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Comparison of Corneal sensitivity between Different types of contact lens wear

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ABSTRACT

Aim and objective:

The aim of this study is to find out corneal sensitivity difference among three types of contact lens wearer (RGP lens, hydrogel Contact lens and silicon hydrogel contact lens) and non-contact lens wearer who walks in tertiary eye care center. This study is conducted experiments in order to detect whether changes in sensitivity were also different for the different zones.

Method:

A prospective study was performed which include total 80 subjects were recruited in this study among them 20 subjects were non-contact lens users, 20 subjects were RGP wearer, 20 were soft hydrogel lens wearer and 20 were silicon hydrogel lens wearer presenting at Dr. D.Y. Patil Institute of Optometry and Visual Sciences, Pune, from October 2022 to February 2023. Corneal sensitivity is measured using fine wisp of cotton and data analysis was done based on distribution.

Result:

Using fine wisp of cotton time taken for response in the form of blinking is measured in seconds and found mean time, for non-contact lens wearer is 0.361, for silicone contact lens wearer is 0.415, for hyderogel contact lens wearer is 0.619 and for RGP contact lens wearer is 0.781. statistical analysis showed that all the experimental groups (non contact lens users, silicone hydrogel lens wearer, hydrogel contact lens wearer and RGP lens wearer) significantly differed in terms of corneal sensitivity from each other.

Conclusion:

The study can be concluded by saying both soft and RGP lens wear produce a similar type of corneal sensitivity loss, although the mechanism for this loss is different for the two lens types. The recovery of corneal sensitivity loss is achieved by cessation of contact lens.

Introduction:

The body's surface tissue with the most extensive innervation is the cornea. It receives the majority of its nerves, which are sensory, from the ciliary branches of the trigeminal nerve's ophthalmic division, which enters the

cornea radially at mid-stromal level and repeatedly divides as it passes superficially to contribute to a dense plexus of nerves right under Bowman's membrane. [1] One of the most sensitive organs in the body is the corneal epithelium, which has a significant number of nerve endings. The cornea has the highest concentration of free nerve endings in the body, which results in a high level of sensitivity to noxious stimulus. In identifying and avoiding injury to the cornea and anterior ocular surface, they are essential.[2]

Both soft and rigid gas permeable (RGP) contact lenses have supplanted as the primary method of refractive correction for millions of individuals worldwide. There are many advantages to wearing contact lenses, including the improvement of retinal image quality due to astigmatism and high myopia/hyperopia correction, their therapeutic role in the treatment of corneal disease, and the avoidance of the need for glasses in circumstances where they are inappropriate. Despite the large number of contact lens wearers worldwide, discontinuation of wear is still a major problem that limits the amount of successful wearers.[3] Wearing contacts has been linked to a variety of unfavorable side effects, including corneal oedema, neovascularization, papillary conjunctivitis, dry eye, and marginal ulcers. The loss of corneal feeling is one of the more peculiar adverse effects of wearing contact lenses. [4]

The cornea, which is both innervated by sensory nerve terminals that are functionally diverse, interact with the contact lens.[5] The functional unit made up of the ocular surface (cornea, conjunctiva, and meibomian glands), the lacrimal glands, and the sensory and motor neurons that connect them receives sensory information from the cornea and conjunctiva. The afferent and efferent nerves form an intricate network that joins the parts of the integrated unit into a homeostatic loop, which has the main goal of preserving the ocular surface's health. Moreover, corneal sensory nerves have different trophic effects on the cornea, which may influence how wound healing after corneal injury is modulated.[8]

One technique to evaluate the functioning of the sensory nerves is to measure the ocular surface sensitivity, which has been a helpful clinical indicator of corneal health in contact lens wearers. There are three possible reasons why sensitivity loss occurs:[9]

1. sensory adaptation to mechanical stimulation
2. metabolic impairment of the cornea affecting the nerves
3. Corneal acidosis suppressing nerve function.

In this study, corneal sensitivity of RGP lens, hydrogel Contact lens and silicon hydrogel contact lens wearer and non-contact lens wearer corneal sensitivity is measured with the help of wisp of cotton.

One previous study found that both soft and RGP lens wear produce a similar type of corneal sensitivity loss, although the mechanism for this loss is different for the two lens types.[9] Another study found that as the time of wear increases, both in the short-term (days) and long-term (months), the greater the loss of sensation.[10] Another Study found that corneal sensitivity decreased in both who wore lenses contained 38% and who wore lenses contained 55% during the first 8 h following insertion, the decrease was more marked in the group who wore 38% water lenses.[11]

Methodology:

It was a prospective study done at Dr. D.Y.Patil Institute of Optometry and Visual Science, Pune from October 2022 to February 2023. Institutional sub-ethical clearance was taken before starting the study. Informed consent was signed by all the participants. Subjects with any ocular pathology were excluded from the study. Age groups 18 or more and willing to participate in the study were included.

Total 80 subjects were recruited in this study among them 20 subjects were non-contact lens users, 60 were contact lens users. In contact lens users 20 subjects were RGP wearers, 20 were soft hydrogel lens wearers and 20 were silicon hydrogel lens wearers

Subjects were approached in such a way that the thin cotton wisp was out of the subjects' field of vision. While the participant was looking down, the superior corneal zone (SCZ) of the eye was first measured. The participant was asked to look up while we measured the inferior corneal zone (ICZ). The central corneal zone (CCZ) was assessed while the subject was facing straight ahead, while the nasal (NCZ) and temporal (TCZ) corneal zones were measured with the subject gazing outward and inward, respectively. A stopwatch is used to record the subject's blinking time in seconds.

There were variances in the sensitivity of the right and left eyes, and these variations can be attributed to the fact that the right eye was assessed first. The left eye experienced some additional fatigue as a result of this. Thus, only changes in sensitivity in the right eye will be taken into account in this investigation.

Statistical Analysis:

Data was entered in Microsoft Excel 2019 (Part of Microsoft Office Professional Edition) [computer program]. Microsoft; 2019) and analyzed using MedCalc v18.2.1 (MedCalc Statistical Software version 18.2.1 (MedCalc Software, Ostend, Belgium; http://www.medcalc.org; 2018).

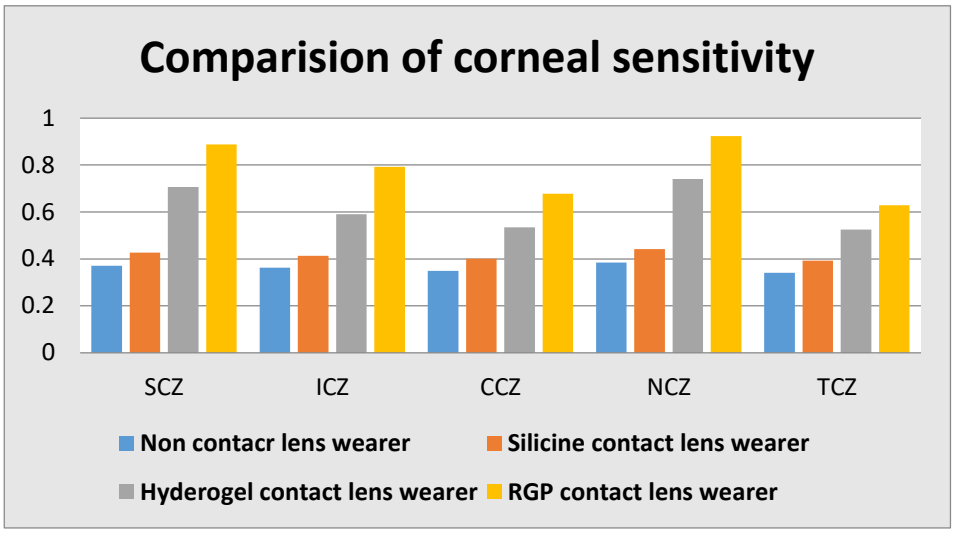
Categorical variables were summarized using number (N) & percentages (%) and 95% confidence limits (where applicable), continuous variables expressed as mean and SD & Median and IQR (where applicable). Normal distribution was verified by Shapiro-Wilk test. Kruskal-Wallis test was used to check for significance of observations between multiple groups. In all the tests performed, $P < 0.05$ was considered to be statistically significant.

RESULT:

Total 80 subjects were recruited in this study among them 20 subjects were non-contact lens users and 60 were contact lens wearers.

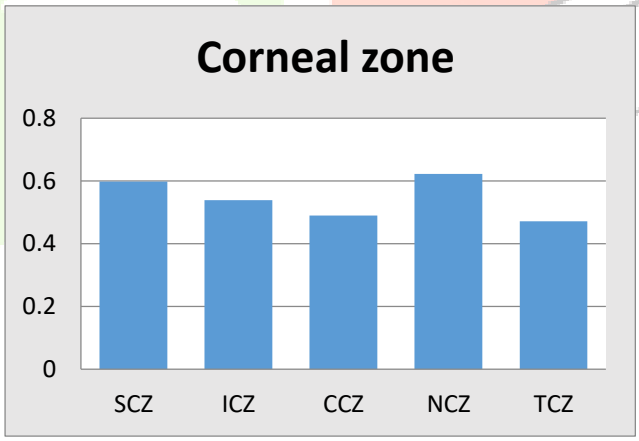
The percentage analysis shows the ratio of Male and Female of which 41 (51.2%) were Male and 39 (48.7%) were Female. Statistically analyzed 95% CI for male is 39.81 to 62.59 and for female is 37.41 to 60.19. The ratio of age of which 44 (55%) subjects were from 18 to 30 years and 36 (45%) more than 30 years old. The percentage analysis shows 20 (25%) were non-contact lens wearer, 20 (25%) were silicone contact lens wearers, 20 (25%) were hyderogel contact lens wearer and 20 (25%) were RGP contact lens wearer. Statistical analysis shows 95% CI of 20 non-contact lens users is 15.99 to 35.94 and 95% CI of 60 contact lens wearers is 64.06 to 84.01

Graph 1: Comparison of corneal sensitivity (response in terms of blink time in seconds) with non-contact lens wearer and different type of contact lens wearer



Graph shows, among 20 non contact lens wearer mean blink response time in seconds at superior corneal zone is 0.371, at Inferior corneal zone is 0.362, at central corneal zone is 0.349, at Nasal corneal zone is 0.384 and at Temporal corneal zone is 0.341,among 20 silicone contact lens wearer mean blink response time in seconds at superior corneal zone is 0.426, at Inferior corneal zone is 0.413, at central corneal zone is 0.401, at Nasal corneal zone is 0.442 and at Temporal corneal zone is 0.393 among 20 Hyderogel contact lens wearer mean blink response time in seconds at superior corneal zone is 0.706, at Inferior corneal zone is 0.591, at central corneal zone is 0.535, at Nasal corneal zone is 0.741 and at Temporal corneal zone is 0.525, among 20 RGP contact lens wearer mean blink response time in seconds at superior corneal zone is 0.888, at Inferior corneal zone is 0.792, at central corneal zone is 0.677, at Nasal corneal zone is 0.923 and at Temporal corneal zone is 0.628

Graph 2: Comparison of Corneal Sensitivity in different corneal zone



Graph shows, highest corneal sensitivity loss is at nasal corneal zone and lowest is at central and temporal corneal zone. Corneal sensitivity mean value in seconds for NCZ is 0.623, SCZ is 0.598, ICZ is 0.539, CCZ is 0.49 and for TCZ is 0.471

Statistical analysis:

Based on analysis of Kruskal-Wallis test it can be concluded that there were significant difference in all five corneal zone between contact lens wearers and non contact lens users.

Table 1: Shows result of Krushkal wallis test

Corneal Zone	H statistic (degree of freedom)	P value
SCZ	67.39 (3)	<0.001
ICZ	67.89 (3)	<0.001
CCZ	68.06 (3)	<0.001
NCZ	66.95 (3)	<0.001
TCZ	69.39 (3)	<0.001

Post statistical analysis showed that all the experimental groups (non contact lens users, silicone hydrogel lens wearer, hydrogel contact lens wearer and RGP lens wearer) significantly differed in terms of corneal sensitivity from each other.

Table 2**:** Shows Statistical summary of non-contact lens wearer and contact lens wearer at each testing location

Experimental Group	Corneal Zone	Mean (Sd)	95% Ci Mean	Median	Minimun	Maximum
None	SCZ	0.371 (0.031)	0.356 to 0.386	0.37	0.31	0.42
	ICZ	0.362 (0.029)	0.349 to 0.375	0.36	0.32	0.41
	CCZ	0.349 (0.029)	0.334 to 0.363	0.36	0.3	0.41
	NCZ	0.384 (0.030)	0.370 to 0.398	0.38	0.33	0.43
	TCZ	0.341 (0.027)	0.327 to 0.354	0.35	0.3	0.4
Silicone hydrogel lens	SCZ	0.426 (0.021)	0.416 to 0.436	0.42	0.39	0.47
	ICZ	0.413 (0.019)	0.404 to 0.422	0.41	0.38	0.45
	CCZ	0.401 (0.022)	0.390 to 0.411	0.4	0.37	0.44
	NCZ	0.442 (0.025)	0.430 to 0.454	0.44	0.4	0.49
	TCZ	0.393 (0.016)	0.385 to 0.400	0.39	0.36	0.42
Hydrogel contact lens	SCZ	0.706 (0.22)	0.599 to 0.814	0.57	0.48	1.02
	ICZ	0.591 (0.14)	0.524 to 0.658	0.56	0.47	1
	CCZ	0.535 (0.035)	0.519 to 0.551	0.545	0.46	0.58
	NCZ	0.741 (0.24)	0.629 to 0.854	0.58	0.49	1.04
	TCZ	0.525 (0.032)	0.510 to 0.540	0.53	0.46	0.57
Rigid gas permeable lens	SCZ	0.888 (0.21)	0.790 to 0.987	1.01	0.57	1.05
	ICZ	0.792 (0.23)	0.687 to 0.898	0.79	0.56	1.03
	CCZ	0.677 (0.19)	0.586 to 0.768	0.58	0.54	1.02
	NCZ	0.923 (0.20)	0.828 to 1.019	1.03	0.57	1.07
	TCZ	0.628 (0.16)	0.553 to 0.703	0.57	0.53	1

Discussion:

The main aim of this study was to elucidate how different types of contact lens wearers' corneal sensitivity varied. Additionally, this study conducted tests to see if changes in sensitivity were also varied for the various corneal zones as it is known that the number of nerve endings in the cornea varies for each zone.

Paul J. Murphy, Sudi Patel et al in their study concluded that significant reduction in corneal sensitivity was found between the contact lens wearers and non-lens wearers (p =0.000), no difference was found between the two lens-type sub groups (p= 0.939).[9]

In this study, with fine wisp of cotton time taken for response in form of blinking is measured in seconds and found all the experimental groups (non contact lens users, silicone hydrogel lens wearer, hydrogel contact lens wearer and RGP lens wearer) significantly differed in terms of corneal sensitivity from each other.

According to the findings of this study, the central and temporal zones are less sensitive. These findings are consistent with the location of surface nerve terminals on the corneal epithelium. Corneal innervations density was shown by Rozsa & Beverman (1982) to decrease from the apex of eye to its periphery.[11]

Earlier studies have revealed that altered metabolic activity, caused by a decreased oxygen and carbon dioxide gaseous exchange, is the primary cause of diminished corneal nerve function. Contact lens wearers gain from decreased corneal nerve function in the form of improved ocular comfort.[12] It's possible that increasing oxygen delivery and reducing carbon dioxide from the anterior corneal surface while wearing contacts will reduce comfort levels, possibly even to the point where contacts are painful to wear. If this is the case, then wearing RGP lenses should have a less significant impact than wearing soft lenses because the degree of gaseous exchange is higher with RGP lenses due to the combined effects of lens material and tear exchange.

The entire corneal surface is covered by soft lenses, which means that both the centre and the periphery of the cornea are impacted by the changed metabolic function. Wearers of RGP lenses do not experience any impairment in metabolic activity since the peripheral cornea is not covered by the lens in these cases. However, it is more exposed to the mechanical action of the lens edges during blinking and this causes peripheral corneal sensitivity loss.

As the eye relies on the corneal nerves to identify foreign things that could damage the ocular surface, a lower corneal sensitivity could be harmful to the cornea's long-term health. Contrarily, while the comfort of wearing contacts is enhanced by a decrease in corneal sensitivity, there is a corresponding rise in the possibility of an undetected foreign body on the ocular surface. It is possible for the harmful particle to get trapped under the lens, extending the time that it may cause eye irritation. Because of this, it's crucial that contact lens use have as little of an impact as possible on corneal nerve function.[9]

Contact lens removal can restore corneal sensitivity; however it depends on the type and quantity worn. After wearing soft contact lenses, sensitivity typically returns more quickly than with hard lenses.

Conclusion:

The study can be concluded by saying both soft hydrogel and RGP lens wearer produced similar type of corneal sensitivity loss, although the mechanism for this loss is different for the two lens types. The recovery of corneal sensitivity loss is achieved by cessation of contact lens. This review has demonstrated the usefulness of assessing corneal sensitivity as a measure of corneal health with contact lens wear. This study was done manually assessing the time period. The limitation of this study can be overcome by the availability of aesthesiometer for more precise reading.

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