

**Visual Acuity amongst BDS Students in Performance of Restorative Procedures: A Cross Sectional Observational Study**

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**Abstract**

The body of evidence for using magnification devices in dentistry is weak in particular, near vision in dental working distance has rarely been tested. This might be due to the fact that the test commonly used for near vision, such as the reading type test of the British Faculty Ophthalmologists, are obviously not sensitive enough for dental purposes, and a commonly accepted visual test that would fulfill the necessary optical requirements is not available. Increased use of smart mobile devices has affected the visual acuity of students which in turn manifests on their visual performance in

clinical procedures. This study aims to introduce the need of testing visual acuity for restorative dentist and endodontist, as standard of practice and provide recommendations for clinicians on choosing a magnification suited to their needs, provide years of service and reduce the risk of eye, neck, and back strain.

**Keywords:** Back Strain, Visual Acuity, Dentistry

**Introduction**

Mobile usage and screen time is high on rise these days. According to Dubey et al about 68% of adolescents have a screen time more than 2 hours. As we spend more time

tethering & browsing there is increasing concern for visual acuity.<sup>1</sup>

Visual acuity is clarity or sharpness of vision. To maintain proper vision intraocular lens and muscles plays an important role. If anything compromises these, it affects the visual acuity.

Convergence is the ability of eyes to converge and maintain binocular vision and Accommodation is the ability of eyes to focus on an image as its distance varies. When there is any defect in eye muscles eyes cannot converge and accommodate resulting in Convergence and Accommodation Insufficiency.<sup>2, 3</sup>

Many medical professions employ magnifying equipment like loupes to increase the precision of manual labour. With its small operating field, dentistry looks bound for failure. So optical aids are recommended. The concept of amplification, on the other hand, is a myth.

In dentistry, magnification devices should be utilized as standard equipment which is relatively new. It indicates that throughout the last few decades, the use of magnification in dentistry is becoming more common.

However, there is a growing body of scientific research concerning the impact of visual acuity on dental performance. Further clinically relevant research on this aspect is required near vision discrimination tests are tests that allow for the differentiation of near vision in people.<sup>4,5</sup> Studies carried out under standardized conditions in our department may be different to the clinical situation in a given private practice where the habitual environment is individually chosen by the dentist. The aim of the present study was to evaluate the visual acuity of undergraduate students with respect to magnification devices and their age.

## Materials and Methods

The study was conducted on undergraduate students of MES Dental College and Hospital, Perinthalmanna. As the part of a cross sectional observational study Thirty BDS students were randomly selected for the purpose of the study. Our hypothesis was “excessive mobile usage causes convergence and accommodative insufficiency in turn affects the visual performance of dentists”. Questions were prepared to obtain data regarding mobile phone usage and its screen time of these students. Students selected were in the age group between 20-23 years, out of which twenty five were females and five were males.

As a baseline criterion, we divided the students based on their duration of screen time involvement. Data's were collected according to the duration of screen time at three different time intervals.

≤ 1 hour

2-3 hours

>3 hours

Screening test was conducted to assess the convergence and accommodative insufficiency among these students with a specialized equipment called Royal Air force Ruler (RAF Ruler) which was used as a parameter to test the visual acuity of pilots in Royal Air force selection campaign.



Figure 1: RAF Ruler

After collecting the details regarding their mobile phone usage, these students were asked to undergo the screening test to assess their visual acuity with RAF Ruler.

For the screening test, students were instructed to sit in a balanced / neutral posture (ISO standard 11226 ergonomics) with the following features:

1. Straight back and respect for body symmetry, avoiding rounding of back “C” shaped.
2. Forward inclination of trunk not more than 20°
3. Forward inclination of head up to 20-25°
4. Arms placed along the body, forward oriented with 10°, forearm raised up to 25° from horizontal trunk
5. Angle between thigh & shank should be 105-110° or more
6. Feet on the floor oriented forward in same plane with shank

RAF near point rule (RNPR) is used to measure near point of convergence (NPC) and near point of accommodation (NPA)

Measurement procedure for NPC – To measure the NPC, the dot on the line is the standard target. The examiner holds the ruler and gently places the cheek rest on the inferior orbital margin. The clinician asks the patient to focus on the black dot and slowly moves towards the patient’s eyes at a constant and linear rate of about 1 +/- 2cms /second.

The subjective breakpoint is indicated when the patient either reports diplopia or until the slider is stopped by the cheek rest. The recovery is noted when the student reports one target when the slide is slowly moved back. Then the NPC & NPA were calculated accordingly.



Figure 2: Assessment of CI and AI using RAF Ruler

### Evaluation and Statistical Analysis

CI: 17 /21(>3hrs screen Time)

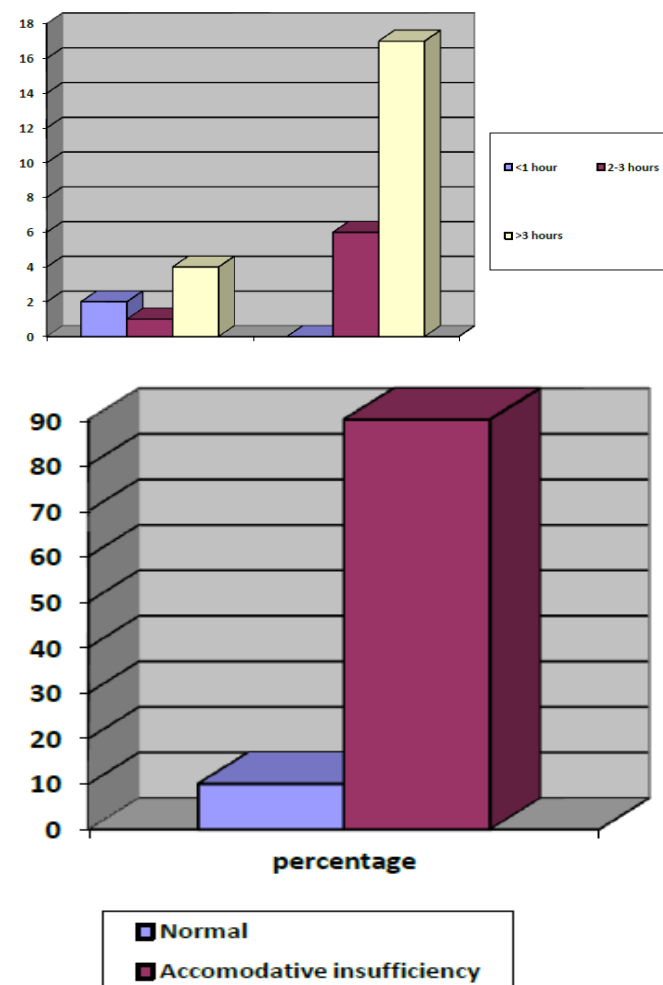
AI-21/21(>3hrs)

### TEST OF SIGNIFICANCE

#### CHI SQUARE TEST

P value –CI (>3hrs)=0.041

P Value-AI(>3hrs)=0.001



## Result

In simulated clinical conditions, visual acuity of 30 BDS students tested using Reduced Snellen Chart in BNP using Royal Air force ruler(RAF). On analyzing data it was found that 17 out of 21 students had convergence insufficiency in which the statistical values were significant with p value of 0.041 for convergence insufficiency. On analyzing data it was found that 21 out of 21 students had accommodative insufficiency in which the statistical values were significant with p value of 0.001 for accommodative insufficiency.

## Discussion

Prolonged use of digital devices like computers or smart phones can cause a condition called *computer vision syndrome*, also known as digital eye strain. This condition **affects around 50% of adults and children.**

Symptoms of digital eye strain include:

- Sore eyes
- Blurred vision
- Neck and shoulder pain
- Headaches normally, when your eyes focus on a very near object, like a pencil near your nose, they must point slightly inwards to see a unified and clear image.

Digital eyestrain often leads to dry eyes and puts an extra burden on the muscles that help the eye focus. Also, the eyes do not blink as frequently when looking at digital devices, which cause faster disruption and evaporation of the film of tears that protects the surface of the eye. With convergence insufficiency, the eyes aren't able to work in unison to point inward. Instead, one eye may point outward when trying to focus on a near object, leading to blurred or double vision. Students with convergence insufficiency may struggle to perform visually demanding near tasks like reading and homework. In fact, many students who have vision-

related learning problems are often misdiagnosed as having learning disabilities the researchers discovered that the number of hours spent in front of a screen directly correlated to the likelihood of developing digital eye strain and convergence insufficiency. More than half of the students experienced symptoms of both visual conditions, with **17% of cases being severe convergence insufficiency.** 2, 3

Accommodative Insufficiencies (AI) is a condition that affects the ability to maintain near vision focus for a prolonged time. AI has been reported to be a common cause of asthenopia and other symptoms, in schoolchildren, associated with near vision.<sup>1</sup> The inability to concentrate for long periods during near visual work can reduce the level of student achievement, so CI and AI are presented as negative factors in relation to health and quality of life, as both interfere with reading and near work, contributing to diminished performance at school. Concerning the rates of CI in general populations, several studies show different results. Among the various studies published, the data related to the prevalence of this condition range from 1.7 to 33 %.<sup>2, 3</sup> Magnification devices are widely used in many medical professions and in dentistry. Ergonomic benefits, better diagnosis and treatment planning and better quality of therapy are potential benefits of the use of magnification devices.<sup>4,5,6</sup> Although there are not many scientific evidences available to support the fact that magnification improves the performance of dentist it is obvious that good vision is crucial in dentistry.<sup>10</sup>

The newly developed near vision tests have shown that there is a high variability in the individual visual performance. Magnification devices can compensate visual deficiencies. Thus, the aim of the present study was to evaluate the visual performance of BDS students in their individual clinical setting.

Visual deficiencies can be compensated with magnification aids. It is important to differentiate between Galilean and Keplerian loupes. The lightweight Galilean loupes allow an almost straight posture and offer improved ergonomics. Younger dentists profit more from the ergonomic aspects, while dentists over the age of 40 can compensate their age-related visual deficiencies when using this type of loupe. Keplerian loupes, with their superior optical construction, improve the visual performance for dentists of all age groups.<sup>6</sup> The optical advantages come at the cost of ergonomic constraints due to the weight of these loupes. The microscope is highly superior visually and ergonomically, and it is indispensable for the visual control of endodontic treatments.

The proper use of loupes or surgical microscopes in dentistry has been included in the curriculum of BDS students over the past few years, and is also strongly promoted among dental practitioners. Thus, magnifying aids are becoming increasingly more common in dental practices.<sup>4, 5</sup> Almost everyone using loupes and microscopes is convinced that these instruments have advantages and improve both the quality and ergonomics of their clinical performance.<sup>5</sup>

For measuring the visual acuity at dental working distance, enough small vision tests are mandatory to obtain the full range of results. This is impossible using the classic near vision tests, due to the limitations of the traditional technique of letterpress printing. Therefore, one condition for valid studies on dentists' visual acuity and the influence of magnification aids is the development of miniaturized eye test-s of an adequate dimension. Burton and Bridgman minimized an eye chart through suitable lenses, thus enabling evaluation of the near vision test at dental working distance. <sup>11</sup>As mentioned, however, the clinical situation cannot be

simulated using this technique. Binocular vision measures Near Point of Convergence with RAF (Royal Air Force) rule and as stimulus a column of letters 20/30 size at 40 cm. The test was stopped at the point of consistent diplopia. Recorded to the nearest halfcentimetre (average of 3 measures). Accommodation Amplitude of accommodation with RAF rule (push up and push down) and a line of letters 20/30 size at 40 cm as stimulus. Recorded to the nearest halfcentimetre, only for the right eye, according to clinical protocols suggested in others studies.<sup>3,7,8</sup> For the push-up method, the subjects initially viewed the target at a distance of approximately 40 cm and then the target was moved slowly toward the child along the ruler. The test was stopped at the point of consistent blur, not the first blur. In the push-down method, the accommodative target was advanced toward the subject until a significant blur was produced, and then the target was pushed away until the subject could just read the letters. In simulated clinical conditions, visual acuity of 30 BDS students tested using Reduced Snellen Chart in BNP using Royal Air force ruler (RAF). On analyzing data it was found that 17 out of 21 students had convergence insufficiency in which the statistical values were significant with p value of 0.041 for convergence insufficiency. On analyzing data it was found that 21 out of 21 students had accommodative insufficiency in which the statistical values were significant with p value of 0.001 for accommodative insufficiency.

### Conclusion

Within the limitations of the study – narrow range of age group – 20-23 years, vision assessment only with screening test, even though students were affected with Convergence insufficiency & Accommodative Insufficiency due to increased screen time their visual performance while performing dental procedures were

not affected . But further studies are required to evaluate the correlation between screen time and visual performance.

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