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Research Paper:
Estimation of Final Cylindrical Spectacle Correction by Pentacam

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The authors declared no conflict

ABSTRACT

Background and Objectives: Keratoconus is a non-inflammatory asymmetric corneal degenerative disease characterized by the steepening and distortion of the cornea. In this disease, irregular astigmatism makes the subjective refraction difficult. Using the Pentacam, we aimed to determine the corrective astigmatism of the spectacle.

Methods: The subjective refraction and Pentacam imaging were performed for 317 keratoconic patients who referred to the Salouti Eye Clinic, Shiraz, Iran. Then, the astigmatism values obtained with subjective refraction were compared with the values of anterior and posterior corneal surface astigmatism obtained with the Pentacam imaging.

Results: The mean age of 317 keratoconic patients was 29.81 years (range: 15 to 45 years). The minimum, maximum, and average astigmatism of the corneal front surface were 0.3, 16.8, and 3.21 diopters, respectively. Also, the minimum, maximum, and average astigmatism of the corneal back surface were 0, 2.8, and 0.67 diopters, respectively. Moreover, the P value was lower than 0.001 in the regression analysis of the subjective refraction for both the power and axis of the cylinder.

Conclusion: The regression formulas obtained in this study can accurately (with a probability of 99%) predict refractive astigmatism, using corneal astigmatism.

Keywords: Pentacam, Keratoconus, Spectacle, Subjective refraction

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What is "already known" in this topic:

In Keratoconus, irregular astigmatism makes the subjective refraction difficult. The Pentacam is a reliable elevation-based corneal imaging system that shows the power distribution of cornea in the anterior and posterior surfaces.

What this article adds:

Corneal astigmatism can accurately predict refractive astigmatism.

1. Introduction

Keratoconus (KCN) is a non-inflammatory asymmetric corneal degenerative disease [1, 2] that is characterized by steepening and distortion of the cornea [3, 4]. KCN usually appears in the second or third decade of the life [5, 6]. The ocular symptoms and signs of KCN vary depending on disease severity [5]. Besides, one of the first indications of the disease is that the patients routinely complain about their spectacle correction [3].

Spectacle prescription is one of the most challenging issues in the optical correction of KCN. Although contact lenses provide better visual acuity, they are expensive, sophisticated to use, and need an adaptation period [4, 7, 8]. Also, the surgery approaches are complicated and unaffordable for many patients [9-11]. Therefore, spectacle correction should be considered as a first [7] and most favorable optical correction for KCN patient. In the early stages of KCN, the patient's vision can be fully correctable with spectacle [4, 7]. The patient's best corrective visual acuity decreases as the disease progresses, thus, the optimal visual acuity does not always mean a complete visual acuity. Also, some patients may tend to wear spectacles because of their occupational conditions and visual needs. Moreover, some patients tend to use contact lenses when they need higher visual acuity and spectacles when they do not need full visual acuity. Therefore, spectacle correction can be considered as the most favorable optical correction for KCN patients, considering the disadvantages of the other methods of the management of KCN. However, spectacle correction is a great challenge for practitioner. The irregular cornea makes the objective data unreliable, besides, the subjective approaches need proper visual acuity and the excellent cooperation of patient. Practically, spectacle correction is not always achievable. Usually, the unsatisfying and unbearable spectacles of the KCN patients [7] may persuade them to use either contact lens or surgery. However, for many reasons, the contact lenses and surgery do not gratify KCN patients, and some of them prefer to use spectacles again.

The objective refractive errors can be determined with several methods. Autorefractometry is an automated, fast, and reliable method of objective refraction [12]. However, autorefractometer readings are unobtainable in corneal irregularity, because most autorefractometer samples are located in the selected areas of the pupil, while the full pupil is used for vision. Also, the influences of the different areas of the pupil for vision differ from those used by the autorefractometer in the assessment of the refractive error. Therefore, if the cornea is irregular in the pupillary area, the effects of this irregularity are often revealed differently by the subjective results [3]. Retinoscopy is another objective method for the measurement of the refractive state. An inhomogeneous light-shadow movement is seen in retinoscopy. At the corneal center, the refraction may be slightly myopic, in comparison with the periphery. The scissors light movement is very common in KCN patients. Indeed, besides the highly-developed devices, classic retinoscopy can successfully classify KCN [6]. However, the retinoscopy endpoint is difficult to define accurately in KCN patients, because of distorted images [12]. In KCN patients, the data of subjective refraction significantly differ from those of the aberrometry-derived spherical equivalent refraction. Also, the subjective refraction data give significantly better logMAR acuity than the aberrometer's auto-refraction data. Finally, further investigation into deriving objective refraction data from aberrometry measurements is warranted in KCN [13]. The logMAR visual acuity achieved using the subjective and aberrometry auto-refraction data were measured in the six keratoconic subjects. Results: The subjective and aberrometry-derived spherical equivalent refraction data were significantly different in the keratoconus group (p0.015).

It is very difficult and sometimes impossible to achieve the desired objective refraction with common methods in KCN patients. Thus, many examiners have to solely rely on subjective refraction, which is mostly performed by trial and error method in KCN patients [12]. Although the conventional subjective refraction is the standard method of refraction, it is a psychophysical examination (like the measurement of visual acuity) that can vary owing to several factors. The ability of persons to discern dioptric differences varies from 0.12 D to 1.0 D [14].

As the cornea is the main determinant factor of the ocular refractive status, the evaluation of the cornea may help to determine ocular astigmatism. The Pentacam is a reliable elevation-based corneal imaging system. The Pentacam findings show the power distribution of cornea in the anterior and posterior surfaces. These findings can be used to determine ocular astigmatism.

2. Materials and Methods

This study was conducted in the Salouti eye clinic, Shiraz, Iran. The patients who could collaborate on the experiments were included in the study. A total of 317 keratoconic patients took part in this study; they had no history of eye surgery or other eye diseases. Also, the patients were between 15 and 45 years old.

Initially, if possible, we obtained approximate objective refraction from patients, using the autorefractometer or retinoscope. Then, we measured the uncorrected visual acuity using the logarithmic charts. Next, we started the subjective refraction. First, we put the amount of cylinder in front of the trial frame and rotated the frame's screw, so that, the patient could report the resolution. Then, to correct the axis obtained, we changed it by 5 or 10 degrees and asked the patient about the resolution changing. We continued this process to obtain the best visual acuity. Then, the power of the cylinder was adjusted by increasing or decreasing it. Also, we refined the axis with each change in the power of the cylinder. Then, the amount of the sphere was modified. Again, the axis and the power of the cylinder were refined with each change in the amount of the sphere. We continued this process to obtain the best visual acuity.

The patient's cornea was imaged with the Pentacam system, after determining the best subjective refraction with the best visual acuity.

After determining the best subjective refraction with the best visual acuity, the patient's cornea was imaged using the Pentacam system. Then, 4-map refractive displays were extracted and the amount of corneal front surface astigmatism, corneal back surface astigmatism, and their axes were obtained with vector analysis [15-17]. Next, we used the following formulas to estimate the objective refraction.

1. Axis of corrective cylinder = flat corneal front surface axis.

2. Power of corrective cylinder = − corneal front surface astigmatism + (corneal back Surface astigmatism × cos2θ).

θ = |corneal front surface axis − corneal back surface axis|.

We then compared the calculated values separately with the cylindrical subjective refraction, using SPSS. Also, linear regression was used to determine the correction coefficients of these formulas.

3. Results

This study examined 317 eyes from KCN patients within the age range of 15 to 45 years. Tables 1 and 2 report the information about the age and amount of astigmatism, respectively.

We performed a regression analysis to find the relationship between the subjective and calculated cylindrical

Table 1. Mean±Standard Deviation of the age of the subjects

Group	No.	Mean±SD	Min.	Max.
Grade 1 of KCN	127	28.61±6.945	15	42
Grade 2 of KCN	104	30.09±6.624	15	45
Grade 3 of KCN	73	31.56±6.881	16	45
Grade 4 of KCN	13	29.46±6.651	18	41
Total	317	29.81±6.910	15	45

Table 2. Description of corneal astigmatism in front and back surfaces

Group	Corneal Front Surface Astigmatism, Diopter			Corneal Back Surface Astigmatism, Diopter		
	Mean±SD	Min	Max	Mean±SD	Min.	Max.
Grade 1 of KCN	2.43±1.19	0.3	7.3	0.53±0.23	0.1	1.5
Grade 2 of KCN	3.31±1.55	0.3	7.8	0.71±0.33	0.1	1.6
Grade 3 of KCN	4.10±1.88	0.4	9.6	0.82±0.41	0	2.1
Grade 4 of KCN	4.94±4.08	1.1	16.8	0.94±0.68	0.2	2.8
Total	3.21±1.85	0.3	16.8	0.67±0.36	0	2.8

Table 3. Regression analysis of subjective refraction

Refraction	A[a]	P	B[a]	P	CD[b]
Power of cylinder	-0.784	< 0.001	0.523	< 0.001	0.581
Axis of cylinder	24.025	< 0.001	0.725	< 0.001	0.351

[a] Linear regression: Y = A + BX; [b] Coefficient of determination.

refractions, using the formulas mentioned before. Table 3 presents the obtained results.

According to Table 3, the P-value for the power and axis of the cylinder is lower than 0.001. The calculated cylindrical refraction is significantly related to the subjective cylindrical refraction, therefore, using the calculated formula, it is possible to predict the power and axis of the cylinder of subjective refraction, with a probability of 99.9%. In this regard, Figures 1 and 2 show that calculated cylindrical refraction has a normal distribution, and linear regression can express its changes.

4. Discussion

Achieving cylindrical spectacle power can be very difficult and time-consuming in keratoconic patients, because of the irregular shape of the cornea. Therefore, other surgical and non-surgical methods have been developed, each of which has its disadvantages and cannot be done for all patients [18-21]. Also, the patients with KCN constitute an important group because of the high prevalence, younger age of onset, active lifestyle, and higher visual requirements [19]. As mentioned before, the patients' vision can be fully corrected with spectacle, in the early stages of KCN. But in the later stages of the disorder, it is up to the patient to choose between more comfort and optical correction or better vision and the disadvantages of the other methods. Thus, the spectacle is of priority in

KCN patients, because the use of glasses is easier, safer, and cheaper. Therefore, if the patient can get a good vision with spectacles, has a history of using glasses, and is more comfortable with them, it is important to consider the prescription of glasses.

The study samples were in the different stages of KCN (Table 1). Therefore, the present results can be extended to the different stages of the disorder. The present study has preference over other similar studies, regarding the sample size and the extent of astigmatis [22, 23]. Also, using corneal astigmatism, most of the studies have determined refractive astigmatism related to regular astigmatism [24, 25]. Moreover, the study participants were in the peak age range of the incidence and prevalence of KCN (Table 1). Research has considered the age range corresponding to the present study as the main age range for the appearance of symptoms and problems of KCN [26-28].

Table 2 shows the role of anterior and posterior corneal surface astigmatism in refractive astigmatism. Atsuo Tomidokoro et al. conducted a study titled Changes in Anterior and Posterior Corneal Curvatures in Keratoconus

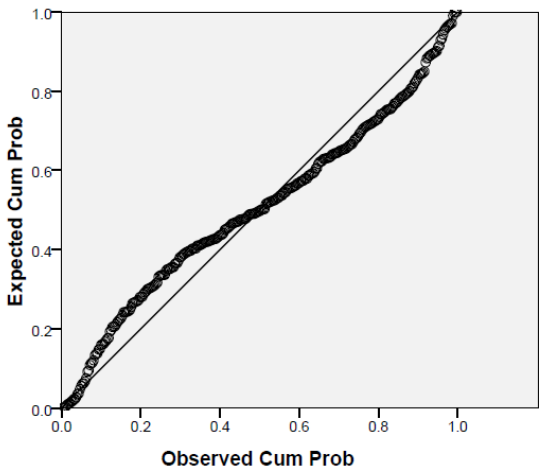

Figure 1. P-P plot for the power of cylinder

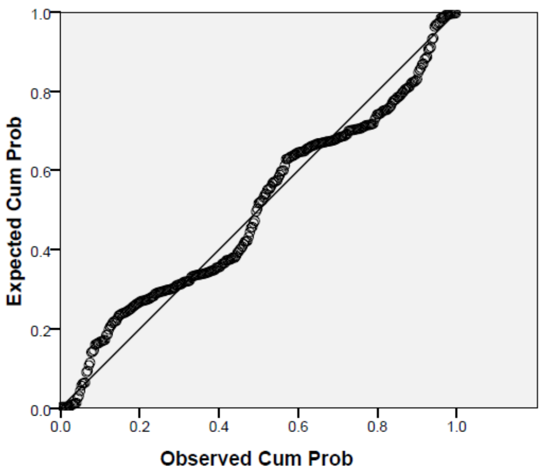

Figure 2. P-P plot for the axis of cylinder

and concluded that both anterior and posterior corneal curvatures were affected in KCN; these changes were observed in the early stage of the disorder [29]. Also, David P. Pinero et al. revealed a strong correlation between the anterior and posterior surface astigmatism in KCN groups. Besides, the eyes with clinical or subclinical KCN had the higher levels of the manifest, anterior, and posterior corneal astigmatism [30]. In eyes with KCN, the magnitudes of anterior and posterior corneal astigmatism are significantly correlated with each other, also, the presence of posterior corneal astigmatism is not negligible for the accurate astigmatic correction [31]. Hence, we used both anterior and posterior corneal astigmatism to achieve refractive astigmatism. Consistent with our findings, Feizi et al. achieved the mean magnitude of 1.0 D for posterior astigmatism (range, 0.0-2.90 D) [32] Based on all these studies, we used both anterior and posterior corneal surface astigmatism to determine refractive astigmatism.

It is widely accepted that there is a statistical linear relationship between the corneal and refractive astigmatism [24]. This relationship was first postulated by Javal in 1890, in an early attempt to use the keratometer as an aid in objective refraction. More than 30 years later, Grosvenor et al. refined and simplified the Javal rule, based on more rigorous analyses. The results were confirmed by other authors. However, both the conventional and simplified Javal rules only considered WTR (with the rule) and ATR (against the rule) astigmatism [25]. Using power vectors, Laura Remon examined the relationship between corneal and refractive astigmatism in adults. The power vectors can predict WTR, ATR, and also oblique astigmatism [25].

Using Pentacam, we determined the power and axis of the anterior and posterior surface astigmatism of the cornea. Also, refractive astigmatism was determined with subjective refraction in the present study. Then, linear regression analysis was used to determine the relationship between corneal astigmatism and refractive astigmatism, which included both axis and power. According to Table 3, these regression formulas can accurately predict (with a probability of 99%) refractive astigmatism, using corneal astigmatism (P<0.001). Other studies have established linear relationships between corneal astigmatism and refractive astigmatism in regular corneas [24, 25], while the present regression formulas can be used in irregular corneas. In patients with KCN, subjective refraction is determined based on trial and error. On the contrary, these regression formulas predict cylindrical refraction and present it as objective cylindrical refraction.

Many sources present the mathematical models of the power and axial changes of regular cylinders. These changes are sinusoidal in regular astigmatism [33, 34]. Also, some studies have used the Fourier series harmonic analysis to extract the irregular components of astigmatism and convert them into regular components; thus, these studies have proposed various models to quantify irregular astigmatism [33-36] regular astigmatic (2′ harmonic).

The graphs obtained in this study (Figures 1 and 2) clearly show the sinusoidal nature of the axis and power of the astigmatism changes. Therefore, both the numerical indices and the graphs of the proposed model indicate the synchronicity of the model with the real changes in the axis and power of astigmatism. This study provides a suitable and practical model not only for determining subjective astigmatism but also for describing irregular astigmatism. Although other studies suggest the decomposition of irregular astigmatism components into regular components [33-36] regular astigmatic (2′ harmonic, the present model is clinically applicable and can be easily extracted and used.

5. Conclusion

The present study provides a suitable model for estimating corrective astigmatism of glasses, based on Pentacam findings. According to the proposed model, it can be understood from the methods of determining the decomposed astigmatism harmonics to similar models to determine corrective astigmatism. Also, the proposed model may be used to achieve appropriate results, using other similar corneal imaging devices. The final formulas of regression analysis of the model are as follows:

1. For calculating the axis of the cylinder of refraction, we can use the following formula:

axis of cylinder = 24 + 0.73 × (flat corneal front surface axis).

2. For calculating the power of the cylinder of refraction, we can use the following formula:

power of cylinder = −0.8 + 0.5 × (−corneal front surface astigmatism + (corneal back surface astigmatism × cos2θ)).

$\theta = |\text{corneal front surface axis} - \text{corneal back surface axis}|$.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Iran University of Medical Sciences. (Code: IR.IUMS.REC.1398.236).

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Authors' contributions

General design, data collection, analysis and discussion: Raziye Dayyani; Data analysis: Ebrahim Jafarzadehpur; General design and data presentation:Ramin Salouti; Discussion: Ali Mirzajani.

Conflict of interest

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References

[1] Wang M. Keratoconus & keratoectasia: Prevention, diagnosis, and treatment. SWARTZ TS. United States: SLACK Incorporated; 2009. https://books.google.com/books?hl=en&lr=&id=mrpv9r-wd8AC&oi=fnd&pg=PA1&dq=Keratoconus+%26

[2] Léoni-Mesplié S, Mortemousque B, Touboul D, Malet F, Praud D, Mesplié N, et al. Scalability and severity of keratoconus in children. Am J Ophthalmol. 2012; 154(1):56-62. [DOI:10.1016/j.ajo.2012.01.025] [PMID]

[3] Benjamin JW. Borish s clinical refraction. United States: Butterworth-Heinemann; 1998. https://books.google.com/books?id=uxHODAAAQBAJ&dq=

[4] Bennett ES, Henry VA. Clinical manual of contact lenses. Philadelphia: Wolters Kluwer/Lippincott Williams & Wilkins; 2015. https://books.google.com/books?id=2fG4jwEACAAJ&dq=

[5] Romero-Jiménez M, Santodomingo-Rubido J, Wolffsohn JS. Keratoconus: A review. Cont Lens Anterior Eye. 2010; 33(4):157-66. [DOI:10.1016/j.clae.2010.04.006] [PMID]

[6] Goebels S, Käsmann-Kellner B, Eppig T, Seitz B, Langenbucher A. Can retinoscopy keep up in keratoconus diagnosis? Cont Lens Anterior Eye. 2015; 38(4):234-9. [DOI:10.1016/j.clae.2015.01.015] [PMID]

[7] Rico-Del-Viejo L, Garcia-Montero M, Hernández-Verdejo JL, García-Lázaro S, Gómez-Sanz FJ, Lorente-Velázquez A. Nonsurgical procedures for keratoconus management. J Ophthalmol. 2017; 2017:9707650. [DOI:10.1155/2017/9707650] [PMID] [PMCID]

[8] Alipour F, Khaheshi S, Soleimanzadeh M, Heidarzadeh S. Contact lens-related complications: A review. J Ophthalmic Vis Res. 2017;12(2):193-204. [PMCID] [PMID]

[9] Watson SL, Ramsay A, Dart JK, Bunce C, Craig E. Comparison of deep lamellar keratoplasty and penetrating keratoplasty in patients with keratoconus. Ophthalmology. 2004; 111(9):1676-82. [DOI:10.1016/j.ophtha.2004.02.010] [PMID]

[10] Olson RJ, Pingree M, Ridges R, Lundergan ML, Jr CA, Clinch TE. Penetrating keratoplasty for keratoconus: A long-term review of results and complications. J Cataract Refract Surg. 2000; 26(7):987-91. [DOI:10.1016/S0886-3350(00)00430-2]

[11] Kanellopoulos AJ, Lawrence HP, Perry HD, Donnenfeld ED. Modified Intracorneal Ring Segment Implantations (INTACS) for the management of moderate to advanced keratoconus: Efficacy and complications. Cornea. 2006; 25(1):29-33. [DOI:10.1016/j.ajo.2006.01.059]

[12] Bhootra AK. Clinical refraction guide. JP Medical Ltd; 2019. https://www.amazon.com/Clinical-Refraction-Guide-Kumar-Bhootra/dp/9352708628

[13] Jinabhai A, O'Donnell C, Radhakrishnan H. A comparison between subjective refraction and aberrometry-derived refraction in keratoconus patients and control subjects. Curr Eye Res. 2010; 35(8):703-14. [DOI:10.3109/02713681003797921] [PMID]

[14] Leinonen J, Laakkonen E, Laatikainen L. Repeatability (test-retest variability) of refractive error measurement in clinical settings. Acta Ophthalmol Scand. 2006; 84(4):532-6. [DOI:10.1111/j.1600-0420.2006.00695.x] [PMID]

[15] Gauvin M, Wallerstein A. AstigMATIC: An automatic tool for standard astigmatism vector analysis. BMC Ophthalmology. 2018; 18(1):1-7. https://bmcophthalmol.biomedcentral.com/articles/10.1186/s12886-018-0920-1

[16] Freitas GO, Ambrósio Jr R, Alves MR. Vector analysis of astigmatism according to the methods of Alpins and Thibos: A systematic review. e-Oftalmo. CBO: Rev Dig Oftalmol. 2016; 2(3):1-6. [DOI:10.17545/e-oftalmo.cbo/2016.58]

[17] Alpins N. Astigmatism analysis by the Alpins method. J Cataract Refract Surg. 2001; 27(1):31-49. [DOI:10.1016/S0886-3350(00)00798-7]

[18] Tamayo GE, Serrano MG. Treatment of irregular astigmatism and keratoconus with the VISX C-CAP method. Int Ophthalmol Clin. 2003; 43(3):103-10. [DOI:10.1097/00004397-200343030-00010] [PMID]

[19] Javadi MA, Naderi M, Zare M, Jenaban A. Comparison of the effect of three suturing techniques on postkeratoplasty astigmatism in keratoconus. Cornea. 2006; 25(9):1029-33. [DOI:10.1097/01.ico.0000230498.99648.69] [PMID]

[20] Alió JL, Belda JI, Artola A, García-Lledó M, Osman A. Contact lens fitting to correct irregular astigmatism after corneal refractive surgery. J Cataract Refract Surg. 2002; 28(10):1750-7. [DOI:10.1016/S0886-3350(02)01489-X]

[21] Nejabat M, Khalili MR, Dehghani C. Cone location and correction of keratoconus with rigid gas-permeable contact lenses. Contact Lens Anterior Eye. 2012; 35(1):17-21. [DOI:10.1016/j.clae.2011.08.007] [PMID]

[22] Nilagiri VK, Sciences V, Eye H, Metlapally S, Group VS, Kalaiselvan P, et al. LogMAR and Stereoacuity in Keratoconus Corrected with Spectacles and RGP Contact Lenses. Optom Vis Sci. 2019; 95(4):391-8. [DOI:10.1097/OPX.0000000000001205] [PMID] [PMCID]

[23] Colin J, Malet FJ. Intacs for the correction of keratoconus: two-year follow-up. J Cataract Refract Surg. 2007; 33(1):69-74. [DOI:10.1016/S0084-392X(08)79021-X]

[24] Keller PR, Collins MJ, Carney LG, Davis BA, Van Saarloos PP. The relation between corneal and total astigmatism. Optom Vis Sci. 1996; 73(2):86-91. [DOI:10.1097/00006324-199602000-00003] [PMID]

[25] Remón L, Benlloch J, Furlan WD. Corneal and refractive astigmatism in adults: A power vectors analysis. Optometry and Vision Science. 2009; 86(10):1182-6. [DOI:10.1097/OPX.0b013e3181baac2c] [PMID]

[26] Gokhale NS. Epidemiology of keratoconus. Indian J Ophthalmol. 2013; 61(8):382-3. [DOI:10.4103/0301-4738.116054] [PMID] [PMCID]

[27] Godefrooij DA, De Wit GA, Uiterwaal CS, Imhof SM, Wisse RP. Age-specific incidence and prevalence of keratoconus: A nationwide registration study. Am J Ophthalmol. 2017; 175:169-72. [DOI:10.1016/j.ajo.2016.12.015] [PMID]

[28] Nielsen K, Hjortdal J, Nohr EA, Ehlers N. Incidence and prevalence of keratoconus in Denmark. Acta Ophthalmol Scand. 2007; 85(8):890-2. [DOI:10.1111/j.1600-0420.2007.00981.x] [PMID]

[29] Tomidokoro A, Oshika T, Amano S, Higaki S, Maeda N, Miyata K. Changes in anterior and posterior corneal curvatures in keratoconus. Ophthalmology. 2000; 107(7):1328-32. [DOI:10.1016/S0161-6420(00)00159-7]

[30] Piñero DP, Alió JL, Alesón A, Vergara ME, Miranda M. Corneal volume, pachymetry, and correlation of anterior and posterior corneal shape in subclinical and different stages of clinical keratoconus. J Cataract Refract Surg. 2010; 36(5):814-25. https://doi.org/10.1016/j.jcrs.2009.11.012

[31] Kamiya K, Shimizu K, Igarashi A, Miyake T. Assessment of anterior, posterior, and total central corneal astigmatism in eyes with keratoconus. Am J Ophthalmol. 2015; 160(5):851-7. [DOI:10.1016/j.ajo.2015.08.016] [PMID]

[32] Feizi S, Delfazayebaher S, Javadi MA, Karimian F, Ownagh V, Sadeghpour F. Mean posterior corneal power and astigmatism in normal versus keratoconic eyes. J Ophthalmic Vis Res. 2018; 13(2):93-100. [DOI:10.4103/jovr.jovr_19_17] [PMID] [PMCID]

[33] Hjortdal J, Erdmann L, Bek T. Fourier analysis of video-keratographic data. A tool for separation of spherical, regular astigmatic and irregular astigmatic corneal power components. Ophthalmic Physiol Opt. 1995; 15(3):171-85. [DOI:10.1016/0275-5408(95)90569-N] [PMID]

[34] Oshika T. Quantitative evaluation of corneal irregular astigmatism and wavefront aberrations. Cornea. 2000; 19(6):S165-72. [DOI:10.1097/00003226-200011003-00006]

[35] Naeser K, Hjortdal J. Polar value analysis of refractive data. J Cataract Refract Surg. 2001; 27(1):86-94. [DOI:10.1016/S0886-3350(00)00799-9]

[36] Oshika T, Tomidokoro A, Maruo K, Tokunaga T, Miyata N. Quantitative evaluation of irregular astigmatism by Fourier series harmonic analysis of videokeratography data. Investig Ophthalmol Vis Sci. 1998; 39(5):705-9. https://iovs.arvojournals.org/article.aspx?articleid=2181064

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تخمین تصحیح نهایی بخش سیلندریکال عینک با استفاده از پنتاکم

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چکیده

مقدمه قوز قرنیه یک دژنراسیون نامتقارن قرنیه است که با افزایش انحنا و اعوجاج قرنیه مشخص می‌شود. وجود آستیگماتیسم نامنظم در این بیماری، انجام رفرکشن سابجکتیو را با مشکل روبه‌رو می‌کند. هدف این مطالعه تعیین آستیگماتیسم تصحیحی عینک با استفاده از پنتاکم است.

مواد و روش‌ها برای ۳۱۷ بیمار مبتلا به قوز قرنیه که به کلینیک چشم دکتر صلوتی واقع در شهرستان شیراز مراجعه کرده بودند، رفرکشن سابجکتیو و تصویربرداری قرنیه‌ای پنتاکم انجام شد. سپس آستیگماتیسم به دست آمده با رفرکشن سابجکتیو با آستیگماتیسم‌های سطح قدامی و خلفی قرنیه که با دستگاه پنتاکم به دست آمده بود، مقایسه شد.

یافته‌ها میانگین سنی ۳۱۷ بیمار مبتلا به قوز قرنیه که بین ۱۵ تا ۴۵ ساله بودند، ۲۹/۸۱ بود. حداقل، حداکثر و میانگین آستیگماتیسم سطح قدامی قرنیه به ترتیب ۰/۳، ۱۶/۸ و ۳/۲۱ بود. حداقل، حداکثر و میانگین آستیگماتیسم سطح خلفی قرنیه به ترتیب ۰، ۲/۸ و ۰/۶۷ بود. مقدار P در آنالیز رگرسیونی رفرکشن سابجکتیو برای قدرت و محور سیلندر کمتر از ۰/۰۰۱ بود.

نتیجه‌گیری فرمول‌های رگرسیونی به دست آمده در این مطالعه می‌توانند آستیگماتیسم رفرکشن را با استفاده از آستیگماتیسم قرنیه پیش‌بینی کنند.

کلیدواژه‌ها:

پنتاکم، قوز قرنیه، عینک، رفرکشن سابجکتیو

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