The Open Ophthalmology Journal

Content list available at: https://openophthalmologyjournal.com

RESEARCH ARTICLE

Refractive and Topographic Parameters of the Belin/Ambrósio Module in Patients with Refractive Defects in Cuenca, Ecuador

Eduardo Rojas Alvarez[1,*], Javier Santiago Alvarez Guachichulca[1] and David Sebastián Chávez Espinoza[1]

[1]*University of Cuenca, Faculty of Medical Sciences, Cuenca, Ecuador*

Abstract:

Objective:

This study aimed to describe the refractive and topographic parameters of the Belin/Ambrósio module in patients with refractive defects at the Latino clinic in Cuenca, Ecuador, between 2017 to 2021.

Methods:

A descriptive, cross-sectional study was carried out. A database included anonymous cases of patients with refractive defects treated at the ophthalmological consultation of a Latino clinic from January, 2017 to June, 2021 was searched. Data was collected using a form containing study variables. Microsoft Excel and SPSS were used for data collection and analysis using frequencies, percentages, and measures of central tendency.

Results:

The sample consisted of 120 patients; 61.7% were women, and 38.3% were men. Moreover, 70.8% of patients were young adults. The pachymetry mean of the center of the pupil, apex, and position of lowest pachymetry was 521 µm, 520 µm, and 513 µm, respectively. The means of the flattest keratometry, curviest keratometry, and maximum keratometry were 43.30 D, 46.32 D, and 48.01 D, respectively.

Conclusion:

Cases distribution according to anterior and posterior elevation showed pathological values in more than 50% of the studied corneas. According to the average progression index, pathological elevation was found in 18.8% of the cases, and according to the average deviations, 25.4% presented corneal ectasia in different stages.

Keywords: Keratoconus, Belin Ambrósio, Corneal ectasia, Refractive defects, Patients, Corneas.

Article History	Received: September 16, 2022	Revised: December 30, 2022	Accepted: January 26, 2023

1. INTRODUCTION

Refractive defects are among the most frequently treatable disturbances of visual function worldwide [1, 2]. However, in recent decades, corneal refractive surgery (CRS) has been successful in correcting refractive defects. It presents high levels of satisfaction due to excellent uncorrected visual acuity and minimal residual defects [3]. Abnormal preoperative topography is the most important risk factor for developing postoperative ectasia, followed by a low residual stromal bed [4]. Furthermore, the biomechanical properties of the cornea are important in screening and identifying keratoconus (KC) and other ectatic disorders, particularly those with subclinical disease [5].

* Address correspondence to this author at the University of Cuenca, Faculty of Medical Sciences, Cuenca, Ecuador; Tel: (+593) 0997365322;
E-mail: drerojasalvarez@gmail.com

KC is an ectatic disorder with progressive corneal thinning and a clinical picture of corneal protrusion, progressive irregular astigmatism, corneal fibrosis, and visual impairment. It is an absolute contraindication for CRS; therefore, preoperative diagnosis is very important [6]. Although the diagnosis of KC in stages of clinical maturity and its follow-up is not difficult, diagnosis at the subclinical stage can be challenging [7, 8]. Many methods have been described in the literature to assess and document KC progression. Proposed current systems use complex keratometry index to describe disease progression [9]. The Belin/Ambrósio (BA) enhanced ectasia visualization map has been designed using information from the Pentacam device, which is currently considered the most sensitive device for detecting the early form of KC. It is based on Scheimpflug images using maximum keratometry data, anterior and posterior elevation, and tomographic thickness. This provides a complete analysis of the cornea and

allows rapid and effective KC screening before refractive surgery for a better prognosis of the possible ectatic disease [10].

There are few studies on the utility and efficacy of the BA-enhanced ectasia display in the Latin American population [11]. The BA map criteria were developed mainly on a database of patients who were white non-Hispanic people [12]. Mean and maximum keratometry, pachymetry values at the thinnest point of the cornea, corneal posterior curvature index, corneal asphericity coefficient, anterior and posterior corneal elevation values, and corneal ectasia progression indices are unknown in this region. For this reason, the objective of this manuscript is to describe the refractive and topographic parameters of the BA module in patients with refractive defects in Cuenca, Ecuador.

2. MATERIALS AND METHODS

An observational, descriptive, cross-sectional study was conducted. The present study was conducted at the ophthalmological outpatient consultation Latino clinic located in Cuenca, province of Azuay, Ecuador. It included all the patients with refractive defects treated at the ophthalmological outpatient consultation Latino clinic from January, 2017, to June, 2021. The sample consisted of 120 patients who met the following criteria:

2.1. Inclusion Criteria

- Cases of patients with a diagnosis of previous refractive error.

- Cases that have the Pentacam BA enhanced ectasia display module.

2.2. Exclusion Criteria

- Cases that do not have all the study variables.

- Cases whose Pentacam report is illegible.

2.3. Study Variables

The following sex variables were considered in this study:

Sex: Physical and biological characteristics that the individual is born with, being able to be male or female.

Age: Time elapsed in years from birth to the time of the study, being able to be a child (0-9 years), adolescent (10-19 years), young adult (20-39 years), adult (40-64 years), and older adult (≥65 years).

Visual acuity: The degree of vision that the patient achieves with correction and without correction.

Refractive defect: Identified corneal refractive disorder.

Pachymetry: Measurement of corneal thickness.

Keratometry: Measurement of corneal curvature.

Q coefficient: An index that describes the changes in the corneal curvature from the center to the periphery and can be classified as cornea oblate (>0), cornea prolate (<0), and cornea spherical (=0).

Elevation: Measurement of elevation on the anterior and posterior face of the cornea, which may be on the anterior face: normal (<5 μm), suspicious (5-7 μm), and pathological (>7 μm), and on the posterior face: normal (<12 μm), suspicious (12-16 μm), and pathological (>16 μm).

Progression index: It shows changes in corneal thickness with respect to the general population, which can be normal (<1.2 μm), suspicious (1.2-1.7 μm), and diagnostic (<1.7 μm).

Ambrósio relational thickness (ART MAX): The relationship between the thinnest point of the cornea and the maximum pachymetric progression index, which can be normal (>400 μm), suspicious (300-400 μm), and diagnostic (<300 μm).

Deviations: Measurement of the deviations of the topographic index, which can be normal (<1.6), suspicious (1.6-2.6), and diagnostic (>2.6).

2.4. Statistical Analysis

Topographic, pachymetric, and keratometric data were obtained from the corneal tomography report (OCULUS Pentacam). The information was collected and stored in a database created with Microsoft Excel, 2019 version. Subsequently, the data were processed using the SPSS program, 28 version. For this purpose, descriptive statistics were used, including frequencies, percentages, and measures of central tendency. The results are presented in Tables for better understanding.

3. RESULTS

The sample consisted of a total of 120 patients, of whom 61.7% (n=74) were women, and 38.3% (n=46) were men. Regarding the age groups, the largest number of cases was concentrated in the young adult group, with a percentage of 70.8% (n=85), followed by the adolescent group, with 20% (n=24). The group with the lowest number of cases was the children group, with only 1.7% (n=2). Within the 120 study cases, a total of 240 eyes were counted. Concerning corneal refractive errors, a total of 233 eyes with refractive errors were counted, of which the refractive error that was most frequently found was myopic astigmatism, with a percentage of 79% (n=184), followed by hypermetropic astigmatism with 17.6% (n=41). Only 0.4% (n=1) presented simple hypermetropy.

Regarding visual acuity with no correction, the highest percentage of cases was within the range of 0.10 to 0.19, with a percentage of 31.6% (n=71), followed by the range of cases with visual acuity less than 0.10 with 26.7% (n=60). On the other hand, the highest percentage of cases of visual acuity with correction was found in cases with acuity greater than 0.50, *i.e.*, 85.7% of cases (n=197), while the lowest number of cases fell within the category of acuity less than 0.10 with 0.9% of cases (n=2) (Table **1**).

Table 1. Distribution of cases according to visual acuity with no correction and with correction.

Visual acuity	No correction		With correction	
	n	%	n	%
>0.50	24	10.7	197	85.7
0.40 – 0.50	15	6.7	11	4.8
0.30 – 0.39	9	4.0	6	2.6
0.20 – 0.29	46	20.4	11	4.8
0.10 – 0.19	71	31.6	3	1.3
<0.10	60	26.7	2	0.9
Total	225	100.0	230	100.0

Table 2. Distribution of cases according to pachymetry of the center of the pupil, apex, and position of least pachymetry.

Pachymetry µm	Center		Apex		Lowest	
	n	%	n	%	n	%
>500	178	74.2	174	72.5	167	69.6
490 - 499	10	4.2	10	4.2	14	5.8
480 - 489	18	7.5	15	6.3	10	4.2
470 - 479	10	4.2	10	4.2	13	5.4
460 - 469	8	3.3	5	2.1	7	2.9
450 - 459	6	2.5	9	3.8	9	3.8
<450	10	4.2	13	5.4	20	8.3
Total	240	100.0	236	98.3	240	100.0
Mean	521		520		513	
Median	525		527		520	
Minimum	268		219		218	
Maximum	603		602		597	

The pachymetric values of the center of the pupil, apex, and position of lesser pachymetry were greater than 500 µm in most cases, with 74.2% (n=178), 72.5% (n=174), and 69.6% (n=167), respectively. The mean measurement of the center of the pupil was 521 µm, with a minimum value of 268 µm, while the mean measurement of the apex was 520 µm, with a minimum value of 219 µm. The mean of the position with the lowest pachymetry was 513 µm, with a minimum value of 218 µm (Table **2**).

The flattest keratometry values had a mean of 43.30 D, with a standard deviation of 3.28 and a maximum value of 66.40 D. On the other hand, the most curved keratometry values had a mean of 46.32 D, with a standard deviation of 4.15 and a maximum value of 75.80 D. Additionally, the maximum keratometry values had an average of 48.01 D, with a standard deviation of 6.57 and a maximum value of 94,00 D. According to the asphericity coefficient, the predominant type of cornea was oblate, presenting in 72.5% (n=174) of the cases. On the other hand, within the population studied, no case was found with a spherical cornea.

Regarding corneal elevation, 48.3% (n=116) of cases had normal frontal elevation values, and 27.5% (n=66) of cases had pathological values. Concerning the posterior elevation, 65.4% (n=167) of the cases had normal values, while 24.6% (n=59) had pathological values (Table **3**). According to the rate of progression, the highest percentage of cases with both minimal and medium progression had values within the normal range with 80.4% (n=193) and 67.1% (n=161), respectively, while the highest percentage of cases corresponding to maximum progression had suspicious values, accounting for a total of 60.8% cases (n=146) (Table **4**).

Table 3. Distribution of cases according to anterior and posterior elevation.

Elevation	Anterior		Posterior	
	n	%	n	%
Normal	116	48.3	157	65.4
Pathological	66	27.5	59	24.6
Suspicious	58	24.2	24	10.0
Total	240	100.0	240	100.0

Table 4. Distribution of cases according to minimum, maximum, and average progression rate.

Progression Rate	Minimum		Maximum		Mean	
	n	%	n	%	n	%
Diagnosis	23	9.6	59	24.6	45	18.8
Normal	193	80.4	35	14.6	161	67.1
Suspicious	24	10.0	146	60.8	34	14.2
Total	240	100.0	240	100.0	240	100.0

According to the ART MAX measurement, cases with values corresponding to suspicious or normal measurements had the highest percentages, with 38.3% (n=92) and 37.9%

(n=91), respectively. A 23.8% (n=57) of cases had diagnostic values of corneal ectasia. With respect to deviations from the refractive and topographic parameters of the Belin/Ambrosio module, the highest percentage of cases for all deviations had values within normality. However, in the final mean, 25.4% (n=61) of all cases had diagnostic values of corneal ectasia, and 27.55 (n=66) had suspicious values, as shown in Table **5**.

Table 5. Distribution of cases according to deviations.

Deviations	Df		Db		Dp		Dt		Da		D	
	n	%	n	%	n	%	n	%	n	%	n	%
Diagnosis	59	24.6	53	22.1	61	25.4	31	12.9	42	17.5	61	25.4
Normal	153	63.8	179	74.6	138	57.5	182	75.8	173	72.1	113	47.1
Suspicious	28	11.7	8	3.3	41	17.1	27	11.3	25	10.4	66	27.5
Total	240	100.0	240	100.0	240	100.0	240	100.0	240	100.0	240	100.0

Note: Df: anterior surface deviations, Db: posterior surface deviations, Dp: pachymetric progression deviations, Dt: thinner point deviations, Da: displacement of the thinnest point with respect to the apex, D: final average.

4. DISCUSSION

KC is a progressive degenerative corneal disease. It is the most common corneal ectatic pathology [11]. Currently, corneal tomography allows for identifying eyes with keratoconus in the early stages, which is very important in selecting candidates for refractive surgery. In addition, corneal tomography plays an important role in monitoring KC progression [13].

In this study, a total of 120 cases were included, of which 240 eyes were considered for the analysis. The study population was composed mostly of women, and the age group with the highest number of cases was young adults. This data showed that the female population between 20 and 39 years of age was the one that attended the ophthalmological consultation more frequently during the study period, which was in agreement with other similar studies in which corneal defects were analyzed and whose study population was mainly female [14]. However, these findings were contradictory to the results of some studies, which found that the male population visited ophthalmological consultation clinics more frequently [15].

Regarding refractive errors, myopic astigmatism was the type of defect found most frequently in this study, followed by hypermetropic astigmatism. The international literature states that up to 90% of the general population may have astigmatism; however, the majority do not present significant clinical manifestations. Furthermore, for reasons of self-selection, refractive errors, including astigmatism, have a much higher incidence among patients attending ophthalmology consultation clinics [16].

Some patients do not achieve better visual acuity values with a correction due to the presence of optical aberrations induced by the KC. In addition, several patients in the study sample did not have an optical correction from an early age, due to which they presented amblyopia.

The results of pachymetry measurements of the center of the pupil, apex, and lower pachymetry had values above 500 µm in most cases. However, a considerable percentage of cases presented pachymetric values below 480 µm, which is suggestive of ectatic pathology of the cornea. In addition, the thinnest pachymetry mean found in the present study was 513 µm, differing from the internationally reported mean value of 536 µm [17]. These differences could be related to the type of population studied. It should be considered that most of the reference studies have been carried out in American, European, or Asian populations, and only a few studies have analyzed the BA module applied to the Latin American population.

Regarding the keratometry values, the mean value of the flattest keratometry found in this study was 43.30 D. This value differed slightly from that obtained in the research carried out by Hashemi on the Asian population, whose mean value was 42.98 D. Likewise, the mean value of keratometry plus curve found in this study was 46.32 D, while that found in a study by Hashemi was 43.98 D [18]. Therefore, the reported values demonstrated that the corneal curvature of our study population was slightly higher than that found in other populations

The Q coefficient in more than 70% of the cases had values above 0, indicating that most of the study population presented an oblate corneal morphology associated with lower optical quality. However, these values contradicted those published in a study conducted by Yebra *et al*., in which 89.91% of the population presented corneal asphericity values between -0.10 to -0.35, corresponding to a prolate corneal morphology [19]. These differences could be due to the fact that this study included a population with previously diagnosed refractive defects, which would explain the higher incidence of morphological defects of the cornea.

Most of the population studied had normal values for anterior and posterior elevation. However, in approximately a quarter of the cases studied, pathological values for anterior and posterior elevation were obtained. These measurements effectively discriminate keratoconus from normal corneas. In addition, elevation difference measurements can provide useful information to improve the accuracy of keratoconus diagnosis, especially in the early stage of the disease [20].

Concerning the pachymetric progression index, it was found that the mean progression in most of the cases studied presented values corresponding to normality, finding pathological progression in approximately one-fifth of the cases. Other studies that evaluated the progression of corneal ectasia reported disease progression in up to 39.6% of cases and reported that younger age coupled with biomechanical properties of the cornea might be important indicators of future progression [21].

As for the ART MAX measurement, pathological information was found to be important in about a quarter of all corneas studied. In the study carried out by Bautista *et al*., it was found that an ART MAX value $\leq$350 is related to a significantly softer corneal biomechanical behavior and, therefore, is associated with a higher risk of presenting ectasia. In addition, they found that more than 95% of the eyes met the criteria for susceptibility to ectasia [22].

Finally, according to the final average of deviations, corneal ectasia was found in approximately a quarter of all corneas studied. The study carried out by Ambrosio *et al*. referenced a value of 1.00 as the cut-off point for the mean of

deviations for the detection of keratoconus [23]. Furthermore, Huseynli and Abdulaliyeva conducted a study on a population of Caucasian patients and reported that the overall D value, anterior and posterior elevations, and the pachymetric progression index have higher predictive accuracy in differentiating normal corneas from corneas with ectasia [24]. Similarly, Rodrigues *et al*. reported that the overall D-index was shown to have a close relationship with posterior surface deviation in early-stage keratoconus cases, while the thinnest point deviation showed a reduced relationship [25].

It is important to clarify that the results were obtained from patients at the ophthalmological outpatient clinic who already had some visual problems and not from the general population. Therefore, there is a higher concentration of corneal pathological data of more than 50% and 25.4% with some degree of corneal ectasia, which is not representative of the population without the visual disease. It would be necessary for future studies to analyze these parameters in an apparently healthy population.

CONCLUSION

The refractive defect that appeared with the greatest predominance was myopic astigmatism. Of the cases found, most of them presented corrected visual acuity greater than 0.50. However, about 10% of cases did not achieve adequate visual acuity despite correction. According to the pachymetry values of the center of the pupil, apex, and position of least pachymetry, a mean of 521 µm, 520 µm, and 513 µm, respectively, was obtained. Similarly, the flattest keratometry, most curved keratometry, and maximum keratometry values had a mean of 43.30 D, 46.32 D, and 48.01 D, respectively. In the distribution of cases according to frontal elevation and posterior elevation, pathological values were found in more than 50% of the corneas studied. According to the average progression index, pathological elevation was found in approximately one-fifth of the cases, and according to the average number of deviations, a quarter of the corneas analyzed presented corneal ectasia in different stages.

ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

The Bioethics Committee of the Cuenca University approved this research.

HUMAN AND ANIMAL RIGHTS

Animals were not used in this investigation. All human research and procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Declaration of Helsinki of 1975, revised in 2013.

CONSENT FOR PUBLICATION

Written informed consent was obtained from all patients who participated in the study.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available from the corresponding author, [E.A], on special request.

FUNDING

None.

CONFLICT OF INTERESTS

We have no conflicts of interest to disclose.

ACKNOWLEDGEMENTS

Declared none.

REFERENCES

[1] Schiefer U, Kraus C, Baumbach P, Ungewiß J, Michels R. Refractive errors. Dtsch Arztebl Int 2016; 113(41): 693-702. [PMID: 27839543]

[2] Irving EL, Machan CM, Lam S, Hrynchak PK, Lillakas L. Refractive error magnitude and variability: Relation to age. J Optom 2019; 12(1): 55-63. [http://dx.doi.org/10.1016/j.optom.2018.02.002] [PMID: 29567041]

[3] Murueta-Goyena A, Cañadas P. Visual outcomes and management after corneal refractive surgery: A review. J Optom 2018; 11(2): 121-9. [http://dx.doi.org/10.1016/j.optom.2017.09.002] [PMID: 29183707]

[4] Miranda Hernandez I, Barroso Lorenzo R, Ledia Perea H, Ramos Perera Y. Selección del paciente para cirugía refractiva: Actualización. Rev Cuba Oftalmol 2015; 28(3): 10-20.

[5] Salomão MQ, Hofling-Lima AL, Gomes Esporcatte LP, *et al.* The role of corneal biomechanics for the evaluation of ectasia patients. Int J Environ Res Public Health 2020; 17(6): 2113. [http://dx.doi.org/10.3390/ijerph17062113] [PMID: 32209975]

[6] Sorkin N, Varssano D. Corneal collagen crosslinking: A systematic review. Ophthalmologica 2014; 232(1): 10-27. [http://dx.doi.org/10.1159/000357979] [PMID: 24751584]

[7] Thulasidas M, Teotia P. Evaluation of corneal topography and tomography in fellow eyes of unilateral keratoconus patients for early detection of subclinical keratoconus. Indian J Ophthalmol 2020; 68(11): 2415-20. [http://dx.doi.org/10.4103/ijo.IJO_2129_19] [PMID: 33120630]

[8] Guo LL, Tian L, Cao K, *et al.* Comparison of the morphological and biomechanical characteristics of keratoconus, forme fruste keratoconus, and normal corneas. Semin Ophthalmol 2021; 36(8): 671-8. [http://dx.doi.org/10.1080/08820538.2021.1896752] [PMID: 33734947]

[9] Duncan JK, Belin MW, Borgstrom M. Assessing progression of keratoconus: Novel tomographic determinants. Eye Vis 2016; 3(1): 6. [http://dx.doi.org/10.1186/s40662-016-0038-6] [PMID: 26973847]

[10] Imbornoni L, McGhee C, Belin M. Evolution of keratoconus: From diagnosis to therapeutics. Klin Monatsbl Augenheilkd 2018; 235(6): 680-8. [http://dx.doi.org/10.1055/s-0044-100617] [PMID: 29698993]

[11] Bamdad S, Sedaghat MR, Yasemi M, Vahedi A. Sensitivity and specificity of belin ambrosio enhanced ectasia display in early diagnosis of keratoconus. J Ophthalmol 2020; 2020: 7625659. [http://dx.doi.org/10.1155/2020/7625659] [PMID: 33489342]

[12] Xie Y, Zhao L, Yang X, *et al.* Screening candidates for refractive surgery with corneal tomographic–based deep learning. JAMA Ophthalmol 2020; 138(5): 519-26. [http://dx.doi.org/10.1001/jamaophthalmol.2020.0507] [PMID: 32215587]

[13] Gokul A, Vellara HR, Patel DV. Advanced anterior segment imaging in keratoconus: A review. Clin Exp Ophthalmol 2018; 46(2): 122-32. [http://dx.doi.org/10.1111/ceo.13108] [PMID: 29160595]

[14] Milanés Armengol AR, Molina Castellanos K, Alves Tavares IA, Milanés Molina M, Ojeda Leal ÁM, Milanés Armengol AR, *et al.* Caracterización de pacientes con ametropías. Isla de Fogo, Cabo Verde. 2015-2017. Medisur 2019; 17(2): 230-40.

[15] Pérez VN, González PNA, Castillo BG, Lima León CE, Del SFLA, Pérez VN. Pacientes con queratocono atendidos en la Consulta de Cirugía refractiva. Acta Médica Cent 2020; 14(4): 423-31.
[16] Wu PL, Lee CY, Cheng HC, *et al.* Correction of myopic astigmatism with topography-guided laser *in situ* keratomileusis (TOPOLINK). Healthcare 2020; 8(4): 477. [http://dx.doi.org/10.3390/healthcare8040477] [PMID: 33187386]
[17] Feng MT, Kim JT, Ambrósio R Jr, *et al.* International values of central pachymetry in normal subjects by rotating scheimpflug camera. Asia Pac J Ophthalmol 2012; 1(1): 13-8. [http://dx.doi.org/10.1097/APO.0b013e31823e58da] [PMID: 26107012]
[18] Hashemi H, Yekta A, Shokrollahzadeh F, *et al.* The distribution of keratometry in a population based study. J Curr Ophthalmol 2021; 33(1): 17-22. [PMID: 34084952]
[19] Yebra-Pimentel E, González-Méijome JM, Cerviño A, Giráldez MJ, González-Pérez J, Parafita MA. Asfericidad corneal en una población de adultos jóvenes: Implicaciones clínicas. Arch Soc Esp Oftalmol 2004; 79(8): 385-92. [http://dx.doi.org/10.4321/S0365-66912004000800006] [PMID: 15306965]
[20] Orucoglu F, Toker E. Comparative analysis of anterior segment parameters in normal and keratoconus eyes generated by scheimpflug tomography. J Ophthalmol 2015; 2015(1): 1-8. [http://dx.doi.org/10.1155/2015/925414] [PMID: 25878897]
[21] Erol MA, Atalay E, Özalp O, Divarcı A, Yıldırım N. Superiority of baseline biomechanical properties over corneal tomography in predicting keratoconus progression. Turk J Ophthalmol 2021; 51(5): 257-64. [http://dx.doi.org/10.4274/tjo.galenos.2020.78949] [PMID: 34702018]
[22] Baptista PM, Marta AA, Marques JH, *et al.* The role of corneal biomechanics in the assessment of ectasia susceptibility before laser vision correction. Clin Ophthalmol 2021; 15(1): 745-58. [http://dx.doi.org/10.2147/OPTH.S296744] [PMID: 33642854]
[23] Ambrósio R Jr, Valbon BF, Faria-Correia F, Ramos I, Luz A. Scheimpflug imaging for laser refractive surgery. Curr Opin Ophthalmol 2013; 24(4): 310-20. [http://dx.doi.org/10.1097/ICU.0b013e3283622a94] [PMID: 23680761]
[24] Huseynli S, Abdulaliyeva F. Evaluation of scheimpflug tomography parameters in subclinical keratoconus, clinical keratoconus and normal caucasian eyes. Türk Oftalmoloji Dergisi 2018; 48(3): 99-108. [http://dx.doi.org/10.4274/tjo.89587] [PMID: 29988819]
[25] Rodrigues FW, Vilela ABV, Nishi JF, da Silva RE. Comparative analysis of tomographic indices in patients at early stage of keratoconus. Rev Bras Oftalmol 2021; 80(3): 37-9. [http://dx.doi.org/10.37039/1982.8551.20210003]