, 8.60, and 9.55, respectively. A mean score of 10 was found after the test was performed on 25 patients (Figure 3).

An ANOVA was done to compare the three groups after 25 subjects. The ANOVA result showed F = 2.1457 and F critic = 3.1558. As the F critic was more than the F value, statistically there was no significant difference among the groups (Table 1).

Discussion

Binocular vision anomalies can be detected using specific tests. Hussaindeen et al.[5] suggested a minimum test battery of three tests: namely, the near point of convergence with penlight and red filter, the difference between distance and near phoria, and monocular accommodative facility. Thus, testing accommodation is very important. Their study used accommodative facility, whereas we tested accommodative amplitude using the push-up method. They concluded that these tests yield good sensitivity and specificity for the diagnosis of non-strabismic binocular vision anomalies in a community set-up. Detection of binocular vision anomalies is very important; therefore, it is required learning for undergraduate students in their third year of optometry training. The present study determined how efficiently three tests of binocular function were learned.

The cover test group showed that a mean score of 9.65 (or near-perfect) is obtained at 25 patients. Mean score was 5.45 at only 5 subjects. The relationship of the number of subjects to the score was found to follow a linear equation y=ax+b, where a was 1.03 and b was 4.48. The score was found to increase with an increase in the number of subjects. A score of 8.65 was found at 20 patients.

The near point of accommodation group also showed that a mean of 9.65 or near-perfect score is obtained at 25 patients. The mean score for this group was also 5.45 at 5 subjects. The relationship between the number of subjects and the score followed a linear equation y=ax+b, where a was 1.03 and b was 4.48.

The near point of convergence group showed that a mean of 10, or a perfect score, is obtained at 25 patients. The mean score was 5.85 at 5 subjects. The relationship between the number of subjects and the score followed a linear equation y=ax+b, where a was 1.14 and b was 4.67.

Two theory lectures and one discussion session preceded practical sessions involving patients. This methodology was found to be acceptable, as the student's score depends on actual patient evaluations. Theory and group discussion helped with basic understanding, but actual practice was only in patient care. ANOVA was carried out to evaluate the difference found in the number of subjects needed for learning each procedure and the minimum required number of subjects for best understanding and test completion.

The ANOVA showed that there was no significant difference between the three groups, which suggests that the learning time required for each of the three was the same. For each procedure, it was found that at least a 70% score was obtained by each subject only after examining 20 patients. A near-perfect score of 9.65 or above was found after examining 25 patients. It could be extrapolated that practising these procedures on at least 20 patients is the tipping point that offers good efficiency in training with effectiveness in test completion. In terms of the number of days of posting at a specialty binocular vision clinic, at least 20 days should be mandatory for all third-year optometry students. As the number of patients at different clinics is different, at least one patient per day is required.

There was no similar study on student learning curves in binocular vision testing available. Macedo-de-Araujo et al.[10] assessed the learning curve of novel practitioners with minor previous experience in scleral contact lens fitting on irregular and regular corneas. They carried out their study on novel practitioners with minor experience, whereas the present study included third-year optometry students who were introduced to these procedures for the first time. They found that the practitioner's fitting experience reduces both the number of trial lenses required to achieve best fit and the number of reorders with time. After sixty cases, there was a significant reduction in trial lens use and reorder necessity. In the present study, for each of the procedures, increased scores were observed with increasing numbers of subjects evaluated.

Randleman et al.[11] analysed the outcomes of resident surgeon-performed phacoemulsification and assessed the learning curve. Visual outcomes and postoperative complication rates were recorded. Six hundred and eighty cases were included, and outcomes improved significantly beyond the first eighty cases. In the present study, learning efficacy was found to be increased significantly after performing the procedures on the first 20 subjects. Near-perfect scores were observed after performing the procedures on 25 subjects.

Oli et al.[12] compared the time taken by vitreoretinal surgeons and vitreoretinal fellows for glued intraocular lens surgery for various indications. Results showed that the average time taken by vitreoretinal surgeons was ninety minutes, while the time taken by vitreoretinal fellows was one hundred thirty minutes. They concluded that the procedure gives promising results and that the learning curve increases with increasing numbers of procedures done under supervision. Thus, grasping the capacity of students under study is also important, as is different IQ and different learning capacity. Effective learning will also reduce the time taken by students to perform the binocular vision evaluation procedures after completion of their training, thus helpful in actual practice.

Video coaching improving contemporary technical and non-technical ability in laparoscopic education was studied by Liao et al.[13] They compared the educational effect on technical and non-technical skills of video coaching for teaching laparoscopic procedures. They concluded that video coaching can help surgeons build their expertise. Video coaching can also shorten the learning curve and improve self-efficacy. Thus, it may be interesting to include video coaching sessions to improve learning in situations related to optometry.

The above studies show that learning efficacy increases with procedure repetition. Increasing experience by repetition reduces the time taken to perform the procedure, with improved clinical outcomes.

Conclusion

Statistically, there was no significant difference found in the number of subjects required to learn any of the three evaluation procedures. Thus, it can be extrapolated that for teaching any technique of binocular vision evaluation, a minimum of 20 practical sessions is needed. Uniformity of allotting a minimum of 20 days' posting to all third-year optometry students should be done. Ideally, all third-year students should have at least 25 practical sessions to master these procedures adequately. Development of video coaching or virtual patient examination applications may be further helpful in increasing learning efficacy.

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Appendix: Questionnaire

Cover test

1) Did the candidate inform subject the purpose of the test?
2) Did the candidate provide subject with appropriate fixation target?
3) Did the candidate perform direct cover test for distance with and without prescription?
4) Did the candidate perform cover uncover test for distance with and without prescription?
5) Did the candidate perform alternate cover test for distance with and without prescription?
6) Did the candidate perform direct cover test for near with and without prescription?
7) Did the candidate perform cover uncover test for near with and without prescription?
8) Did the candidate perform alternate cover test for near with and without prescription?
9) Did the candidate record results correctly?
10) Did the candidate demonstrate the skill satisfactory?

Near point of convergence

1) Did the candidate inform subject the purpose of the test?
2) Did the candidate instruct subject correctly?
3) Did the candidate provide appropriate fixation target?
4) Did the candidate perform test with proper refractive correction in place?
5) Did the candidate move fixation target in patient's line of sight?
6) Did the candidate measure break and recovery point from lateral canthus?
7) Was the candidate able to appreciate break point objectively?
8) Did the candidate repeat the test several times?
9) Did the candidate record results correctly ?
10) Did the candidate demonstrate skill satisfactory?

Near point of accommodation

1) Did the candidate inform subject the purpose of the test?
2) Did the subject instruct subject correctly?
3) Did the candidate provide appropriate fixation target?
4) Did the candidate perform test with appropriate refractive correction in place?
5) Did the candidate move fixation target in patient's line of sight?
6) Did the candidate measure blur and recovery point from spectacle plane?
7) Was the candidate perform test monocularly and binocularly?
8) Did the candidate repeat the test several times?
9) Did the candidate record results correctly ?
10) Did the candidate demonstrate skill satisfactory?