



Original Research Article

## **An Investigation into the Radius of Curvature of the Cornea of Young Adults in Relation to the Conformity of an 8.6mm Base Curve Contact Lens**

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### **ABSTRACT**

A greater majority of contact lenses supplied by importers in Nigeria have a base curve of 8.6mm. Clinical practice has shown that this fits comfortably on a cornea with a radius of curvature of 7.8mm. People with a cornea radius of curvature below 7.8mm will find such contact lenses to be too loose on the cornea causing it to fall out. Also people with a radius of curvature above 7.8mm will find such contact lenses to be too steep on the cornea causing pain and discomfort. The radius of curvature of the cornea of 249 subjects making up 498 eyes were measured and compared to 7.8 mm. Results from this study showed that 13.7% of these eyes had a cornea radius of curvature of 7.8 mm; 61.2% had a radius of curvature above 7.8 mm and 25.1% had a radius of curvature below 7.8 mm. Result from this study also showed the mean ( $\pm$ S.D) radius of curvature of the male and female subjects to be  $8.03\pm 0.29$  mm and  $7.91\pm 0.28$  mm respectively. Statistical analysis of gender differentiation of the cornea radius of curvature using the Paired T-test at 95% confidence interval and 0.05 level of significance showed that there is a significant difference in the radius of curvature.

**Keywords:** Contact lens, Base curve, Radius of Curvature, Cornea

### **INTRODUCTION**

The cornea is a transparent, dome-shaped window covering the front of the eye. It can also be seen as the slightly raised part of the front of the eyeball. It is a powerful refracting surface, providing two-third of the eye's focusing power. <sup>(1)</sup> Like the crystal on a watch, it gives us a clear window to look through. The cornea is extremely sensitive. There are more nerve endings in the cornea than anywhere else in the body. The cornea serves as a gateway into the eye for the external images. The

avascular cornea is not an isolated tissue. It forms together with the sclera, the outer shell of the eyeball, occupying one third of the ocular tunic. It accounts for a substantial proportion of both anterior ocular surface of the conjunctival fibrous collagen which is responsible for the mechanical strength of both the sclera and cornea, protecting the inner components of the eye from physical injury and maintaining the ocular contour. The cornea also contributes to the ocular biodefense system. <sup>(1)</sup> A slight change in corneal contour may result in a refractive

error. Small changes in the smoothness of the cornea surface or in the total thickness of the cornea can lead to visual distortion. The shape of the anterior corneal surface is transversely oval as a result of scleralization superiorly and inferiorly. The adult human cornea measures about 11-12mm horizontally and 9-11mm vertically. <sup>(2)</sup> It is approximately 0.5mm thick at the center and the thickness increases gradually towards the periphery where it is about 0.7mm thick. The curvature of the corneal surface is not constant being greatest at the center and smallest at the periphery. The radius of curvature is between 7.5mm and 8.0mm at the central 3mm optical zone of the cornea where the surface is almost spherical. The refractive power of the cornea is 40-44 diopters and constitutes about two third of the refractive power of the eye. <sup>(2)</sup> Optical properties of the cornea are determined by its transparency, surface smoothness, contour and refractive index.

Contact lenses are tiny saucer-shaped pieces of plastic. They are placed on the cornea of the eye and float on a thin layer of tear fluid. In some cases, contact lenses may offer improved vision correction when compared to glasses because they correct the refractive error closer to the eye. Contact lenses are considered medical devices that fit on top of the cornea and provide a wider field of view unobstructed by the lenses or frames and can be worn to correct vision, for cosmetic or therapeutic reasons. <sup>(2)</sup> Age and gender can influence attitude towards ametropic correction with females showing the most change over time. <sup>(3)</sup> People choose to wear contact lenses for many reasons. Aesthetics and cosmetics are often motivating factors for people who would like to avoid wearing glasses or would like to change the appearance of their eyes. Other people wear contacts for more visual reasons. When compared with spectacles, contact lenses typically provide

better peripheral vision, and do not collect moisture such as rain, snow, condensation, or sweat. This makes them ideal for sports and other outdoor activities. Additionally, there are conditions such as keratoconus and aniseikonia that are typically corrected better by contacts than by glasses. <sup>(4)</sup>

The base curve of a contact lens is the curvature of the back surface. Contact lenses must fit well to the wearer's cornea in order to be comfortable and to facilitate tear exchange and oxygen transmission. The central area of the anterior surface of a normal cornea is measured by its two principal meridians. A cornea with different radii of curvature can usually be considered a toric refracting surface. The measurement of the radius of curvature of the cornea and its refractive power with the use of a keratometer is called keratometry.

In Nigeria, a greater majority of contact lenses supplied by contact lens importers have a base curve of 8.6mm. Clinical practice has shown that this fits comfortably on a cornea with a radius of curvature of 7.8mm. People with a cornea radius of curvature below 7.8mm will find such contact lenses to be too loose on the cornea causing it to fall out. Also people with a radius of curvature above 7.8mm will find such contact lenses to be too steep on the cornea causing pain and discomfort. For people with a cornea radius of curvature of 7.8mm, they will find a contact lens of 8.6mm base curve to be quite comfortable. In a study conducted to determine the influence of the base curve on the movement on the corneal surface and on the subjective comfort, there was a statistically significant difference on comfort rate between the lenses of 8.4 mm base curve and 8.6 mm base curve. <sup>(5)</sup> Odjimogho and Akinlabi <sup>(6)</sup> did a study on comparative study of corneal curvatures between hyperopes and myopes. The vertical and horizontal central corneal curvatures of all subjects were measured

with Bausch and Lomb Keratometer. The results obtained showed that the observed mean for hyperopic k-reading was slightly higher than that of myopes and there was a significant statistical difference between k-readings for hyperopes and myopes using unpaired T-test.

## MATERIALS AND METHODS

This study was carried out in Optometry clinic of Madonna University Teaching Hospital, Elele, Rivers State, Nigeria. The study was a prospective clinical research in which two hundred and forty nine subjects between the ages of 18-29 years were used. Eighty-eight subjects were males and one hundred and sixty-one subjects were females. All the subjects used for this study gave a written consent to be part of the research. The procedure involved taking a complete profile of the subjects. Internal and external examination of the eyes was carried out with the Keeler Ophthalmoscope and Slit-Lamp Biomicroscope respectively in order to exclude subjects with pathological abnormalities of the eyes. The Bausch and Lomb Keratometer was then used to measure the radius of curvature of both eyes.

### Statistical Methods

The SPSS statistical software program was used to analyze the data obtained from the research. The gender differentiation of radius of curvature of the cornea was tested using the Paired T-test at 95% confidence interval and 0.05 level of significance.

## RESULTS

Using a 7.8 mm radius of curvature as our reference for a good conformity to an 8.6mm contact lens base curve, we found that from the 249 subjects examined, 13.7% had a cornea radius of curvature of 7.8 mm; 61.2% had a radius of curvature

above 7.8 mm and 25.1% had a radius of curvature below 7.8 mm. Statistical analysis of the gender differentiation of cornea radius of curvature showed that there was a significant difference in radius of curvature between the male and female subjects.

## DISCUSSION

Out of the 249 subjects used for this study, 88 were males while 161 were females. Table 1 shows the age group representation of the subjects; the frequency and the percentage frequencies. In Table 2, the cornea radius of curvature of both eyes of the subjects is shown. For the 249 subjects, 498 eyes were examined and 68 eyes had a cornea radius of curvature of 7.8 mm. A contact lens with 8.6 mm base curve will fit comfortably on the cornea of these subjects. Santodomingo-Rubido, et al.<sup>(7)</sup> in his study found the mean comfort radius of curvature for an 8.6 mm contact lens base curve to be  $7.7 \pm 1.8$  mm. From Table 2, three hundred and five eyes had a radius of curvature above 7.8 mm, while 125 eyes had a radius of curvature below 7.8 mm. The mean radius of curvature for the male and female subjects was 8.03 and 7.91 mm respectively as shown in Table 3. The table also shows the standard deviation, variance and standard error mean. Statistical analysis of the gender differentiation of the cornea radius of curvature using the paired T-test at 95% confidence interval and 0.05 level of significance showed that there is a significant difference in the radius of curvature. The SPSS data output is shown on Table 4.

**Table 1: Frequency distribution of subjects according to age group.**

Age Group	Frequency	Percentage Frequency (%)
18-20	100	40.2
21-23	76	30.5
24-26	49	19.7
27-29	24	9.6
Total	249	100

**Table 2: Frequency distribution of the cornea radius of curvature using 7.8 mm as reference.**

Radius of Curvature (mm)	Frequency	Percentage Frequency (%)
7.8	68	13.7
Above 7.8	305	61.2
Below 7.8	125	25.1
Total	498	100

**Table 3: Statistical values of the cornea radius of curvature for the male and female subjects.**

Radius of Curvature(Mm)	Frequency	Mean	Standard Deviation	Variance	Standard Error Mean
Male	176	8.03	0.29	0.082	0.022
Female	322	7.91	0.28	0.077	0.015

**Table 4: SPSS data output for testing of hypothesis of males and females radius of curvatures using the Paired sample T-test.**

	Paired Differences					T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 FEMALES – MALES	-.12239	.40615	.03061	-.18281	-.06197	-3.998	175	.000

Contact lens wear is common in the developed and developing part of the world. It is worn for refractive, therapeutic and cosmetic purposes. In a study conducted in Port-Harcourt, Rivers State, it was concluded that the annual contact lens patient flow increased from two hundred and forty four in 2003 to three hundred and forty-five in 2006 indicating a 40-41% increase.<sup>(8)</sup> A study in Owerri, Nigeria showed that young adults within the age range of 20-34 years made up the greater age group of contact lens wearers with 60.89%.<sup>(9)</sup> From our study, a majority of the subjects had a cornea radius of curvature above 7.8 mm. These people are likely to experience some pain and discomfort while wearing the contact lenses with an 8.6 mm base curve as the lenses will be too steep on the cornea. Also those with a radius of curvature below 7.8 mm will find a contact lens with a base curve of 8.6 mm to be too loose and hence may tend to fall out of the cornea surface. These two group of people will require a change of their contact lenses

earlier than scheduled as they are not comfortable with what they have. In the developing countries like Nigeria, contact lenses are less affordable than spectacles and requires to be replaced a lot sooner than spectacles. Having to change a contact lens a lot sooner than scheduled will have further impact on the finances of the patient. A study showed poor comfort fit of an 8.6 mm base curve contact lens on corneas above 8.0mm radius of curvature.<sup>(10)</sup> This research affords the eye care practitioners the means to advice the importers of contact lenses in Nigeria on the need for a wider variety of base curves of contact lenses order than the very common 8.6 mm base curves that are widely imported. There is a strong need for a good communication line between the eye care practitioners and the suppliers of these contact lenses so as to ensure that contact lens users enjoy good value for their money.

### CONCLUSION

Results obtained from this study showed that there is a great number of

young adults with radius of curvature greater than 7.8mm which means that an 8.6mm base curve soft contact lens will be too steep and will cause considerable pain and discomfort on the persons wearing them. A much greater variety of base curve contact lenses is needed to give the eye care practitioner more options when fitting contact lenses on their patients. Base curves such as 8.5 mm, 8.7 mm, 8.8 mm, etc. are needed in greater quantities ensure proper fitting of contact lenses.

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