

## Visual outcome in Keratoconus with spherical rigid gas permeable contact lens

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### Abstract

**Introduction:** Keratoconus is a bilateral asymmetric progressive ectasia of cornea commonly associated with vernal keratoconjunctivitis and Atopic dermatitis. Rigid gas permeable (RGP) contact lens is the first choice for refractive correction in keratoconic eyes. The visual outcome in Keratoconus with spherical RGP contact lens along with the mean age of presentation, gender predominance, ethnicity, associated conditions, refractive error and corneal astigmatism was evaluated.

**Methods:** The records of the Keratoconus patients attending cornea and contact lens clinic for last 6 years were reviewed and analyzed using SPSS-14 software. Data on laterality, race, age, gender, refractive error, visual acuity (VA), associated conditions and contact lens parameters were obtained. A total of 22 patients with 38 keratoconic eyes were included in the study.

**Results:** The mean age of Keratoconus presentation was  $18.11 \pm 4.45$  years. Sixteen cases (72.73 %) were bilateral; 6 (27.27 %) were unilateral. Mean uncorrected visual acuity (UCVA) was  $0.86 \pm 0.40$  Log MAR. Mean spectacle visual acuity was  $0.54 \pm 0.38$  Log MAR. Mean visual acuity with spherical RGP contact lenses was  $0.08 \pm 0.14$  Log MAR. The difference between mean spectacle visual acuity and mean VA with spherical RGP contact lens was statistically significant ( $p < 0.001$ ).

**Conclusion:** In all stages of Keratoconus, improvement in visual acuity with spherical RGP contact lens was highly significant.

**Key words:** Contact Lenses, Keratoconus, Visual Acuity.

### Introduction

Keratoconus is a bilateral, asymmetric, chronic, progressive ectasia of the cornea characterized by steepening and distortion of the cornea, thinning of the apical cornea, and sometimes, corneal scarring.

<sup>[1]</sup> It is characterized by progressive irregular myopic astigmatism, central corneal thinning, and protrusion.

<sup>[2]</sup> It is bilateral in 96% of cases, although asymmetric cases are also possible.<sup>[3]</sup> Keratoconus typically appears between the age of 10 and 20 years.<sup>[4]</sup>

There is a large variation in prevalence of Keratoconus in different regions due to its genetic nature and substantial variation in the diagnosis.<sup>[5]</sup>

Keratoconus is usually an isolated (non-syndromic) disease, but it has been associated with the Down syndrome, Leber's congenital amaurosis, Turner syndrome, prolapse of the mitral valve, collagenoses, Retinitis pigmentosa and Marfan syndrome.<sup>[6]</sup>

The treatment of the Keratoconus and other non-inflammatory corneal diseases connected to the corneal thinning can vary from a simple correction with glasses to keratoplasty.<sup>[7, 8]</sup> Contact lenses form the mainstay-therapy in Keratoconus.<sup>[9]</sup> They should be prescribed as soon as possible in cases with Keratoconus in order to prevent further development of amblyopia.<sup>[4]</sup> The visual

acuity (VA) in Keratoconus is far better with contact lenses (CL) than with glasses.<sup>[7, 8]</sup>

A study was conducted to determine the visual outcome in Keratoconus with spherical RGP contact lens along with the mean age of presentation, gender predominance, ethnicity, associated conditions, refractive error and corneal astigmatism.

## Methods

The records of the Keratoconus patients attending cornea and contact lens clinic for the first time for last 6 years were reviewed. Data on laterality, ethnicity, age, gender, refractive error (objective and subjective), Visual Acuity (VA) (Uncorrected, with spectacles and with RGP contact lenses ), associated conditions, keratometric readings (K) and contact lens parameters [Back optic zone radius (BOZR), Total diameter (TD), Back optic zone diameter (BOZD) and power of the RGP contact lens] were obtained. Thirty eight eyes of 22 patients were included in the study.

The keratoconic cases were classified on the following groups based on the Keratometric values (K) of the flatter meridian:<sup>[10]</sup>

- Early stage of Keratoconus ( $K < 48D$ )
- Mid stage of Keratoconus ( $K = 48 - 54 D$ )
- And late stage of Keratoconus ( $K > 54 D$ )

Data were plotted in the excel spreadsheet and analyzed using SPSS 14.0 software. The data were divided into series with attributive features and series with numeric features. The percentage of the structure was prepared in the series with attributive features, while the average value and the standard deviation were prepared in the series with numeric features. The differences between the VA with different means were analyzed using paired t test. The p value of less than 0.01 was considered as significant.

## Results

Mean age of presentation of the keratoconic cases was  $18.11 \pm 4.45$  years ranging from 10 to 24 years. Regarding gender distribution, 77.27% (17) were males and 23% (5) were females. Out of a total number of 22 patients, 72.23% (16) had bilateral Keratoconus and 27.77% (6) had unilateral Keratoconus. Of the 22 patients, majority were Aryans (68.18%,  $n=15$ ) and the rest (31.82%,  $n=7$ ) were Mongolians.

Keratoconus was mostly associated with Vernal Keratoconjunctivitis followed by atopic cases.

Mean corneal curvature in vertical meridian was  $53.63 \pm 7.10 D$  whereas that in the horizontal meridian was  $49.34 \pm 6.11 D$  as seen in (Table 1). Most of the cases had with the rule astigmatism followed by irregular astigmatism.

**Table 1: Keratometric values showing Mean Corneal Curvature**

|                   | Keratometry (mm) | Keratometry (Dioptres) |
|-------------------|------------------|------------------------|
| <b>Vertical</b>   | $6.37 \pm 0.75$  | $53.68 \pm 7.10$       |
| <b>Horizontal</b> | $6.99 \pm 0.69$  | $49.34 \pm 6.11$       |

Twenty three eyes (60.53%) had early Keratoconus, 7 (18.42%) had mid Keratoconus and 8 (21.05%) eyes had late Keratoconus as shown in (Table 2)

**Table 2: Grading of Keratoconus according to Keratometry Readings**

|                        | Frequency (N) | Percent (%) |
|------------------------|---------------|-------------|
| <b>Early (Mild)</b>    | 23            | 60.53       |
| <b>Mid ( Moderate)</b> | 7             | 18.42       |
| <b>Late (Severe)</b>   | 8             | 21.05       |
| <b>Total</b>           | <b>38</b>     | <b>100</b>  |

Regarding astigmatism, cylindrical power upto -9 D was determined with the mean value of  $-3.34 \pm 2.13 D$ .

Mean uncorrected visual acuity (UCVA) was  $0.86 \pm 0.40$  Log MAR whereas mean visual acuity with RGP contact lens was  $0.08 \pm 0.14$  Log MAR which was significantly better ( $P < 0.0001$ ). Similarly, comparing visual acuity with RGP contact lens ( $0.08 \pm 14$  Logmar) and with spectacle ( $0.54 \pm 0.38$  Logmar), visual acuity with RGP contact lens was significantly better ( $P < 0.0001$ ) as shown in (Table 3).

**Table 3: Visual Acuity in Keratoconus with spectacle and RGP lenses**

|                            | Mean (Log MAR)  |
|----------------------------|-----------------|
| <b>UCVA</b>                | $0.86 \pm 0.40$ |
| <b>Spectacle VA</b>        | $0.54 \pm 0.38$ |
| <b>RGP Contact Lens VA</b> | $0.08 \pm 0.14$ |

With RGP CL, 86.84% of the cases had VA better than 0.18 Log MAR. Other 10.53% had VA better than 0.48 Log MAR. In one of the eyes with severe Keratoconus, VA didn't improve significantly with RGP contact lens and hence was planned for penetrating keratoplasty (PK) as shown in (Table 4)

**Table 4: Visual Acuity Improvement in Keratoconus patients with RGP contact lenses**

| VA § in Log MAR ¥ | Snellen VA § (Equivalent) | Frequency | Percentage |
|-------------------|---------------------------|-----------|------------|
| =< 0.18           | >= 6/9                    | 33        | 86.84%     |
| 0.20–0.48         | 6/9–6/18                  | 4         | 10.53%     |
| >= 0.50           | =< 6/18                   | 1         | 2.63%      |

¶RGP = Rigid gas permeable

¥ MAR = Minimum Angle of Resolution

§VA = Visual Acuity

Mean visual acuity with RGP contact lens in early Keratoconus was  $-0.01 \pm 0.26$  Log MAR, in mid Keratoconus was  $0.16 \pm 0.18$  Log MAR and in late Keratoconus was  $0.32 \pm 0.61$  Log MAR as seen in table (Table 5)

**Table 5: Mean Visual acuity with RGP lenses in different grades of Keratoconus.**

|                | Early (Mild) Keratoconus | Mid (Moderate) Keratoconus | Late (Severe) Keratoconus |
|----------------|--------------------------|----------------------------|---------------------------|
| Mean (Log MAR) | $-0.01 \pm 0.26$         | $0.16 \pm 0.18$            | $0.32 \pm 0.61$           |

Mean BOZR of the spherical RGP contact lens used was  $6.93 \pm 0.44$  mm. Mean Power of the RGP contact lens used was  $-4.95 \pm 2.82$  Dioptre.

Discussion

Typically, Keratoconus presents in early adulthood and visual symptoms result from irregular astigmatism and increasing myopia.<sup>[6, 7]</sup> In Our study, the mean age of presentation was  $18.11 \pm 4.45$  years. Similarly, in a study conducted by Ljubic the mean age value of Keratoconus onset was  $26.81 \pm 1.25$ .<sup>[4]</sup> Georgiou *et al* have reported that Asian patients presented at a statistically younger age than white patients; a mean age of 21.5 vs 26.4 years.<sup>[11]</sup> These findings were supported by those of Pearson *et al* who showed Asians presented at a mean age of 22.3 years.<sup>[12]</sup>

In our study, Keratoconus was bilateral in 72.23% cases. According to Rabinowitz *et al*, Keratoconus is bilateral in approximately 96% of the cases.<sup>[13]</sup> Burns *et al* also has reported Keratoconus to have bilateral involvement in over 90% of patients.<sup>[14]</sup>

According to Zadnik *et al*, there does not appear to be a significant difference in the incidence of Keratoconus between left and right eyes nor between males and females.<sup>[15]</sup> But, in our study majority of the cases (77.27%) were males. This may be due to the fact that in developing countries like Nepal, women have poorer reach to health care than men.

In terms of laterality and gender predominance, our study abides by the study done by Lim and Vogt,<sup>[1]</sup> but in the study done by Ljubic,<sup>[4]</sup> Keratoconus was more prevalent in females.

Greater population of Aryans in our set up could account to their greater presentation. Moreover, Aryans are more educated and aware than Mongolians as the latter mostly comprises of people with low socioeconomic status in the Nepalese community.

The cause of Keratoconus is unknown, although metabolic/chemical changes in the corneal tissue have been documented. However, the disease has been associated with atopy, connective tissue disorders, eye rubbing, contact lens wear, and inheritance. In our study, Keratoconus was mostly associated with vernal conjunctivitis and atopy. In fact, several studies suggest that Keratoconus is a complex genetic disease.<sup>[16]</sup>

The mainstay of optical correction for patients with Keratoconus is the wearing of rigid gas permeable (RGP) contact lenses because of the ability of RGP contact lenses to mask irregular astigmatism by creating a new, smooth optical refracting surface.<sup>[16]</sup>

In the study conducted by Jain *et al*, in 23 cases (38 eyes) of Keratoconus, the refractive cylinder ranged from one to eleven dioptres (Mean  $4.43 \pm 2.24$ D).<sup>[17]</sup> In our study, cylindrical power upto -9.00 D was determined with the mean value of  $-3.34 \pm 2.13$  D.

In the study of Lim N and Vogt U, with contact lens wear, 87% of patients had a visual acuity of 6/9 or better.<sup>[1]</sup> Similarly, in our study, 86.84% of the cases had visual acuity better than 0.18 Log MAR (equivalent to 6/9) and the other 10.53% had visual acuity better than 0.48 Log MAR (6/18) with spherical RGP contact lenses.

## Conclusion

The results show that there is a marked improvement in visual acuity by spherical RGP contact lens in all stages of Keratoconus. The difference between the visual acuity with spectacles and with RGP contact lens was highly significant. However, the improvement in visual acuity in early stage of Keratoconus is much more marked than in the mid and late stages.

**Conflict of interest:** None declared.

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