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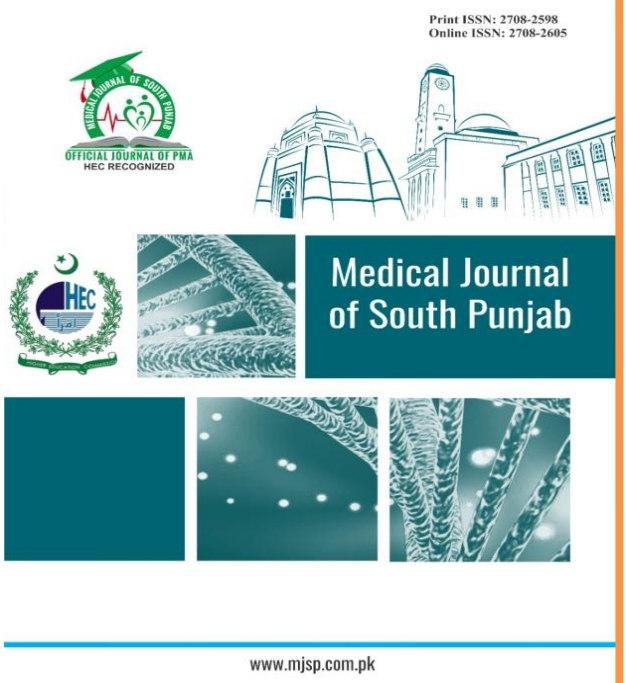

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Original Article

Variation in corneal curvature and thickness after wearing corneal and scleral RGP contact lenses for three months in patients of keratoconus

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ABSTRACT

Objective: To investigate the changes in corneal curvature and thickness in patients of Keratoconus, wearing Rose k2 corneal and XL (scleral lenses) from last three months.

Methods: Cross-sectional study was conducted at The Keratoconus Clinic, Eye 2 Eye Optometrists Lahore. A total of 44 eyes were fitted with rose k2 corneal (15) and rose k2 XL (29) lenses respectively. Curvature and thickness were measured by keratometry and pentacam scan at two time points: first on lens dispensing visit and three month later after some hours of lens wear. Variation in curvature and thickness were measured.

Results: The study comprised twenty-three people with keratoconus (44 eyes). Eight patients (15 eyes) were using Rose K2 corneal design, whereas fifteen patients were using Rose K2 XL(scleral) lenses (29 eyes). The average optical Pachymetry was ±2.7 percent higher ($p<0.001$) three months following lens removal than at the dispensing visit. Following contact lens wear, the average K1 (flat) was 0.29 diopters (D) lower ($p=0.037$), whereas the average K2 (steep) was 0.70 diopters (D) lower ($p<0.001$).

Conclusion: This study concluded that rose k2 corneal and XL lenses caused flattening of corneal curvature and increased the pachymetry values as well but the duration of this change is unknown.

Keywords: Keratoconus, Corneal RGP, Scleral Lenses, corneal pachymetry and curvature

1. INTRODUCTION

Different from uneven astigmatism resulting from corneal ectasia, keratoconus is a gradual, degenerative corneal dystrophy.[1, 2] Depending on the severity of the condition, corneal ectasia can cause distortion and loss of vision in keratoconus patients. This condition is frequently irreversible even with traditional glasses and contact lenses. Keratoconus typically manifests as asymmetric expression even if it is bilateral. It usually appears in adolescence, develops during that time, and settles in the fourth decade.[1, 3] Keratoconus has no single cause, however it has been associated with rubbing one's eyes, atopy, heredity, connective tissue anomalies, Down syndrome, and oxidative stress.[4]

A practitioner may be prompted to examine or diagnose keratoconus if they observe clinical signs such as Vogt's striae, Fleischer's ring, stromal thinning, corneal scarring, or, in the early stages, decreased vision that cannot be restored to 20/20 in the absence of additional variables.[5,7]When diagnosing and treating individuals with keratoconus, it is clinically advisable to assess corneal pachymetry using topography and tomography.[8] Divergent views exist regarding the frequency of keratoconus in men and women; various outcomes have been documented for both kinds of cases, and several investigators propose that the ailment impacts both genders equally.[9, 10]

The diseased "cone" area—the precise location of which varies—is where corneal ectasia happens. cause the cornea to sustain structural damage, which would restrict its ability to serve as the visual system's transparent refractive interface.[11,12] .As keratoconus grows, visual implications frequently become more visible to the patient; nevertheless, they are usually more severe in one eye than the other, especially in the early stages.[13]

By maintaining a rigid spherical surface on the anterior plane of the ocular refraction system, the tear film, which has a refractive index close to the cornea, and the optically smooth lens can neutralise a significant amount of irregular astigmatism and aberrations caused by the irregular anterior cornea.[14] Instead of fitting these lenses to intentionally bear on the apex of the cone, which caused and exacerbated apical scarring and other undesirable effects, or using the apical clearance method, where there is a risk of increased lens-to-cornea adhesion and seal-off in the periphery, the 3-point touch philosophy should be used to fit these lenses.

Large-diameter gas-permeable contact lenses that vault over the ocular surface and land on the sclera are known as scleral contact lenses because they leave a fluid layer between the lens and the eye.[15] The typical size range for scleral lenses is 15 to 25 mm, depending on the size and how it relates to the patient's ocular surface anatomy.[16]

2. METHODOLOGY

Cross-sectional study was conducted at The Keratoconus Clinic, Eye 2 Eye Optometrists Lahore during 3 months of duration. Sample size was calculated according to WHO formula using convenient sampling technique.

Sample Size:

$$\underline{n = Z^2 p(1-p)}$$

$$d^2$$

N= Sample Size

Z= Confidence Interval =95%=1.96

d = error = 5% = 0.05%

p= prevalence value 0.03

So,

$$n = \frac{(1.96)^2(0.05)(1-0.138)}{(0.05)^2}$$

$$n = 44$$

Prior to the initiation of any experimental procedure or data collection, all individuals provided written informed consent. 23 (44 eyes) young, healthy adult individuals aged 18 to 39 years old took part in the study.

3. RESULTS

In Rose K2 Corneal RGP On dispensing visit mean ±SD was on K steep 51.9913±5.84713 and on K flat was 48.2413±5.57652 and after 3 month treatment mean ±SD was 51.2613±5.83600 on K steep and 47.9300±5.58591 on K flat and mean difference was .32315. There was significant difference founded between groups at p-value .007.

In Rose K2 XL scleral On dispensing visit mean ±SD was on K steep 52.8576±8.09022and on K flat was 48.5645±7.11697and after 3 month treatment mean ±SD was 52.1279±8.08953on K steep and 48.2590±7.12175on K flat and mean difference was .32897. There was significant difference founded between groups at p-value .015.

In Rose K2 Corneal RGP On dispensing visit mean ±SD was 502.0667±21.25178 on dispensing visit and after 3-month treatment mean ±SD was 517.6000±21.34345 on K steep and mean difference was 8.55402. There was significant difference founded between groups at p-value .025.

In Rose K2 XI scleral on dispensing visit mean ±SD was 510.6207±13.94739 and after 3 month treatment mean ±SD was 525.7931±13.70969 o and mean difference was 8.19310. There was significant difference founded between groups at p-value .019.

Table-1:Curvature of cornea on dispensing and follow up visit after three months of Rose K2 Corneal RGP and Scleral lens wear.

Contact Lens	On Dispensing Visit		After 3 Months Of Lens Wear			
	K Steep	K Flat	K Steep	K Flat	Difference In Curvature	P-Value
Rose K2 Corneal RGP(15)	51.9913 ±5.84713	48.2413±5.57652	51.2613± 5.83600	47.9300±5.58591	.32315	.007
Rose K2 Xl (Scleral) (29)	52.8576 ±8.09022	48.5645±7.11697	52.1279±8.08953	48.2590±7.12175	.32897	.015

This table explains the significant difference in the values of both groups. The standard difference in both was around ±SD 0.325.

Table-2: corneal thickness on dispensing and follow up visit after three months of Rose K2 Corneal RGP and Scleral lens wear.

Contact Lens	On Dispensing Visit	After 3 Months Of Lens Wear	Difference	P-Value
Rose K2 Corneal RGP	502.0667±21.25178	517.6000±21.34345	8.55402	.025
Rose K2 Xl (Scleral)	510.6207±13.94739	525.7931±13.70969	8.19310	.019

This table explains that there was significant difference founded between groups at p-value .025. In Rose K2 XI scleral on dispensing visit mean ±SD was 510.6207±13.94739 and after 3 month treatment mean ±SD was 525.7931±13.70969 o and mean difference was 8.19310. There

was significant difference founded between groups at p-value .019.

4. DISCUSSION

The introduction of modern rigid gas permeable (RGP) materials with excellent oxygen permeability has made contact lens wear safer (Dk). ScCL wear, on the other hand, decreases the amount of oxygen reaching the cornea as a result of the lens and the thickness of the post-lens tear layer.[17, 18] Hypoxia can create corneal edema, which could jeopardize the optical treatment's effectiveness. ScCL has become one of the most common treatments for keratoconus; however its safety and impact on the anterior region must be thoroughly researched. In previous studies, it was discovered that ScCL has an effect on the ocular surface in keratoconus patients.

A study observed that corneal RGP lenses induced temporary flattening of the corneal curvature, which was reversible upon discontinuation of lens wear.[19] This aligns with our results, as we noted a decrease in K1 and K2 values post-lens removal. , supporting our findings of a 0.29 D and 0.70 D reduction in K1 and K2, respectively .Regarding scleral lenses, The study showing a 2.7% gain in pachymetry and high levels of corneal flattening -0.29 D flat K and -0.70 D steep K (18) are exactly the same as our study that also showed a 2.7% gain in corneal thickness and approximately 0.50 D of anterior corneal flattening respectively.

The other study proved that the scleral lenses with thicker post-lens tear films (≥350 μm) cause a significant corneal edema (mean 4.27%) under open-eye conditions because of oxygen deprivation especially when the materials are lower Dk.(17) Contrary our analysis indicate a comparable degree of corneal thickening (~8.285 μm) following three months of corneal RGP and scleral lens wear indicating that chronic lens wear with the current designs can still cause significant corneal swelling.

Another study prove the effectiveness of scleral lenses in treating keratoconus with great improvement of visual acuity[20]. Nonetheless, other reports on the study show outstanding long-term safety and a low incidence of physiological adverse events (9.6%), our results show a tremendous increase of corneal thickness after only three months of wear (~8.2 μm), which is a possible indication of corneal edema[20]. This indicates that even when the overall safety profiles are good, certain physiological alterations such as swelling may happen at relatively early age, which may be attributed to factors such as post-lens tear film thickness and oxygen transmissibility.Our results are in line with other literature that express worries of hypoxia-induced edema, where the optimal lens fitting and material choice would reduce edema.

In other study suggest that the lenses allow a significant percentage of patients to obtain satisfactory visual acuity, but it states that there may be complications such as corneal edema due to such factors as the post-lens tear film thickness[21] Comparatively, our findings also indicate a large visual improvement with both kinds of lenses but also record a slight and statistically significant corneal curvature increase and a larger increase in corneal thickness (~8.2um) at three months of wear. That implies that although the lenses are efficient, they can cause the corneal shape alteration and physiological swelling.

Another research study established that the corneoscleral profile of keratoconus eye is much steeper and asymmetric than that of the control and that corneal and scleral lens wear cause regional changes in shape, such as flattening in some quadrants and steepening in other quadrants.[22] Comparatively, our findings also indicate that lens wear causes

important changes, namely, a small yet statistically significant flattening of corneal curvature (mean difference = 0.33D) and a much larger increase in corneal thickness (=8.2mu) after three months of wear with both Rose K2 corneal and scleral lenses.

The effect on tear osmolarity in healthy first-time wearers of a scleral contact lens was studied and reported a statistically significant increase between a baseline and 1 month of wearing the scleral lens (p=0.001), indicating that scleral lenses cause a matter to alter the tear film and possibly to reduce tear production.[23] Our results, in turn, also evidence a substantial physiological change upon the use of lenses, but our data evidences a structural change, namely, the corneal thickness increase of about 8.2 to 8.5µm off the end of three months when using both Rose K2 corneal and scleral lenses.

5. CONCLUSION

Finally, our research reveals that wearing RGP contact lenses flattens the anterior cornea and reduces corneal asphericity and astigmatism. Changes in the front corneal surface following three months of lens wear are clinically significant as far as corneal curvature and thickness is concerned, since it should not be confused as keratoconus improvement. Then again, it's critical to check whether adjustments on the front corneal surface that show up after a short period of time endure or advance over the long haul.

6. REFERENCES

1. Bennett ES, Henry VA. Clinical manual of contact lenses: Lippincott Williams & Wilkins; 2013.
2. Gomes JA, Tan D, Rapuano CJ, Belin MW, Ambrósio Jr R, Guell JL, et al. Global consensus on keratoconus and ectatic diseases. Cornea. 2015;34(4):359-69.
3. Krachmer JH, Feder RS, Belin MW. Keratoconus and related noninflammatory corneal thinning disorders. Survey of ophthalmology. 1984;28(4):293-322.
4. Martínez-Abad A, Piñero DP. New perspectives on the detection and progression of keratoconus. Journal of Cataract & Refractive Surgery. 2017;43(9):1213-27.
5. Barr JT, Wilson BS, Gordon MO, Rah MJ, Riley C, Kollbaum PS, et al. Estimation of the incidence and factors predictive of corneal scarring in the Collaborative Longitudinal Evaluation of Keratoconus (CLEK) Study. Cornea. 2006;25(1):16-25.
6. Mandell RB. Contemporary management of keratoconus. International Contact Lens Clinic. 1997;24(2):43-58.
7. Rabinowitz Y. Keratoconus Surv Ophthalmol, 42 (1998). View PDF View article View in Scopus.297-319.
8. Layer ANP-Ds. Human Corneal Anatomy Redefined.
9. Owens H, Gamble G. A profile of keratoconus in New Zealand. Cornea. 2003;22(2):122-5.
10. Wagner H, Barr J, Zadnik K, Group CLEoKS. Collaborative Longitudinal Evaluation of Keratoconus (CLEK) Study: methods and findings to date. Contact Lens and Anterior Eye. 2007;30(4):223-32.
11. Buxton JN. Contact lenses in keratoconus. Eye & Contact Lens. 1978;4(3):74-85.

12. Perry HD, Buxton JN, Fine BS. Round and oval cones in keratoconus. Ophthalmology. 1980;87(9):905-9.

13. Lee LR, Hirst LW, Readshaw G. Clinical detection of unilateral keratoconus. Australian and New Zealand journal of ophthalmology. 1995;23(2):129-33.

14. Griffiths M, Zahner K, Collins M, Carney L. Masking of irregular corneal topography with contact lenses. Eye & Contact Lens. 1998;24(2):76-81.

15. Deshpande AP. Rapid Heterogeneous Integration Technologies for Ocular Microsystems: Autofocusing Smart Contact Lenses: The University of Utah; 2024.

16. van der Worp E, Bornman D, Ferreira DL, Faria-Ribeiro M, Garcia-Porta N, González-Meijome JM. Modern scleral contact lenses: a review. Contact Lens and Anterior Eye. 2014;37(4):240-50.

17. Compan V, Oliveira C, Aguilella-Arzo M, Mollá S, Peixoto-de-Matos SC, González-Méijome JM. Oxygen diffusion and edema with modern scleral rigid gas permeable contact lenses. Investigative ophthalmology & visual science. 2014;55(10):6421-9.

18. Giasson CJ, Morency J, Melillo M, Michaud L. Oxygen tension beneath scleral lenses of different clearances. Optometry and Vision Science. 2017;94(4):466-75.

19. de Araújo RJFM. Clinical performance and biological interactions during scleral contact lens wear: Universidade do Minho (Portugal); 2019.

20. Fuller DG, Wang Y. Safety and efficacy of scleral lenses for keratoconus. Optometry and Vision Science. 2020;97(9):741-8.

21. Lim L, Lim EWL. Current perspectives in the management of keratoconus with contact lenses. Eye. 2020;34(12):2175-96.

22. Van Nuffel S, Consejo A, Koppen C, Kreps EO. The corneoscleral shape in keratoconus patients with and without specialty lens wear. Contact Lens and Anterior Eye. 2021;44(3):101343.

23. Lau JK. The Effect of Scleral Contact Lens Wear on Tear Osmolarity. CRO (Clinical & Refractive Optometry) Journal. 2020;31(3).