

Original Research Article

Can your eye glasses lead to future neck pain and disability? Relation of eyeglasses with neck muscle endurance and posture

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ABSTRACT

Background: Use of spectacles is common for people having vision problems. Unifocal and bifocal are usually the commonly used lenses for vision correction. The aim of the present study was to compare the effect of type of lenses in eyeglasses on the neck muscles endurance and neck posture.

Methods: A sample of 132 subjects were recruited and divided in three groups according to use of unifocal, bifocal or no glasses. Normal healthy subjects using eyeglasses for a minimum of 2 years and as per selection criteria were assessed for their deep neck flexor endurance (DNF) and craniovertebral angle (CVA).

Results: Females had less DNF endurance than males in all groups. DNF endurance was also least reported in subjects using bifocal lenses followed by unifocal and no glasses. These results were similar for both males and females. Bifocal group also had least CVA amongst both sexes.

Conclusions: Use of bifocal lenses reduces the DNF endurance and leads to forward head posture over time. These two factors are commonly associated with development of neck pain and disability. Assessment for the type of lens in eyeglasses should be added in diagnosing musculoskeletal problems in neck. Appropriate neck exercises, corrective postures and advise for correct eyeglasses at an early stage could maintain DNF endurance and therefore, prevent faulty neck postures and associated pain. This small check could be a big step towards reducing the financial and psychological burden on the patient and an affordable and less invasive public health solution to neck related problems.

Keywords: Bifocal, Unifocal, Neck pain, Neck posture, Endurance, DNF

INTRODUCTION

Use of eyeglasses is common among people of all ages having any kind of vision problem. The type of lens used in these eyeglasses is either a unifocal i.e. having a single lens or bifocal i.e. having two lenses for both near and far vision. The latter is more commonly used in middle and old age and commonly by those having presbyopia i.e. a normal loss of near focusing ability that occurs with age due to loss of elasticity of the lens of the eye.¹

Any kind of activity involving eye glasses like reading, writing, a desk job involving computer screens etc. requires a certain amount of neck movement and adjustments or small compensatory postures to make the line of focus perfect and aligned, for a better and clear vision needed for the task. Most of these activities require forward bending of the head on neck or a chin tuck position, hence involving anterior neck muscles. Use of such posture does not usually mean that there is pain or dysfunction but it suggests that there is potential for developing musculoskeletal problems in future.^{2,3}

In such neck positions, the deep neck flexor (DNF) muscles are most commonly recruited to maintain a stable posture of head over the cervical spine. Literature reports that any weakness in these muscles could result in neck pain and associated disability.⁴ A study reported the relation of neck muscle endurance and range of motion on treated and untreated neck pain which showed that neck muscle endurance time was significantly lower for pain group.⁴ Various other studies have also shown the affection on forward head posture due to conditions such as headache, temporo-mandibular joint problem, hearing disorders, neck pathology and pain. However, very less literature is available to show the effect of type of lens i.e. bifocal or unifocal on deep neck muscle endurance and resting head position. This made an interesting research question i.e. could a small simple and light weight devise of daily use like eyeglasses, which is widely used across all age groups, could have a long lasting effect on an individual's neck muscles and posture, eventually requiring a treatment for the same. Hence, this study was designed to find the relation of type of lens on neck muscle endurance and resting head position on normal subjects wearing eyeglasses.

METHODS

Participants

The study consisted of 132 normal subjects, with 97 males and 35 females divided in three groups as per the use of eyeglasses. These groups were Group 1 (bifocal lens) with 39 subjects, group 2 (unifocal lens) with 52 subjects while group 3 included 42 normal subjects not using any kind of glasses. The average age of the study participants was 45.7 ± 5.11 years. Subjects wearing eyeglasses were recruited from people attending the local ophthalmologists clinic for their regular eye checkup, while the normal subjects were their age matched relatives accompanying them to clinic and the staff at the Guru Jambheshwar University of Science and Technology, Hisar. Data collection for this study was done between January to May in 2012. The inclusion criteria for the study participants using any kind of lenses were age between 38- 52 years, as it is the most common age for developing presbyopia, wearing bifocal or unifocal glasses, no history & prevailing problem of neck pain, not undergoing or requiring any treatment for neck pain. The exclusion criteria for the study was subjects wearing glasses for less than a year, into regular exercises, any history of neck trauma, surgery, cervical spondylosis, any problem of headache, tooth ache or hearing, any problem of systemic, muscular or connective tissue disorder.

Selection procedure

Patients who visited a local ophthalmologist's clinic were referred by the clinic staff to the first author a physical therapist, who explained them about the study and its relevance. Patients who were found suitable for the study

were instructed about the study and its objectives and about the planned cervical measurements and assessment. Only those participants who signed the informed consent forms went through further assessment.

Interested patients were screened for the inclusion and exclusion criteria and after getting a written consent for the study they were measured for DNF endurance and cranio-vertebral angles. All the procedures were non-invasive and permitted by departmental ethics committee.

Measurement for DNF endurance

The DNF endurance test was performed according to the method used by Harris et al⁵ and Olson et al.⁶ The subjects were asked to lay in a supine, hook-lying position. They were asked to rest their arms on the abdomen. Further, they were instructed to tuck their chin maximally and then lift their head up from the plinth up to 2.5 cm while maintaining the chin tuck position. Doing this movement created a skin fold on the anterior-lateral side of the neck of the patient. Using a sketch pen a line was drawn across this skin fold to check for its maintenance. While maintaining this position if the subject lost the chin tuck the drawn line was no more in continuity due to separation in skin folds. For a better cueing the therapist also placed two fingers placed below the patients head at the most proximal point of occiput, which acted as a reference height for maintaining the appropriate head position. The subject was instructed to just maintain the head at the level of the stacked fingers below the head while maintaining the chin tuck. The head was not supposed to be rested on the fingers nor lifted above their height, so that the therapist could move the fingers from side to side providing for a tactile cue for maintaining the appropriate head position above the plinth. A stopwatch was used to record the time for which the subject maintained the required position. It was terminated when any 1 of the 4 conditions occurred: (1) Loss of line drawn across skin fold on neck. (2) If the head rested on the therapist's fingers for more than 1 second. (3) If the subject raised the head above the fingers so as losing contact with them. (4) If the subject wanted to discontinue.

Subject was directed once with a verbal cue to maintain the original test position if any deviation was observed by the therapist. A 5 minute break was given between the two endurance tests for adequate muscular recovery. The average of these two scores was then calculated as a final result. During the rest period subject was allowed to just rest, move head sideways but not lift up from the Table.

Measurement of cranio-vertebral angle

The spinous process of seventh cervical vertebrae was palpated while the subject was sitting in an erect position on chair with back supported. This was done by asking him to do full flexion of the neck, on which the C7 spinous process is properly palpated. It was marked with

a small tape and taken as axis for using a bubble goniometer in left sagittal view. The lower stationary arm of the goniometer was parallel to floor and aligned near subject's shoulder. The moving arm of the goniometer was placed near the tragus of ear. This angle was measured and recorded thrice with a gap of two minutes between each reading. The average of these three readings was taken as the final score of cranio-cervical angle.

Statistical analysis

Data was analyzed using the SPSS software (version 21) and descriptive Statistics expressed as mean and standard deviation was calculated for variables like DNF endurance and FHP. One-way analysis of variance (ANOVA) was used to compare DNF endurance and FHP in males and female subjects using Bifocal, Unifocal and subjects not using any type of eyeglasses. Post-hoc comparisons were conducted with all pair wise multiple comparison procedures. Correlation between the Age and Deep Neck Flexor Endurance in subjects using Bifocal glasses, Unifocal glasses and subjects not using any type of glasses was determined by using Pearson Product Moment Correlation Coefficient.

RESULTS

All were using eyeglasses for a minimum of two years. On comparing for DNF endurance of males in three groups showed bifocal group had least DNF endurance followed by unifocal and no lenses group. These were also statistically significant at $p=0.039$ (Table 1). Post hoc analysis showed significant differences between bifocal and no glasses group while comparing for women in three groups also showed similar results i.e. lowest DNF in bifocal group followed by unifocal and no glasses. However, there were no significant between group differences though (Table 2).

The between group comparison of cranio-vertebral angle among males was significant ($p=0.004$) with lowest CVA in bifocal group followed by both the unifocal and no glasses group. Further post hoc analysis showed significant differences between bifocal and unifocal; bifocal and no glasses group in males (Table 1). While in females CVA was also lowest in bifocal group followed by no glasses and unifocal group but were not statistically significant ($p=0.059$) (Table 2).

Table 1: DNF endurance and CVA among males in all groups.

Characteristics	Normal (30)	Unifocal (42)	Bifocal (25)	F	P value
DNF endurance (sec)	47.51±25.91	44.61±18.30	39.08±4.64	3.361	0.039*
CVA	43.13±4.00	43±5.69	33.37±19.41	5.970	0.004*

*significance set at $p<0.05$

Table 2: DNF endurance and CVA among females in all groups.

Characteristics	Normal (12)	Unifocal (9)	Bifocal (14)	F	P value
DNF endurance (sec)	33.46±21.44	32.58±5.56	25.74±10.22	1.097	0.346
CVA	44.16±4.68	46.55±3.64	42.07±4.16	3.102	0.059

Table 3: Correlation of Age with deep neck flexor endurance.

	Bifocal		Unifocal		No glasses	
	Male	Female	Male	Female	Male	Female
Correlation coefficient	-0.188	-0.0718	0.0654	-0.365	-0.218	-0.258
P value	0.368	0.807	0.681	0.334	0.247	0.418

The correlation of age with DNF endurance for males and females within three groups was not significant. Though, there was a weak negative correlation in majority of cases but was not statistically significant (Table 3).

DISCUSSION

The findings of the present study showed that people using bifocal lenses had reduced DNF endurance and CVA i.e. a tendency towards forward head posture as compared to people wearing single lens glasses or no glasses. DNF's play an important role in stabilizing

cervical spine in gross neck movements.^{7,8} Cervical spine function is directly influenced by cervical flexor endurance. Any challenge to cervical spine flexor endurance activity could lead to cervical dysfunction, tissue overload, trauma, and pain.

Whenever there is an imbalance in neck stabilizers or their function is impaired, it leads to loss of proper alignment and posture which can then result in cervical impairment.⁸⁻¹⁰ Therefore, it is evident that cervical spine function is directly influenced by cervical flexor endurance. Since the use of bifocal lenses leads to

weakness of DNF endurance, their long term use can result in cervical pain and associated disability too.

The present DNF values when compared with the reported average DNF endurance values in Indian population are still less. However, it is also important to know the normal average values of DNF endurance in Indian population for a better reference point and correlation for the study. Various previous studies have reported average value of DNF endurance in Indian population with different sample sizes. The largest study reported was done with 212 healthy subjects to measure their DNF endurance in which males had an average DNF endurance of 55.5 ± 25 seconds, while females had 45.2 ± 23 seconds.¹¹ Of the other two studies, one reported an average of 58.36 seconds on 90 subjects but did not give separate values for males and females, while second study with 60 subjects reported average values of 63.73 ± 20.27 seconds in males and 38.43 ± 11.71 seconds in females.^{12,13} A similar study done in 2011 showed average value of DNF endurance in males and females to be 38.9 ± 20.1 seconds and 29.4 ± 13.7 seconds respectively but was not from India.¹⁴ All these studies also indicate women to be having less DNF endurance than males, which is also evident in the present study across all groups.

Of the various postural deviations, forward head posture (FHP) is the most common. It is also advocated that this posture acts as an etiology for numerous musculoskeletal and neurovascular dysfunctions too.^{15,2} Various other factors, which might play an important role in development of FHP could be environmental, such as ocular or non ocular like inner ear disease, certain congenital conditions, bone and joint pathology and sensory impairments requiring head adjustment to compensate for visual or auditory defect. Also certain ophthalmic conditions like nystagmus, strabismus, field defects, photophobia and incorrectly prescribed glasses could lead to compensatory head postures.² Literature has also reported people having neck pain have reduced CVA.¹⁶⁻¹⁸

Yip et al in a study showed that the CV angle in subjects with neck pain was significantly smaller than that in normal subjects. They concluded that there is moderate negative correlation between CV angle and neck disability. Patients with small CV angle have a greater forward head posture, and the greater the forward head posture, the greater the disability.² These results are consistent with the findings of study by Carolyn Hills Willford et al who concluded that subjects wearing multifocal lenses had a greater degree of forward head posture when compared with non multifocal lens wearers.¹⁵

In the present study, subjects using bifocal glasses had reduced CVA, which might predispose them at developing neck pain in future. Since we excluded people having recent neck pain, a retrospective data of detailed

neck pain history of participants could have brought more appropriate association of pain and reduced CVA in study participants.

In bifocal glasses, the reading segment is located on the bottom portion of the lens. The use of a bifocal lens requires a person to extend the occiput in order to focus near vision for reading.¹⁹ Though, there is no direct evidence of use of bifocal glasses being related to development of forward head posture. However, few studies do suggest that bifocal users who are in any occupation involving a desk job and especially those using screens, monitors or visual display unit of any kind are prone to developing neck pain.^{19,20} With these activities, a person tends to slouch forward and may need to tip his head back to focus, resulting in a neck and upper back position of sustained flexion. The combined effects of a flexed mid- and lower cervical spine and an extended occiput on C1 result in a forward head posture.

These results may be because of the increased demand to alter head position when focusing for near vision with the multifocal lenses, such lenses could be indicated as having a negative influence on postural adjustments of the head and neck.^{15,3} So wearing multifocal lenses may influence a person to hold his/her head in a position more forward than the ideal postural alignment.

In present study, it was found that age has no correlation with deep neck flexor endurance in males as well as females using bifocal glasses, unifocal glasses and subjects not using any type of glasses. These findings are similar to those of Anthony Barbar, who in a study done in 1994 stated that there was no significant difference in endurance of deep neck flexors of subjects of various age groups.⁸ It is argued that the stability of muscle endurance in elderly is related to the number of type I fibres and their metabolic efficiency, which does not alter significantly with age.^{22,23} Changes are seen in relative proportion of fast and slow twitch fibres with age in muscle biopsy studies. However, selective decrease in number of fast twitch fibres is seen but not in slow twitch fibres. Therefore, the maintenance of muscle endurance with age could be explained here.

The weakness of DNF muscles or a FHP might not present a major health risk initially but its sustained presence along with constant use of bifocal lenses could result in development of future pain and musculoskeletal dysfunction in neck. People with existing neck problems are more prone to get affected by it whereas in asymptomatic subjects who use bifocal glasses DNF endurance values could be an indicator to their propensity to develop neck problem and dysfunction in future due to decrease in DNF endurance and decrease in CV angle due to their use of bifocals. This was not the case with people using unifocals eyeglasses.

Ideally, it cannot be advised to stop wearing bifocal eyeglasses as they are a necessity for people using them.

The use of type of lens in eyeglasses should also be checked while assessing a patient for neck pain and disability. Therefore, people using bifocal lenses should be advised for regular neck endurance exercises and guided for maintaining correct neck posture. Orthopedicians and physical therapists should add type of eyeglasses assessment in regular case taking and advise people using bifocal lenses for exercises well in advance so that the adverse cumulative effects of use of bifocal lenses is not significant. It will help people in maintaining DNF endurance and a correct neck posture resulting in stronger and well aligned head and neck musculature. This can be useful in eventually preventing occurrence of neck pain and disability and can reduce physical and psychological distress for a person undergoing treatment. Incorporating such small assessment and advice at the very beginning of treatment could go a long way in preventing unnecessary emotional and financial burden on individual and society as a whole. This could also help in improving the medical health and public health statistics in India as neck pain is the most commonly reported health concern by people in desk jobs. Many youngsters and students are increasingly added to this pool of people requiring interventions for wrong posture at work and study, including medications. Proper ergonomic advice, a thorough work place assessment, advice for correct posture added with simple self exercises of DNF endurance should be done for people presenting with neck problems and also wearing eyeglasses.

The study could have been done with more number of participants making it one of its limitations. This would have given better perspective in ambiguous findings in certain groups, especially females, which were under represented. However, this could be due to less use of eyeglasses by women as compared to men due to cosmetic and aesthetics reasons, making them to wear them only when necessary. We did not included progressive lenses in the type of lenses, which are very commonly used now a day. Since the data collection was done in a small town in Haryana, the use of progressive lenses was not much common at this place. However, till date, there is still not any research done with this perspective in mind. Future studies could compare the effect of progressive lenses with the bifocals or other type of lenses too.

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