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Impact of Cosmetic lenses on Contrast Sensitivity function in normal Contact lens wearers

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ABSTRACT

Cosmetic Soft Contact Lenses are expected to affect the contrast sensitivity function to some extent. The study was performed to determine the effect of cosmetic SCL on the contrast sensitivity of the normal CL wearers. In this study 25 CL users fulfilling the following criteria were enrolled. Inclusion Criteria: •Age range between 11-30 years. •Pupil size 4-7mm in moderate illumination. •Visual acuity of 6/6 with no refractive correction in both the eyes (separately). Exclusion Criteria (history of one or more): •Glaucomatous or/ and neurological visual field defects. •Moderate to severe dry eyes (where CLs are contraindicated). •Presence of corneal scar or lenticular opacity. •Allergic to any ingredient of the CL solutions Informed consent was taken from all the CL wearers enrolled for the study. All wearers were worked up in the CL clinic & complete history (Family, Ocular & Occupational), ocular examination on Slit Lamp bio-microscope, evaluation of cosmetic SCL Fitting & Contrast sensitivity testing with & without CL were recorded. Finally, the values were compared statistically with paired student's t-test. Percentage change in average contrast sensitivity was found to be 7.12%, 7.60% & 5.32% in R/E, L/E & B/E respectively. Cosmetic soft Contact lenses could be used for occasional wearing purposes and also for cosmetic purposes in case of disfigured eyes with special care and regular follow-up.

Keywords: Contrast sensitivity, Pelli-Robson Chart, Cosmetic SCL

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INTRODUCTION

Contrast sensitivity (CS) is the ability to perceive slight changes in luminance between regions, which are not separated by definite borders. Contrast sensitivity testing evaluates the patient's ability to perceive a variety of coarse, intermediate or fine details at differing contrasts relative to the background¹. Losses of CS are much more disturbing than the loss of visual acuity (VA). Further, CS may be impaired even in the presence of normal VA.

A contrast threshold (CT) is the smallest amount of contrast required to see a target. CS is the reciprocal value of the CT. A patient who requires a lot of contrast to see a target has low CS and vice-versa. Normal contrast ranges² from 0.5% to 2% at normal day light luminance ranging from 30-300 candelas/m². To get contrasts in percentage multiply the value by 100.

The CS gradually gets poorer for higher spatial frequencies as diffraction and other aberrations blur finer details. The CS also decreases with age and as the illumination in the scotopic range decreases.

Pelli Robson CS chart is a letter optotype contrast chart, which offers only one size of letter targets, attempts to evaluate the most sensitive part of CS curve, near 6cycles/degree. It is a quick, simple, inexpensive, reliable and reproducible method of measuring contrast sensitivity.

Cosmetic soft contact lenses (SCL) are lenses with iris shadowy design-patterns or imprints to enhance or transform the natural iris appearance and hence the cosmetic upliftment. These lenses are now-a-days available in Indian market in various iris-patterns like dot-matrix, circular fringe, etc.

*Albarran & colleagues*³ reported in their study that there is no statistically significant difference in visual performance between wearing disposable SCL and not wearing them, except for static perimetry, in which significant differences occur at eccentricities >30 degrees. They compared certain parameters like contrast sensitivity (Visitech 6000), colour vision and visual field (static Goldmann perimetry) with and without contact lens under different illumination levels to check for possible vision losses.

*Applegate and Massof*⁴ in their prospective study highlighted the changes in the contrast sensitivity function induced by contact lens wear. In that contrast sensitivity function with spectacles and with contact lens corrections were studied and compared. The inference of that study was that the corrections provided a more definite evaluation of visual performance with contact lenses than do the conventional clinical procedures. Later on *Bernstein and Brodick*⁵ did a study to prove the contrast sensitivity changes after wearing contact lenses occasionally for moderately long hours (18 hrs). It concluded that the impairment previously noted by SCL wearers might be limited to astigmatic subjects (having 0.75-1.00DCyl).

*Kirkpatrick and his coworkers*⁶ attempted to resolve the conflicts arising out of reports relative to contrast sensitivity function and SCL wear. Contrast sensitivity was measured at 6 spatial frequencies with spectacles and with contact lens. It resulted in a measurable decrease in contrast sensitivity for only the higher of spatial frequency tested (22.8cycles/degree), when SCLs were worn, but no significant changes in contrast sensitivity function over a time. So, this decrease in contrast sensitivity is attributed to both contact lens and the cornea.

*Cox & Brian Holden*⁷ conducted a study to examine the effect of SCL-induced longitudinal spherical aberration in contrast sensitivity. In this study, the longitudinal spherical aberration of spherical SCLs, both on and off the eye, was calculated using an aspheric corneal model and 2-dimensional ray-tracing program. Significant losses of contrast sensitivity were recorded for the spherically aberrated lenses with the 6mm pupil but not with the 3mm pupil. Theoretical calculations and the contrast sensitivity results indicated that negatively powered lenses produce significantly less spherical aberration in situ than positively powered lenses.

*Timberlake & colleagues*⁸ thought of examining the effect of in vivo CL drying on low-contrast visual acuity (VA) while wearing CLs for short-term. They measured low (7%) contrast VA of subjects who wore hydro-gel CL, rigid gas permeable (RGP) & no contact lens, when subjects blinked normal and when they suppressed blinking. In case of RGP and no contact lens condition, there was not a significant reduction in low contrast VA but in SCLs, there was a substantial reduction (mean loss: 4.1 lines) when blinking was suppressed.

*Spraul & colleagues*⁹ conducted a clinical trial in order to investigate whether special-effect lenses (Crazy lenses) impair visual functions like contrast sensitivity and visual field. A clear SCL and crazy lens were fit in changing sequence to compare the effects. Goldmann visual field displayed a significant constriction of the isopters III/4, I/4 and I/3. Contrast sensitivity was significantly reduced in a photopic condition with and without glare, and in a scotopic condition without glare. Furthermore, the special effect lenses were associated with a decrease in lens wearing comfort.

It was presumed that there is going to be a decrease in contrast sensitivity with cosmetic lens wear. But, there was hardly any data in the available literature regarding effect of plano cosmetic CL on the contrast sensitivity. In view of this present study was planned to evaluate the contrast sensitivity changes in cosmetic SCL in our clinical set up. Till to date, no such study has been performed and published on Indian scenario despite the fact that the usage of cosmetic CLs has increased very rapidly in this ever growing market.

MATERIALS AND METHOD

In this prospective study, 25 subjects were taken randomly from the CL clinic of the Department of Ophthalmology, Govt. Medical College and Hospital, Chandigarh (2010).

Patients fulfilling following inclusion and exclusion criteria were included in this study.

Inclusion Criteria:

- Age range between 11-30 years.
- Pupil size 4-7mm in moderate illumination.
- Visual acuity of 6/6 with no refractive correction in both the eyes (separately).

Exclusion Criteria (history of one or more):

- Glaucomatous or/ and neurological visual field defects.
- Moderate to severe dry eyes (where CLs are contraindicated).
- Presence of corneal scar or lenticular opacity.
- Allergic to any ingredient of the CL solutions

Informed consent was taken from all the subjects enrolled for the study. All individuals were worked up in the CL clinic, where a Pro-forma was filled up which included detailed history, ocular examination on Slit Lamp bio-microscope, evaluation of Cosmetic SCL Fitting and visual fields charting.

Complete slit-lamp examination of each eye was performed for assessing the status of lids, conjunctiva, tear-film, cornea, lens & vitreous. Direct Ophthalmoscopy was done to examine the health of the fundus. Pupil diameter and corneal diameter (HVID) were measured with transparent ruler. Also, Goldmann applanation tonometer was used to check the IOP (Intra ocular pressure) and Visual acuity (VA) was recorded with Snellen's VA chart. The refraction was done with the aid of Streak retinoscope to select subjects having no refractive error for the study.

Cosmetic SCLs used were of Bausch & Lomb's (B & L) Soflens disposable (Starcolors-II). The following are the parameters of the Starcolors-II lens:

Material: Polymacon (FDA Group-I); Colour: Blue; Water content: 38.6%

Central thickness: 0.035mm; Optic or clear pupillary zone: 6.00mm

Base curve (B.C.): 8.4 or 8.7; Power: Plano; O.D. (overall diameter): 14.1mm

The contact lenses were fitted on the basis of manual Keratometry. One-hour time (for stabilization of CL) was given for post CL fitting examinations. It was ensured that there was proper centration of SCL with 0.5-1.0mm of movement (with push-up test).

Contrast sensitivity was measured by Pelli-Robson chart Fig 1(a). It is wall chart of size 90cm X 60cm (36inch X 24inch). It consists of 8 lines of letters of equal size (4.9cm X 4.9cm or 2inch X 2inch), each having 6 letters or 2 triplets. Each triplet has three letters of same contrast. The contrast reduces from top-left triplet (Maximum contrast=100%) to bottom-right triplet (Minimum contrast=0.6%). Each letter subtends an angle of 3° at 1meter distance. Both sides of chart are printed with different letter sequence but otherwise identical

properties. Letters used in the chart are called ‘Sloan’ letters. The order in which letters appear on the chart is randomized but, in order that subjects should be aware of the character set used in the lower contrast area of the chart; all ten of the Sloan letters appear in the top three lines of the chart. First high contrast letters help subjects in getting familiarise with the characters, procedure and nature of the test. Contrast sensitivity is recorded in logarithmic CS (1/contrast) units. Below is the key to the Pelli-Robson chart for scoring a subject’s performance. The marginal numbers give the log CS corresponding to the neighbouring group of three letters or triplet.

0.00	O S N	H S N	0.15
0.30	S H O	C H V	0.45
0.65	K D R	Z K D	0.75
0.90	H C D	S N O	1.05
1.20	O V S	D R H	1.35
1.50	D S N	H R K	1.65
1.80	D N Z	N V H	1.95
2.10	R D H	H K Z	2.25

While recording the CS, the chart was kept at 1meter at the subject’s eye level. Subjects were asked to read the chart from top left to down (horizontally across the line) both with and without cosmetic SCL. Subjects were insisted to guess when they could not recognise the letter properly. The log CS value of the last triplet for which at least 2 letters were correctly seen was recorded as the result.

Paired student ‘t’ test was used to compare the changes in the contrast sensitivity on wearing cosmetic SCL. The comparison of each eye before and after 1 hour of CL fitting was done. For all analyses, $p < 0.05$ was considered statistically significant with a 95% confidence level.

All the procedures were carried out in the present study on the human subjects are performed routinely in the Department of Ophthalmology. The procedures were done only after taking written-informed consent from the contact lens wearers. The guidelines of the Central Ethical Committee for Bio-medical research on human subjects by ICMR were adhered to in addition to those of Helsinki Declaration.

RESULTS AND DISCUSSION

Contrast sensitivity was recorded using Pelli-Robson Chart before and after 1 hour of SCL wear. The observations and results are as under:

Demographic distribution:

Age distribution-

Out of 25 subjects; Majority of the subjects 13(52%) were in the age-group of 21-30 years while 12(48%) were in the age-groups of 11-20 years [Table I (a)],

Table I (a): Age Distribution

Age Group	No. of Subjects	Percentage (%)
11-20	12	48%
21-30	13	52%
Total	25	100%

Sex distribution

The majority of subjects included in the study were females 16 (64%) while males were 9(36%). Females were given due preference, as they are the more potential users of cosmetic lenses than the males [Table I (b)],

Table I (b). Sex Distribution

SEX	No. of Subjects	Percentage (%)
Male	9	36%
Female	16	64%
Total	25	100%



Figure 1 (a): Contrast Sensitivity Testing

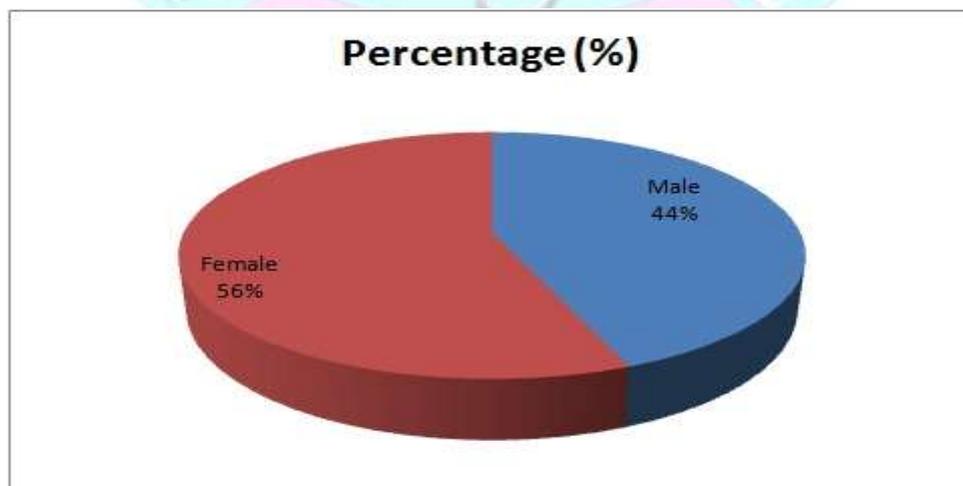


Figure 1 (b): Contrast Sensitivity Testing

AGE DISTRIBUTION

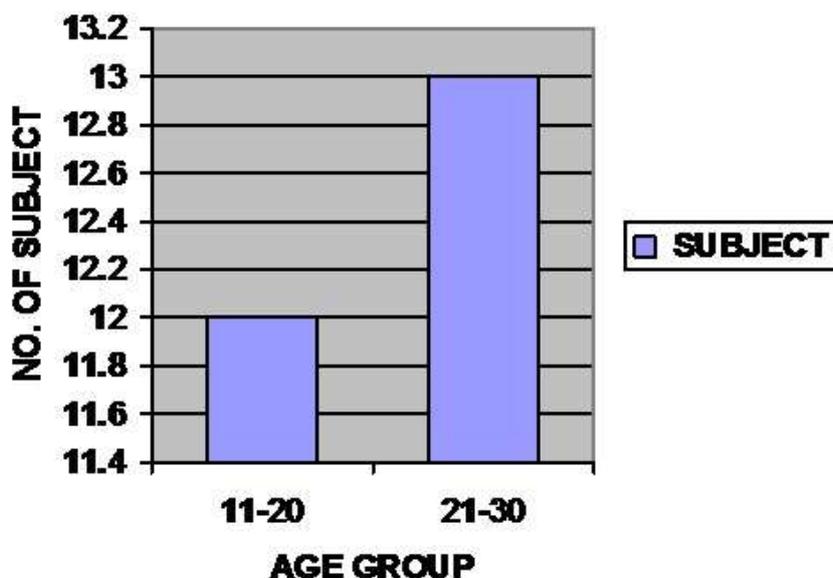


Figure 1 (c): Age Distribution

AVERAGE CONTRAST SENSITIVITY:

Percentage change in average contrast sensitivity was observed to be 7.12%, 7.60% & 5.32% in R/E, L/E & B/E respectively. 't' values were significant in all cases at p=0.05 (95% confidence) [Table II]

Change in Average Contrast sensitivity

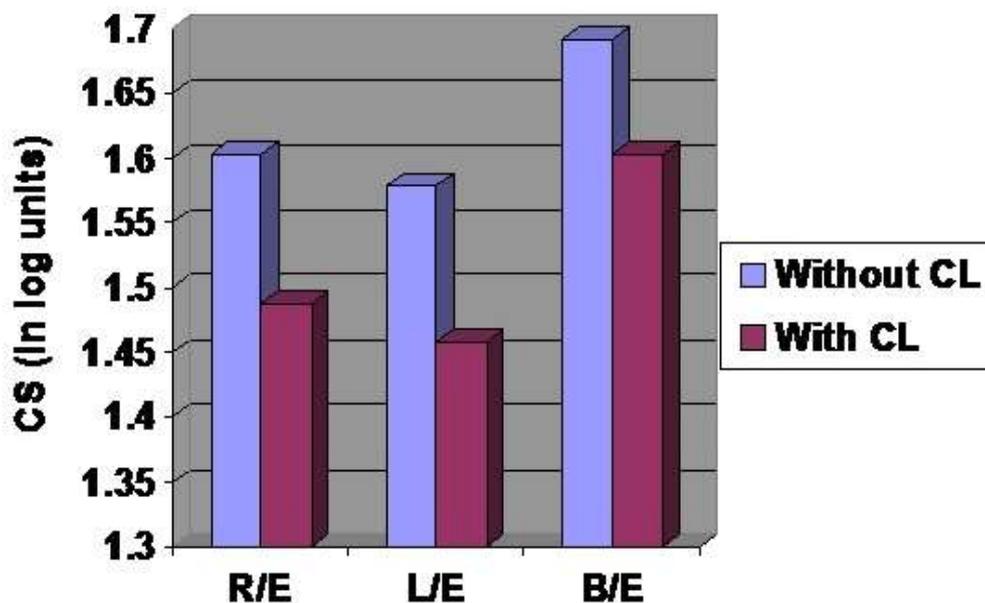


Figure 2: Change in Average Contrast Sensitivity

Table II: Change in Average Contrast Sensitivity

EYE	CS (log units) 'Without CL'	CS (log units) 'With CL'	% Change	't' value*
R/E	1.602	1.488	7.12	8.72
L/E	1.578	1.458	7.60	6.20
B/E	1.692	1.602	5.32	4.24

* Table value of $t_{24} = 2.06$ at $p=0.05$

The contrast sensitivity values were significantly lower which was in contrast to the *Bernstein and Brodick*⁵ observation where significantly relevant changes were found after wearing contact lenses occasionally for moderately long hours (18hours). This difference was probably due to the lens material property or/ and colour design and matrix. Also, the results of the study were in accordance with the *Cox & Brian Holden*⁷ who observed significant losses of contrast sensitivity for the spherically aberrated lenses with the 6mm pupil but not with the 3mm pupil.

CONCLUSION

Final conclusion was drawn that the Cosmetic SCL could result in statistically significant decrease of contrast sensitivity even in subjects with no refractive error. Thus, Cosmetic soft Contact lenses could be used for occasional wearing purposes and also for cosmetic purposes in case of disfigured eyes with special care and regular follow-up.

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