A Modern Approach of Rgp Lens Fitting in Keratoconus Patients

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Abstract:

Aim: To describe the correlation between base curve (BC) of RGP trial lens fitting and topographic findings. Methods: 245 eyes of 200 keratoconus patients (97 females and 103 males), who underwent RGP CL fitting, included in this study. Wavelight Advance Topographer (Oculyzer -II) was used to measure corneal curvature. All participants were divided in to 7 groups based on Sim-k reading. Statistical analysis: Pair t- test. Result: Significant correlation found between final lens BC and Sim-k reading of Oculyzer-II. For group 5 & 7, BC= steep sim-k. For group 2, BC= average sim-k. For Group 1,3,4& 6, BC= flat sim-k. Conclusion: The development of new theory for RGP lens fitting enables eye care professional to achieve an optimum-fit in a shorter period of time by reducing the no of trials. The customary lens fitting methods are suggested to be replaced by the correlation found in this study.

Keywords: Keratoconus (KCN), Rigid gas permeable lens (RGP), Advance topographer (Oculyzer), Contact lens fitting.

Introduction:

Keratoconus is the abnormal, asymmetric, bilateral, progressive thinning of cornea. Frequent changes in visual acuity is the most common symptom. Rapid changes of degree of astigmatism lead to spectacle lens failing to correct vision for long periods of time. Decreased visual acuity, Vogt's striae, Fleischer's ring, stromal thinning and apical corneal scarring are common clinical features of progressive thinning in keratoconus.[1] Rigid gas permeable lenses (RGP) are the treatment of choice to manage advanced keratoconus due to irregular astigmatism. Contact lens are frequently used to regain vision in patient with keratoconus treated with corneal transplants.[2-5,17]

Chan JS, Mandell RB et al. (1998) in their study on 19 RGP wearers tested for fluorescein patterns of RGP contact lenses of different BCs in keratoconic eye. From the central curvature and eccentricity, the experimentally determined alignment lens was compared to the theoretical alignment (TA) value. They found that in case of CL fitting instead of measurement of only central cornea, a knowledge about the eccentricity value from video-keratography gives a better prediction of the BC. [6]. Wishal D. et. al. (2003) in their study, out of 378 eyes of 218 patients with keratoconus, they found 257 (68%) were fitted with a pancorneal RGP-CL. The steep-k, flat-k and central *K*-values were used as parameter to predict the BC and radius of contact lens, though, for pancorneal RGP-CL the non-central *K*-minimum reading added most (35.5%) to the total explained variance in BC radius. While fitting the CL it was noted that women tended to have larger *K*-values than men. With respect to age no differences in *K*-values were found. They conclude that *K*-minimum as a non-central parameter may improve prediction of the final BC and radius for pancorneal RGP-CL reducing chair-time for contact lenses trials to achieve the best fit. They also found the correlation between progression pattern of keratoconus with gender, but not with age [7]. Renseto Ada C, Lipener C in (2005) there study of 53 patients who have undergone different refractive surgery, found an improvement of visual acuity in 60.21% of the cases (VA>20/40), with few complications. Cl is the best option of management of post-operative keratoconus eye to meet their expectation level in terms of visual acuity. To achieve better visual acuity for a keratoconus patient with CL demands knowledge, dedication of eye care practitioner **[8]**. Varsha M Rathi et al (2013) in their study they found that the fitting of contact lens in keratoconus can improve the vision and delay or obviate the need for keratoplasty. In-spite of longer chair-time, with the available different design and materials in the market, it is possible to fit contact lens in patient's eye with keratoconus. For RGP intolerant patient and patient with dry eye with keratoconus, other different modalities of contact lens (e.g., customized soft toric lenses or PBCL, hybrid lenses, Scleral lenses) can be fitted [9].

This study aims to understand the relationships of initial trial lens BC for RGP lens fitting in keratoconus patients from Oculyzer-II, sim-k reading. This study discussed the results of RGP contact lens fitting in moderate and severe keratoconus in Indian eyes.

Methodology: This study included 245 eyes of 200 keratoconus patients (97 females and 103 males), who underwent rigid gas permeable contact lens (CL) trial during 11-month period. Patients with RGP intolerance, ocular surface disorders due to RGP wearing, visual loss due to corneal pathology except Keratoconus, Dry eye, Irregular corneas after post penetrating keratoplasty and refractive surgery, any other corneal pathology were excluded from the study. The patients' folders were reviewed by an experienced ophthalmologist. All subjects were given comprehensive vision examinations before performing test. Pre-fitting best-corrected visual acuity was obtained after un-dilated retinoscopy and subjective refraction. Duo-chrome test was performed for all patients to assess the monocular spherical end point. None of the subjects had any known ocular disease except keratoconus. The data including patient's age, visual acuity, pre-fit Oculyzer data, keratometry readings and the final best-fit BC were extracted. The BC of the CL and the Oculyzer indices were analyzed to find the correlation.

The patients were then classified into seven groups based on their mean simulated keratometry reading: krf-krs (difference between 2 keratometry flat and steep) =0.3mm-0.6mm, krf-krs>0.6mm, krm :greater than or equal to 7.03mm and less than 8mm, krm: greater than or equal to 6.40mm and less than 7.03mm, krm: greater than or equal to 6.14mm and less than 6.40mm, krm: less than 6.14mm and krm: greater than 8mm as groups 1 to 7, respectively. This classification was chosen to show the classification of keratoconus in a better way [17]. Pair t-

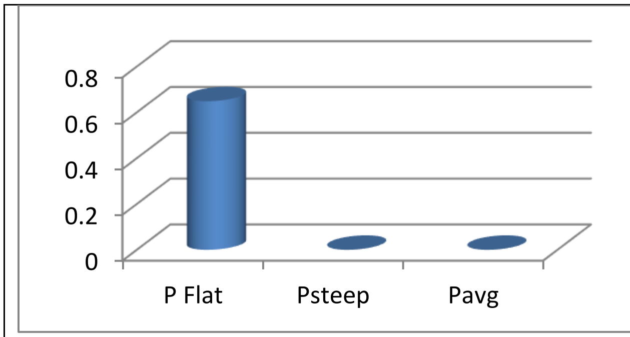
European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 7, Issue 11, 2020

test were employed to defer the formula(s) in an effort to describe the mathematical correlation between the pre-fit Oculyzer and the final best-fit BC. Both eye of each patient was used for analysis.

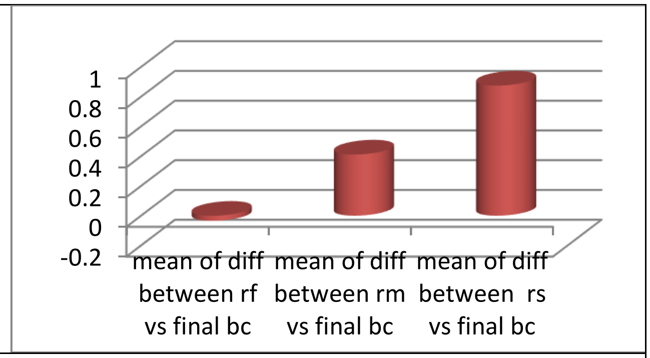
Results:

The data were statistically analyzed by calculating the means and standard deviations of keratometric reading for the entire individual groups as described in methodology.

Group 1: No statistically significant correlation was found between final lens BC and simulated keratometry reading for the Group 1 of patients krf-krs (difference between 2 keratometry flat and steep) >0.6. p (flat) =0.648, p (steep) =9.444, p (avg) =0642.Mean of diff between Krf vs final BC is -0.0338, mean of diff between Krm vs final BC is 0.4115, mean of diff between Krs vs final BC is 0.8747.

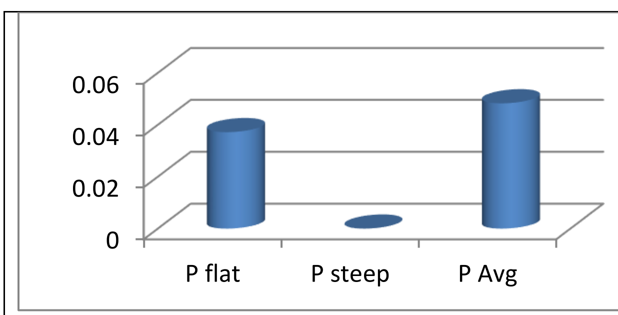


<u>Graph 1</u>: p value of group 1

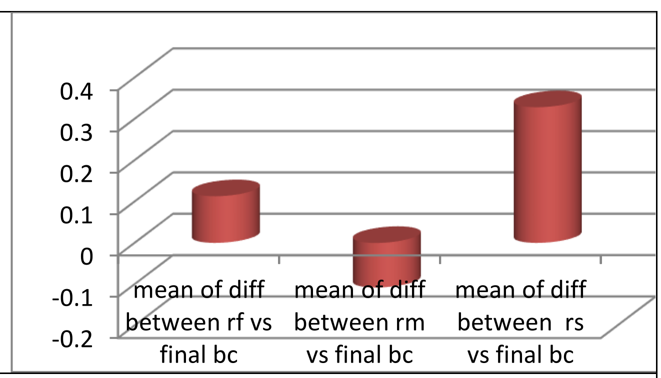


<u>Graph 2:</u> mean difference between final contact lens BC and simulated keratometry reading of group 1.

Group 2 of patients krf-krs (difference between 2 keratometry flat and steep) =0.3mm-0.6mm demonstrated a significant correlation between final lens BC and keratometry reading for average simulated keratometry reading and flat simulated keratometry reading. But no statistically significant correlation was found between BC and steep simulated keratometry reading. P (flat) = 0.0371, P (steep) = 3.897, P (Avg)= 0.0482.



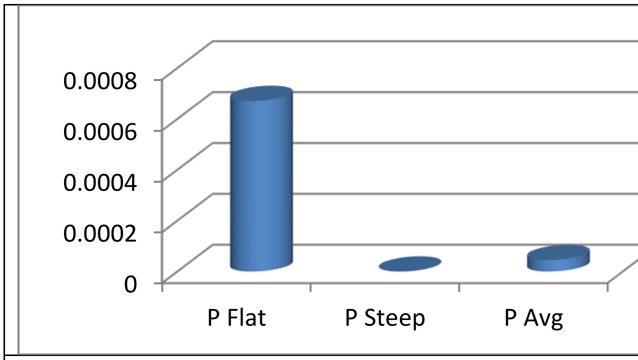
<u>Graph 3</u>: p value of group 2. mean of diff



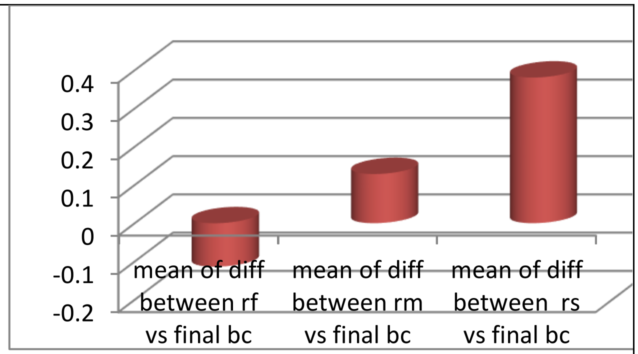
<u>Graph 4:</u> mean difference between final contact

between krf vs final BC: 0.112, mean of diff between krm vs final BC: -0.107, mean of diff between krs vs final BC: 0.328.	lens BC and simulated keratometry reading of group 2.

Group 3 of patients krm: greater than or equal to 7.03 and less than 8 demonstrated a significant correlation between final lens BC and keratometry reading for average simulated keratometry reading and flat simulated keratometry reading. But no statistically significant correlation was found between BC and steep simulated keratometry reading. P (Flat) = 0.000670893, P (Steep) =9.441, P (Avg) = 4.511 and mean of diff between krf vs final BC = -0.113. mean of diff between krm vs final BC=0.128, mean of diff between krs vs final BC = 0.380.

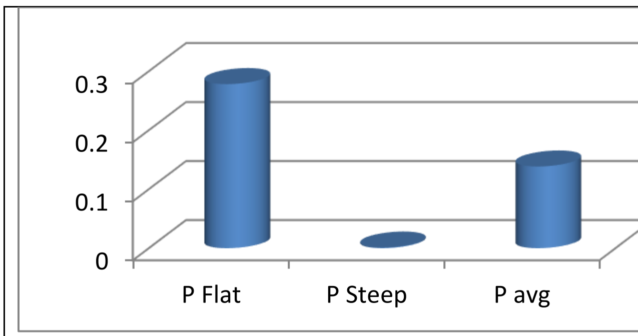


Graph 5: p value of group 3

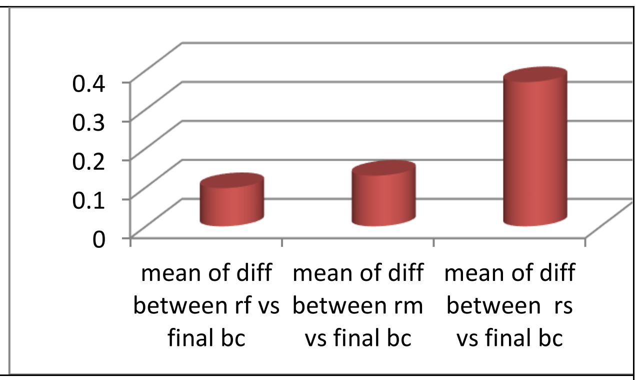


Graph 6: mean difference between final contact lens BC and simulated keratometry reading of group 3.

Group 4 of patients krm: greater than or equal to 6.40 and less than 7.03 demonstrated a significant correlation between final contact lens BC and steep simulated keratometry reading. But no statistically significant correlation was found between final lens BC and average simulated keratometry reading and flat simulated keratometry reading. P (Flat) = 0.278, P (Steep) = 0.001, P (avg) = 0.138. mean of diff between krf vs final BC = 0.098, mean of diff between krm vs final BC= 0.13, mean of diff between krs vs final BC = 0.37.

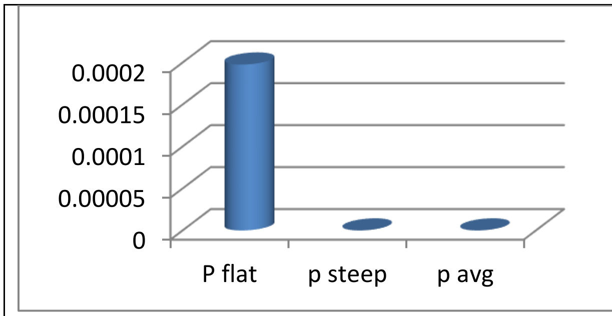


Graph 7: p value of group 4

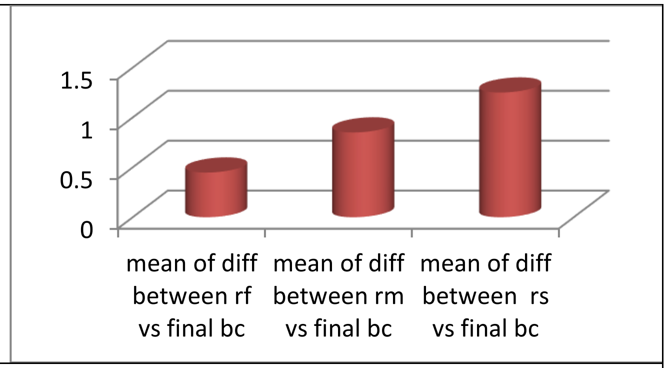


Graph 8: mean difference between final contact lens BC and simulated keratometry reading of group 4.

Group 5 of patients krm: greater than or equal to 6.14 and less than 6.40 demonstrated a significant correlation between final BC and flat simulated keratometry reading. But no statistically significant correlation was found between final contact lens BC with steep simulated keratometry reading and average simulated keratometry reading and flat simulated keratometry reading. P (Flat) = 0.0001, P (Steep) = 7.820, P (avg) = 4.380. mean of difference between krf vs final BC =0.448, mean of diff between krm vs final BC =0.85, mean of diff between krs vs final BC =1.25.

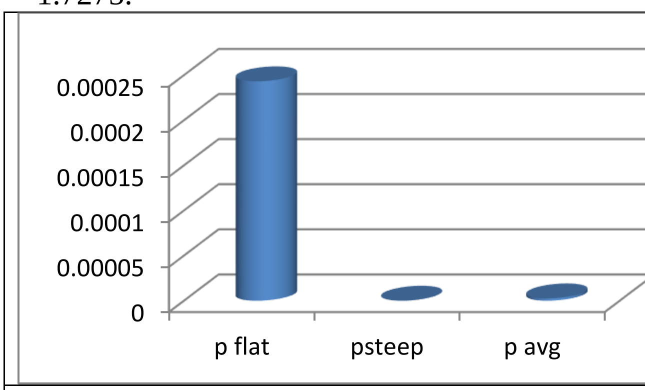


<u>Graph 9</u>: p value of group 5

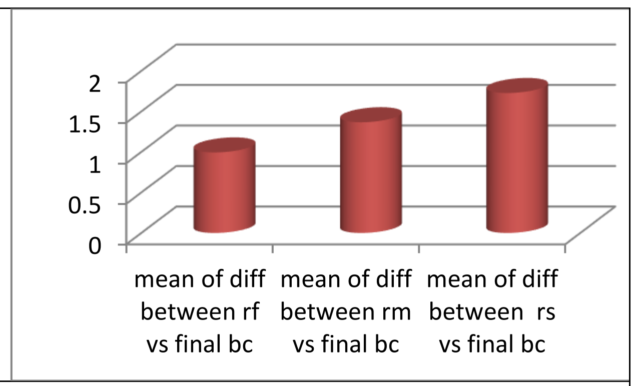


<u>Graph 10:</u> mean difference between final contact lens BC and simulated keratometry reading of group 5.

Group 6 of patients krm: less than 6.14 demonstrated a significant correlation between final contact lens BC and keratometry reading for flat simulated keratometry reading. But no statistically significant correlation was found between final contact lens BC with steep simulated keratometry reading and average simulated keratometry reading and flat simulated keratometry reading. P (Flat) =0.0002, P (Steep) =2.813, P (avg) =2.566. mean of diff between krf vs final BC = 0.993, mean of diff between krm vs final BC =1.366, mean of diff between krs vs final BC =1.7275.

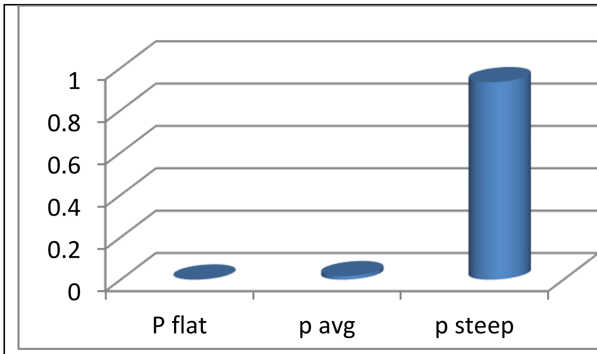


<u>Graph 11</u>: p value of group 6

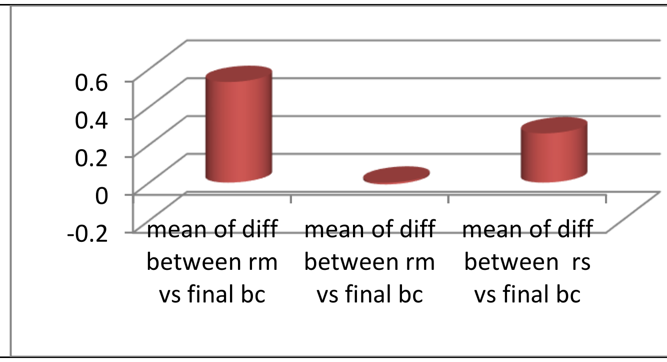


<u>Graph 12:</u> mean difference between final contact lens BC and simulated keratometry reading of group 6.

Group 7 of patients krm: greater than 8 demonstrated a significant correlation between final contact lens BC and keratometry reading for flat simulated keratometry reading. But no statistically significant correlation was found between final contact lens BC with steep simulated keratometry reading and average simulated keratometry reading and flat simulated keratometry reading. P (Flat) =0.0008, P (Steep) =0.932, P (avg) =0.016. mean of diff between krf vs final BC = 0.5315, mean of diff between krm vs final BC =-0.0092, mean of diff between krs vs final BC = 0.26.



Graph 13: p value of group 7



Graph 14: mean difference between final contact lens BC and simulated keratometry reading of group 7

Table 1 shows the starting BC for RGP contact lens according to the classification of keratoconus based on K reading

GROUPS	CLASSIFICATION	Initial BC for rigid contact lens fitting
Gr 7	Sim k, greater than 8 mm	Steep simulated k
Gr 6	Sim k, less than 6.14 mm	Flat simulated k
Gr 5	Sim k, greater than or equal to 6.14 mm and less than 6.40 mm	Steep simulated k
Gr 4	Sim k, greater than or equal to 6.40 mm and less than 7.03 mm	Flat simulated k
Gr 3	Sim k, greater than or equal to 7.03 and less than 8	Flat simulated k
Gr 2	Difference between two keratometry (krf-krs) greater than or equal to 0.3 and less than or equal to 0.6	Avg simulated k
Gr 1	Difference between two keratometry (krf-krs) data greater than 0.6	Flat simulated k

Discussion:

The accurate choose of rigid lens BC with the help of the data obtained from keratometry or Oculyzer is intriguing, however the literature does not provide enough supportive evidences. Pervious literature has reported to fit RGP CL initial BC selection should be equal to the flatter keratometry reading [10,11]. In a study by Lin *et al*, author has found the similar result that the flatter kr of a patient has a strong correlation with the selected lens BC. And they have also proposed a formula to calculate the BC for the patients: BC=4.742+0.364×krf1, when the average of the flatter kr was 7.4mm, however for any change of 0.3mm in kr above or below the average, BC needed to be changed 0.1mm, too. The authors concluded, BC becomes flatter than krf when krf<7.4, while it becomes steeper than krf in values more than 7.4mm. The proposed

single formula by Lin *et al* study makes rigid contact lens fitting simple and easy; however, it seems that other formulas are also necessary due to the variations of kr in different stages of the disease [12]. Current study also supports these same statements of previous studies. For the patient with Kr greater than or equal to 6.40mm and less than 8mm the initial selection of BC will be equal to flat Simulated K.
In another study, Edrington *et al*, tried to fit keratoconic eyes with the first lens which showed apical fluoresceine aggregation (FDACL). The authors found that in mild keratoconus [steeper meridian keratometry <45 diopter (D)] lenses were fitted 1.18 D flatter than FDACL (SD=1.84 diopter). This figure was found to be 2.38D and 4.01D flatter than FDACL for moderate (steeper meridian keratometry= 45-52D) and severe (steeper meridian keratometry >52D) kertoconic eyes, retrospectively. On average, contact lenses were fitted 2.86D flatter than FDACL (11). Because keratoconic patients find flat rigid contact lens fitting more acceptable and tolerable, it is not suitable to select steeper meridian for the lens trial and it is more acceptable to initially choose flatter meridian for these patients [13].
In a study by Zednik *et al*, the authors claim that no specific formula could be used to fit rigid contact lenses in keratoconic patients, however lens BC is closer to the flattest keratometry findings during the initial stages of the disease and the more advanced the disease, the steeper the lens BC. They concluded that the changes in lens BC develops later than corneal BC and in advanced disease the lens BC should be chosen flatter than the flattest curve found by keratometry [14]. Current study supports this study concluding, no specific formula will match always to fit rigid contact lenses. But the nearest BC can be predicted from the measurement of corneal curvature.

The severity of keratoconus is different in patients and this confronts eye care practitioners with a wide spectrum of corneal radial curves in different patients. Therefore, choosing only one BC for lens trial in our patients and then choosing lens power as the initial fit will end up in choosing steeper or flatter lens for a given patient, which needs various changes to fit the lens. It appears that it is more appropriate to choose different BCs for different stages of keratoconus and then determine lens power after fitting by over-refraction. In this study, we found krf to be a powerful predictor of BC in different groups of keratoconus patients. The strength of the present study lies in classifying the patients into five groups and separately analyzing the results in each group, which enabled us to avoid the possible biases and strengthen the results. The main drawback of this study is its inability to compare correlation between left and right eyes, because independent observations would be violated if left and right eyes are correlated in the dependent variable. This issue has been discussed in the literature. [15,16]
Mohammad Taher Rajabi et al, in their study, they have classified all the keratoconus patient into 5 different category and reported that to select the BC for the group with difference between two keratometry; flat and steep=0.3-0.6, formula to be used is BC= 0.321xkrf+5.219 and for the group with krf-krs >0.6mm formula to be used as, BC=0.337xkrf+ 5.090 to select he initial BC in rigid contact lens fitting [17]. But in current study all the patients were classified into 7 different groups and to select the initial BC it is suggested to choose average simulated k, for the group of patients with difference between two keratometry; flat and steep=0.3-0.6 and flat simulated k for the group of patients with krf-krs >0.6mm.

In summary, although rigid gas-permeable contact lenses play a decisive role in the treatment of keratoconic patients, the method of lens fitting play a more important role to increase the chance of successful treatment. Random fitting and multiple lens trials are not easy and safe enough for these patients. To find out the guidelines for choosing initial BC based on keratometry or oculyzer reading is necessary to overcome the above-mentioned limitations in these patient papulations.

Conclusion

Finding such correlation would allow eye care professional to fit rigid contact lenses with more assurance, preventing unnecessary and frequent lens trials, which leads to achieving a well-fit rigid lens in a shorter period of time. This will benefit both the patients and the eye care professional. The customary lens fitting methods are suggested to be replaced by the correlation found in this study and the similar studies.

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