COMPUTER VISION SYNDROME-STUDYING THE EFFECT OF GAZE STABILIZATION EXERCISE VERSUS EXTRINSIC EYE MUSCLE STRENGTHENING EXERCISE IN THE TREATMENT OF ASTHENOPIA AMONG DESKTOP USERS

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KEYWORDS

eye strain, eye muscle exercises, physiotherapy, computer users.

ABSTRACT

Aim: the aim of the present study is to find the effectiveness of gaze stabilization exercise and extrinsic eye strengthening exercise for asthenopia among desktop users.

Background: Asthenopia refers to eye discomfort or strain experienced by individuals after prolonged period of reading using digital screens or performing other visually intense activities. The prevalence of asthenopia was found to be 67.8% with blurred vision being the most reported symptom (27.0%). And other symptoms were eye fatigue, soreness, dryness, blurred vision, headache and difficulty in focusing. Untreated asthenopia can worsen over time, ignoring it might exacerbate the symptoms, impacting overall eye health leading to blurred vision or even long-time vision problems. There is dearth of literature on exercises for asthenopia, hence, the purpose of this study is to find the effectiveness of gaze stabilization exercise versus extrinsic eye strengthening exercise for asthenopia among desktop users.

METHODOLOGY:
Study design: Pre and post comparative study
Sample size: 60
Sampling method: simple random sampling method
Study design: Physiotherapy Outpatient Department, A.C.S Medical College and Hospital, Chennai-95 Study duration: 8-months, intervention period-12 weeks

RESULT: The results of the post-test statistical analysis for the Self-Administered Asthenopia Questionnaire showed that there was a significant statistical difference between groups A and B. The research is thus deemed to be statistically significant there by adopting the alternative hypothesis since Group-B (Gaze Stabilization Exercise) has a large statistical difference from Group-A (Eye Muscle Strengthening Exercise). **CONCLUSION**: This study concludes that gaze stabilization exercise shows more effective than extrinsic eye muscle strengthening exercise.

INTRODUCTION

In modern era of life the use of electronic devices (smartphone, laptop and computer) as a tool at work places, academic institutions, recreation activities and homes are very common. Computers have become part of our daily life, whether at home or at work[1]. Asthenopia refers to the group of visual discomfort symptoms such as impaired reading performance, light sensitivity, blurred vision, diplopia, and perceptual distortion[2]. Increasing rates of such complaints have been reported in various fields of work with the change of lifestyle and the spread of personal computers[3]. These asthenopia symptoms serves as a hindrance and limit personal activities and additional result in potentially speeding up the development of age-related eye disease[4]. Asthenopia is the formal diagnostic term that is nearly synonymous with the more familiar word eye strain, eye strain is very common for example, it is the most frequent symptom reported by computer users. The list of nonspecific symptoms sensations most commonly associated with asthenopia includes eyes strain, eye fatigue, burning irritating pain, ache, sore eyes and headache. Other more specific symptoms include photophobia, blur, double vision, itching, tearing, dryness, and foreign body sensation[5]. Prevalence of asthenopia (presence of at least 1 symptom) was 87.3%, the prevalence of various asthenopia symptoms varied from 85.3% (eye fatigue) to 18.7% (blurring of vision)[6]. The prevalence of asthenopia symptoms was 57% in a study conducted by Haan C et al[7.] The overuse of video terminals is also the main reason for the increase in asthenopia in recent years[8]. Asthenopia is a subjective symptomatic disease referring to a group symptom caused by various factors that make the load on human eyes when viewing objects exceed the load that their visual function can carry, resulting in visual impairment, eye discomfort or systemic symptoms after using the eyes. Asthenopia was associated with ocular complaints, eye dryness, blurred vision, eye pain, burning sensation, slower reading speed, foreign body sensation, photophobia, tears and headache[9]. Asthenopia, or eye strain, can lead to various complications including headaches, difficulty concentrating and even worsen vision. Untreated asthenopia can lead to increased discomfort, decreased productivity and may contribute to the development of other visual issues. Persistent eye strain could also be a sign of underlying vision problems that if ignored, might worsen over time. Regular eye check-ups and adopting eye-friendly practices can help to manage and prevent complications associated with asthenopia[10].

Several authors recommended the use of lubricating eye drops to relieve symptoms. These seem to help relieve symptoms of dryness, tiredness and difficulty focussing. Other treatment options are dietary supplement of either omega-3 fatty acids or blueberry extract. Many studies suggest that ergonomic practices could be important for management of digital eye strain. The widely accepted ergonomic practices include the use of appropriate lighting, careful positioning of the digital devices, adjusting image parameters (resolution, text size, contrast luminance), and taking breaks[11]. Many authors propose breaks as a management strategy. However, Reddy et al, found that breaks alone were not associated with reduced symptoms, whereas looking at far off objects during breaks was the 20/20/20 strategy. Subjects were asked to fill a self-administered anonymous questionnaire that inquired about demographic use of digital devices, symptoms of asthenopia, possible risk factors and protective measures[12]. Extrinsic eye muscle strengthening exercise –swinging -when the eyes shift slowly or rapidly from one point to another of the object, the stationary object appears to move in the direction opposite to the movement of the head and eyes. Apparent movement of the subject is called swing.

Types of swinging: - long and short swing, sky swing, universal swing, circular swing, memory swing, variable swing, forehead swing, baby swing, football swing, orbital swing.

Shifting -moving the eyes from one point to another is called shifting. If you look at 'C' on the chart and then see another letter, it meant you are shifting your eyes from one point to another, shifting may be done from side-to-side, from above to downwards, or in any other direction, horizontal shifting is done more often than others form of shifting. Remember while shifting one should not move the eye balls but the eyes should move with the chin and gentle blinking. Gaze stabilization exercise: The gaze stabilization group perform vestibular adaptation and substitution exercises designed to improve gaze stability[13]. Adaptation exercises required the individual to fixate on a visual target during either horizontal or vertical head movement substitution exercises are designed to forte

the use of other eye movement strategies to substitute for loss of vestibular function and maintain visual fixation. Substitution exercises require the individual to perform eye - head movements between target with the goal of seeing clearly during those tasks. Total time for eye movement exercise did exceed 30 minutes per day[14]. Untreated asthenopia can lead to prolonged vision problems, blurry vision, persistent discomfort, headache decreasing productivity, and difficulties in performing task that requires visual concentration. Ignoring it might exacerbate the symptoms, impacting overall eye health and potentially leading to more severe issues like blurred vision or even long-term vision problems[15].

METHODOLOGY

STUDY DESIGN: experimental study
STUDY TYPE: pre and post comparative type
STUDY SETTING: ACS medical College and hospital outpatient department physiotherapy.
STUDY SAMPLE METHOD: simple random sampling method
SAMPLE SIZE: 60
STUDY DURATION: 8 months, intervention period (12 weeks)
INCLUSION CRITERIA:
•Age group between 20-35 years
•Both the sexes
• Using digital screens for more than 4 hours a day
•Eye pain and discomfort
•Headache
EXCLUSION CRITERIA
•Myopia
•Hyperopia
•Cataracts
•Conjunctivitis
•Migraines
• Eye muscle problems
•Presbyopia
MATERIALS USED:
•"X" card
•Chair
•Pen
OUTCOME MEASURE:
Questionnaire for Asthenopia symptoms
It contains 20 questions, scores above 40 were included.

DATA COLLECTION:

60 subjects who were fulfilling the inclusion criteria were selected. 60 subjects were divided into 2 groups (group A, group B) each consisting of 30 subjects. Group A received gaze stabilization exercise and group B received extrinsic eye strengthening exercise for 12 weeks.

FREQUENCY:-

12 weeks, 7 times per week, 1 session per day, 40 minutes per session.

Group A-

Shifting:

Focus shifting -

The subjects were asked to sit and hold their thumb about 10 inches from their face and focus on it. Then, the subjects were asked to shift focus to an object 10-20 feet away like a wall clock, and hold the focus for a few seconds before shifting back to their thumb.

FIG 1: focus shiftingNear far shifting-

A small object like a pen, was held in front of the subjects' face and then slowly moving it away from subjects' face, asking the subject to keep eyes focused on the pen.

FIG 2: Near far shifting

Swinging

When the eyes shift slowly or rapidly from one point to another of the object, the stationary object appears to move in the direction opposite to the movement of the head and eyes. Apparent movement of the subject is called swing.

Types of swinging:

-long and short swing

-sky swing

-universal swing

-circular Swing

-memory swing

-variable swing

-forehead swing

-baby Swing

-football swing

-orbital swing

Group B:-gaze stabilization exercise

The subjects were asked to sit with their arm outstretched in front of them, holding the target 'x' card, and to slowly begin sweeping their arm to the left and right while focusing on the target 'x'. Subjects were instructed to continue for 1-2 minutes, stop and wait for symptoms to pass, while repeating moving the head up and down in the opposite direction of the target 'x', continuing for 1-2 minutes.

FIG 3: Gaze stabilization exercise

Orbicularis Oculi Strengthening Exercise

1. The lid squeeze
2. Surprise exercise
3. Look around
4. The partial wink

The lid squeeze :

The subjects were asked to sit or stand with their feet about shoulder - width apart. Instructed them to close their eyes and place the heels of their hands over their eyes and pressed against their forehead. Then, instructed them to inhale and tightly squeeze their eyes closed as hard as they can while feeling eyelids working to overcome the resistance of their hands and to hold for five seconds and relax. Then they were asked to repeat this for 15-30 times.

FIG 4 : The lid squeeze

Surprise exercise :

The subjects were asked to sit in a comfortable chair with their feet together and their shoulders in neutral position. Then, they were instructed to raise their eyebrows and eyelids, far as if they were trying to touch the top of their head with their eyelids and eyebrows. Asked them to repeat it for 15-30 times.

Look around :

The subjects were asked to sit or stand and look up as far as they can while keeping their heads as still as possible and hold this position for 5 seconds Then, to look down as far as they can without moving their head and hold this position for 5 seconds and repeat while looking first to the left, then to the right. Asked them to repeat it for 15-30 times.

The partial wink:

The subjects were asked to sit or stand comfortably and then to do partial winking of one eye at a time and holding the position for 5 second. Asked them not to close their eyes. Ask them to repeat it for 15-30 times.

FIG 5 : The partial wink

Trapezius Strengthening Exercise

- The shoulder blade squeeze
- Shrug
- Push up
- Upright row

• The shoulder blade squeeze

The subjects were asked to stand in good posture and slowly squeeze the shoulder blades together and hold for 5 seconds. Then, asked them to release the shoulder blades back to their relaxed positions. Instructed them to repeat it for 15-30 times.

• Shrug

The subjects were asked to stand in a good posture and raise their shoulder as high as they can get them, as if attempting to touch their ears with their relaxed positions and hold for 5 seconds. Then, asked them to release back to their relaxed positions. Instructed them to repeat it for 15-30 times.

• Push up

The subjects were asked to put their hands flat on the floor or the wall. Then, asked them to lower their body toward their hands while keeping their back straight and their stomach tight and they do not let their head drop; keeping their neck in line with the rest of their spine. Asked them to lower their body until they were close to the floor or the wall, and then push back into an upright position. Asked them to inhale as they go down and exhale as they push up. Instructed them to repeat it for 15-30 times.

- Upright row

The subjects were instructed to stand up straight with their fists clenched, pull up their fists as high as they can while bending their elbows, keeping their hands close to the front of their body. Then, asked them to hold it for 5 seconds and to release their arms back into a relaxed position, fists still clenched. Instructed them to repeat it for 15- 30 times.

DATA ANALYSIS:

The collected data were tabulated and analyzed using both descriptive and inferential statistics. All the parameters were assessed using statistical package for social science (SPSS) version 24, with a significance level of p value less than 0.05 and a 95% confidence interval set for all analysis. The Shapiro Wilk test was used to determine the normality of the data at $P > 0.05$. In this study, The Self-Administered Asthenopia Questionnaire typically collects subjective data on fatigue or asthenia levels, which are usually rated on a scale. This kind of data is inherently ordinal, as it represents ordered categories without assuming equal intervals between them. Given these characteristics, the data from a Self-Administered Asthenopia Questionnaire is generally considered non-parametric. This is because nonparametric methods do not assume a normal distribution and are suitable for ordinal data, making them appropriate for analyzing subjective questionnaire responses. Hence non parametric test was adopted into Self-Administered Asthenopia Questionnaire score. Wilcoxon signed rank test was adopted to find the statistical difference within the groups & Mann–Whitney U test was adopted to find statistical difference between the groups. The P value with two tails is less than 0.001. This difference is deemed to be very statistically significant by traditional standards.

STATISTICAL ANALYSIS:

Data was entered in MS excel and analysed using SPSS version 24.

RESULTS:

A statistically significant difference between Group A and Group B, as well as within each group, was found by statistical analysis of the quantitative data. In Group-A pre intervention mean to Self-Administered Asthenopia Questionnaire was 52.43($\pm$6.23). After treating the subject with Eye Muscle Strengthening Exercise, the mean value of Self-Administered Asthenopia Questionnaire was 45.8($\pm$6.59), which show statistically significant difference within the groups. In Group-B pre intervention mean to Self-Administered Asthenopia Questionnaire was 51.33($\pm$8.25). After treating the subject with Gaze Stabilization Exercise, the mean value of Self-Administered Asthenopia Questionnaire was 41.57($\pm$8.05), showing statistically significant difference within the groups.

The results of the post-test statistical analysis for the Self-Administered Asthenopia Questionnaire showed that there was a significant statistical difference between groups A and B. The research is thus deemed to be statistically significant there by adopting the alternative hypothesis since Group-B (Gaze Stabilization Exercise) has a large statistical difference from Group-A (Eye Muscle Strengthening Exercise).

DISCUSSION

Computers have become very important in people's lives throughout the world which increased the number of patients with ocular complaints. Asthenopia may be defined as pain and fatigue of the eyes, uncorrected defects of vision, or imbalance of eye muscles, most of the Asthenopia belongs to accommodative Asthenopia due to errors of refraction and excessive contraction of the ciliary muscle.

The current study aimed to evaluate the effectiveness of gaze stabilization exercise versus extrinsic eye muscle strengthening exercises for Asthenopia among desktop workers. This study was conducted by including the subjects with Asthenopia for about 80 participants by filling the self-administered asthenopia questionnaire. From those 80 participants, s ubjects (n=12) were excluded as we were unable to contact them, subjects(n=6) were not willing to participate, subjects (n=2) had a fear of doing exercises. The included 60 subjects were divided into 2 groups (Group A & Group B) 30 subjects, received extrinsic eye muscle strengthening exercises (shifting Focus shifting, near far shifting) and other 30 subjects, received gaze stabilization exercise (gaze stabilization exercise, orbicularis oculi strengthening exercises, trapezius strengthening exercises. Frequency (12 weeks,7 times per week, 1 session per day 40 minute per session. There data were collected and analyzed. 56% of the participants were male and remaining 43% were female, head ache, eye pain, blurred vision were the most commonly reported symptoms by 80% of the participants. Thus, the result of this study reveals that there is significant improvement in reducing the symptoms and intensity of pain by gaze stabilization exercises and strengthening exercises.

Loyd et al , in October 2020 concluded that wearable IMUS were used to examine the kinematics of head movements during rehabilitation treatment as hypothesized ,such finding may provide a support for the utility of IMUS as a means to measure persons head kinematics during gaze stabilization exercise.[16]

Ruzhi Deng et al , January 2019 concluded that The AQ-19 questionnaire has the potential to be used in clinical trials and outcome research, and most importantly to help clinicians efficiently and effectively diagnose the cause of a patient's asthenopia.[17]

Pradeep. K kurunhikattil et al, 2017 concluded that eye exercises improve the performance of muscular and motor activities of the eyes from the statistical analysis it was found that this eye exercises and neck exercises is very effective in reducing eye strain and neck pain etc.[18]

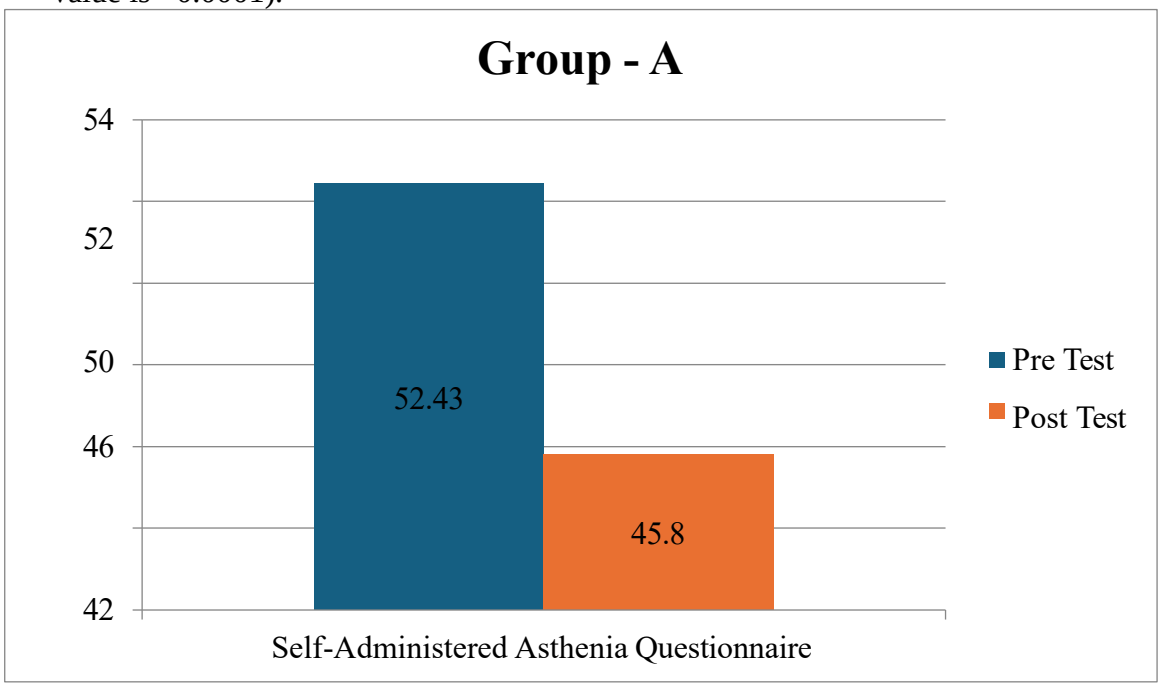
Table-1: Comparison of pre-test & post-test values for Self-Administered Asthenopia Questionnaire – Group A

Group A		Mean	SD	Z test	p value
Self-Administered Asthenopia Questionnaire	Pre test	52.43	6.23	4.4633	<0.0001
	Post test	45.8	6.59		

(*P value < 0.05 - Statistically Significant)

The above table reveals the Mean, z-value and p-value between Self-Administered Asthenopia Questionnaire in pre-test and post-test.

This Group A table shows that there is highly significant difference in Self-Administered Asthenopia Questionnaire values between pre-test and post-test (P value is <0.0001).



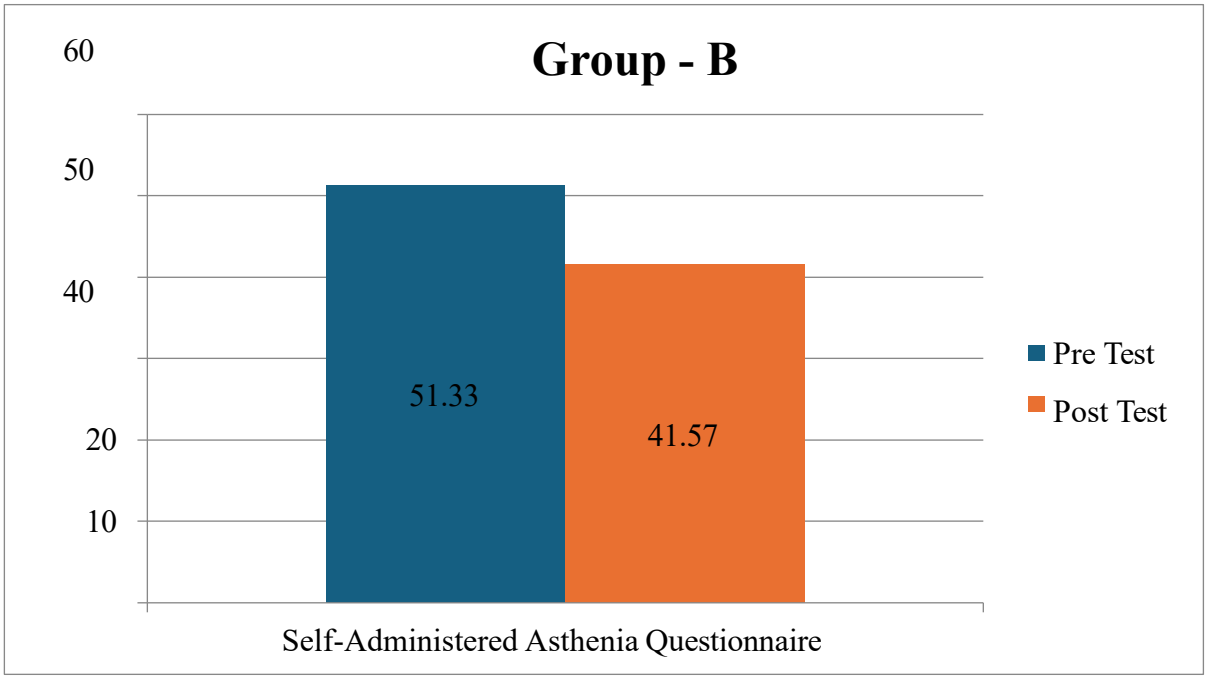
Graph -1: Comparison of pre-test & post-test values for Self-Administered Asthenopia Questionnaire – Group A

Table-2: Comparison of pre-test & post-test values for Self-Administered Asthenopia Questionnaire – Group B

Group B		Mean	SD	Z test	p value
Self-Administered Asthenopia Questionnaire	Pre test	51.33	42.57	4.7821	<0.0001
	Post test	41.57	8.05		

(*P value < 0.05 - Statistically Significant)

The above table reveals the Mean, z-value and p-value between Self-Administered Asthenopia Questionnaire in pre-test and post-test. This Group B table shows that there is significant difference in Self-Administered Asthenopia Questionnaire values between pre-test and post-test (P value is <0.0001).



Graph -2: Comparison of pre-test & post-test values for Self-Administered Asthenopia Questionnaire – Group B

Table -3: Comparison of post-test values Self-Administered Asthenopia Questionnaire of Group A & Group B

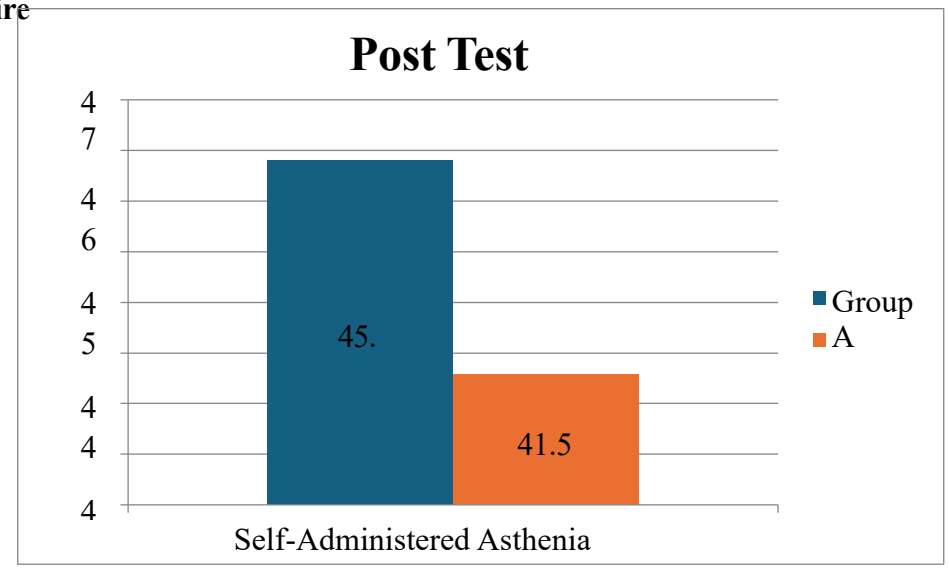
(*P value < 0.05 - Statistically Significant)

Parameter	Post Test Values		Z Score	U value	Significance
	Group A	Group B			
	Mean	Mean			
Self-Administered Asthenopia Questionnaire	45.8	41.57	2.14374	328.5	0.03236

The above table reveals the Mean, Mean Rank, Sum of Ranks, U-value and p-value between pre-test and post-test within Group – A & Group – B

There is a statistically significant difference between the post-test values of Group A and Group B (P value is 0.03236).

Graph- 3: Post Test Values of Group A & Group B – Self-Administered Asthenopia Questionnaire



CONCLUSION

With Reference to the statistical analysis done from data collection using self administered asthenopia questionnaire, it is concluded gaze stabilization exercise shows a significant reduction of asthenopia symptoms.

By the Result obtained from this comparative study, gaze stabilization exercises shows more effective than extrinsic eye muscle strengthening exercises.

LIMITATION OF THE STUDY

- Short duration study
- Sample size was small
- No long term follows up of the subjects
- Study was performed only for age group 18-25 years

RECOMMENDATION OF THE STUDY

- Larger sample can be analysed
- Larger duration of study can be done
- All age group can be taken
- Further, interventions available also Included in the future studies

CONFLICT OF INTEREST:
None declared
FUNDING:
Self-funded.
ETHICAL APPROVAL:
Ethical approval was obtained from Institutional Ethical Committee in a private medical college in Chennai.

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