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Original article

Post-PRK Densitometric and Tomographic Belin ABCD Changes in Healthy Versus Suspicious Corneas

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Abstract

Purpose: To detect corneal densitometric and tomographic Belin ABCD changes during 1-year follow-up after photorefractive keratectomy (PRK).**Patients and Methods:** Prospective observational study carried out on PRK candidates divided into Group 1 (study group) with suspicious corneas (asymmetric bowtie, inferior steepening, central back elevation >15 µm or tongue like extension pattern, thin cornea <510 µm, or abnormal corneal thickness spatial profile curve) and Group 2 (control group) with healthy corneas. The patients were examined at 3, 6, and 12 months after PRK using Pentacam. **Results:** 147 eyes of 75 Egyptian candidates (12 male and 63 female). Group 1 included 73 eyes of 38 patients with average age 23.6±5.7 years versus age- and gender-matched controls (P=0.192). Compared to pre-PRK, UCVA improved significantly in both groups and remained stable till the last visit. Both groups showed significant increase in anterior radius of curvature (ARC) and posterior radius of curvature (PRC) after PRK (P<0.001) that remained stable through 3 post-operative visits. There was no significant difference in ARC and PRC between both groups respectively (P=0.494, P=0.940). Post-PRK progression in parameter C was observed in both groups (decrease in thinnest location) that remained stable till the last visit. There was no change in parameter D (best corrected distant visual acuity) in both groups (P=0.214). Corneal densitometry (CD) decreased significantly in 0-10 mm annulus of anterior layer in both groups (all P<0.001). No post-PRK ectasia was detected during the one-year follow-up. **Conclusion:** ABCD grading is useful for monitoring post-PRK suspicious corneas.

Key words: Photorefractive keratectomy; ABCD system; corneal densitometry.

Introduction

Photorefractive keratectomy (PRK) has widely been used as an effective and safe technique for refractive surgery candidates and is well tolerated by the patients [1, 2]. It is an effective surface laser ablation procedure for the correction of ametropia [2, 3]. In PRK, the corneal epithelium should be removed before stromal ablation. Mechanical debridement seems to be the most common technique for epithelial debridement [2]. The integrity of the epithelial basement membrane and the deposition of abnormal extracellular matrix can put the cornea in a probable situation for corneal haze formation. Mitomycin C (MMC) is applied after excimer laser ablation as a primary modulator for wound healing, limiting corneal haze formation [4].

Corneal ectasia is a well-recognized, serious complication of photorefractive surgeries. It is characterized by progressive stromal thinning and steepening of the cornea, resulting in refractive aberrations and vision loss [5]. Post-PRK ectasia is much less prevalent than post-LASIK ectasia [6].

Ectatic disorder of the cornea, characterized by steepening, apical thinning and scarring leading to visual distortion [7]. The advent of refractive surgery has highlighted the need to identify early or subclinical cases of keratoconus, as these cases are more likely to present as post-refractive surgery ectasia. This has highlighted the deficiencies in the older classification/ staging systems which simply relied on anterior curvature and apical thickness readings such as Amsler- Krumeich (AK) classification which is the most widely used [8]. The Belin ABCD classification/staging system was introduced on the Oculus Pentacam (Oculus GmbH, Wetzlar, Germany) in response to both the shortcomings of the AK system and, in part, in response to the needs outlined in the Global Consensus on Keratoconus and Ectatic Disease [9]. While initially released as a new comprehensive staging or classification system, the ABCD parameters have also subsequently been utilized in a separate progression display (Belin ABCD Progression Display) [10].

In this study, we reported densitometric and corneal tomographic Belin ABCD changes after photorefractive keratectomy.

Patients and methods

This study was a case-control prospective observational study carried out to assess the 1-year changes in corneal tomography after PRK using Belin ABCD display by Pentacam between healthy and suspicious corneas, as well as densitometric changes. The study was conducted at Ebsar Eye Center (Mansoura, Egypt) under the supervision of Benha University Ophthalmology Department staff members and in accordance with the tenets of the Declaration of Helsinki. The study was approved by the institutional review board of Benha University (Research Ethics Committee) with code number: MD 11-11-2022. Written informed consent was taken from all patients prior to surgery. The study was carried out to assess changes in cornea after PRK

through three follow up visits for one year in the period from October 2022 to September 2024.

Our study was divided into group 1 (study group) which included 38 candidates with suspicious corneas and group 2 (control group) which included 37 candidates with healthy corneas who were seeking photorefractive surgery. Inclusion criteria included age (18-50 years), both genders, stable refraction for at least one year and contact lens wear abstinence for three weeks. Group 1: Suspicious cornea, but not keratoconus, included one of the following risk factors: asymmetric bowtie, inferior Steepening/skewed radial axis (20 degrees or greater), inferior steepening, back elevation in the central 3 mm diameter >15 µm or isolated island and tongue like extension pattern, thin cornea <510 µm, superior inferior difference in corneal thickness map > 30 µm or thinnest location difference between both eyes > 30 µm, corneal thickness spatial profile curve deviated before 6 mm circle, border line keratoconus indices of irregularities (yellow)[11-15]. Group 2: Healthy cornea with no risk factors. Any previous history of refractive, or ocular surgery and injury or corneal opacities, dystrophies, autoimmune diseases- were excluded.

Complete assessment was done including; history taking, full routine ophthalmic examination, uncorrected and best corrected visual acuity using decimal chart, corneal haze grading [16, 17] and Oculus Pentacam AXL (Oculus GmbH, Wetzlar, Germany) to detect keratometry readings K1, K2 (front and back) in diopters, central corneal thickness (CCT) and thinnest location (TCT) in µm, Belin Ambrosio ectasia display (BAD-D), thickness progression index (Prog), maximum Ambrosio relational thickness (ARTmax), maximum keratometry (K max), index of surface variance (ISV), index of vertical asymmetry (IVA), index of height asymmetry (IHA), index of height decentration (IHD), corneal densitometry (CD) in anterior layer (120 µm) in zones (0-2 mm, 2-6 mm & 6-10 mm annulus) in grayscale units.

The ABCD system utilizes 4 parameters: Parameter "A": Anterior Radius of Curvature (ARC) in the 3.0 mm zone centered on corneal thinnest location, parameter "B": Posterior Radius of Curvature (PRC) in the 3.0 mm zone centered on corneal thinnest location, parameter "C": Thinnest corneal thickness (TCT) in µm, parameter "D": 'Distance Best Corrected Visual Acuity (BDVA) which must be entered by the user [18]. Belin ABCD display was used to detect any progression in anterior, posterior corneal surface and thickness before and at 3, 6 and 12 months after PRK surgery [10].

Surgical technique

In the PRK procedure, the central 9 mm diameter epithelium was mechanically removed. Laser ablation was performed with Alcon EX-500 excimer laser. Topical Mitomycin C 0.02% was applied for 20 seconds after PRK laser treatment [19], a bandage soft contact lens was placed on the cornea. Eye drops containing 0.1% dexamethasone (tobradex) and 0.5% moxifloxacin (vigamox) was prescribed four times daily for 2

weeks, then 0.1% fluorometholone eye drops (Efemyo) was prescribed two times daily for 1 month. Lubricant eye drops was prescribed for three months [20].

Statistical analysis

Statistical analysis was done by Statistical Package for the Social Sciences (SPSS) v26 (IBM Inc., Chicago, IL, USA). Shapiro-Wilks test and histograms were used to evaluate the normality of the distribution of data. Quantitative parametric variables were presented as mean and standard deviation (SD) and compared between the two groups utilizing unpaired Student's t- test and compared between follow up and preoperative visits by using repeated analysis of variance (ANOVA) [21].

Quantitative non-parametric data were presented as median and interquartile range (IQR) and were analyzed by Mann Whitney-test [22]. Qualitative variables were presented as frequency and percentage (%) and were analyzed utilizing the Chi-square test or Fisher's exact test when appropriate [23]. A two tailed P value < 0.05- was considered statistically significant. Correlation between various variables was done using Pearson moment correlation equation for linear relation of normally distributed variables and Spearman rank correlation equation for non-normal variables/non-linear monotonic relation. Avoid biases arising from between eye correlation (compensate inter-eye correlation as paired organ).

Results

This study assessed 90 patients for eligibility, 5 patients did not meet the criteria and 10 patients refused to participate in the study. The remaining patients were allocated into two groups, 73 eyes of 38 patients (Group 1) as a study group versus 74 eyes of 37 patients (Group 2) as a control group which were age and sex matched to detect densitometric and the Belin ABCD display tomographic corneal changes after photorefractive keratectomy (PRK). All allocated patients were followed-up and analyzed statistically

Table (1) summarizes the demographic and pre-operative clinical characteristics of both groups, the pre-operative Belin ABCD parameters of both groups.

In the **study group**, most prevalent risk factors were thin cornea (≤ 510 µm) in 45 eyes (62% of cases). Corneal thickness spatial profile (CTSP) curve was found deviated before 6 mm circle in 14 eyes (18% of cases). Superior-inferior difference in corneal thickness map > 30 µm, or decentered thinnest location- was observed in 4 eyes (5% of cases). Anterior topographic map irregularities- were found in 9 eyes (12% of cases). Posterior topographic map irregularities: back elevation >15 µm or isolated island- were observed in 7 eyes (9% of cases) and tongue like projection in 8 eyes (11% of cases). Abnormal index of height decentration (IHD)- was observed in 20 eyes (27% of cases). Abnormal Belin Ambrosio ectasia display deviation (BAD-D)- was found in 35 eyes (48% of cases).

Longitudinal post-operative observations:

Uncorrected visual acuity (UCVA)

Uncorrected visual acuity (UCVA) improved significantly in all post-operative visits in each group, compared to the preoperative one, while, no significant differences were observed in the UCVA between both groups at each visit.

Corneal haze

All candidates subjectively complained from mild glare in the first post-operative month then glare disappeared.

Subjectively, corneal haze was minimal in early post-operative period. Only four candidates had grade 1 haze and five candidates had grade 0.5 haze in post-operative 3 months visit then became clear cornea (grade 0) in post-operative 6 months visit.

Corneal densitometry (CD) assessment with Pentacam decreased significantly in all post-operative visits in each group, compared to the preoperative one, in anterior layer (120 µm) zones 0-2 mm, 2-6 mm and 6-10 mm annulus (all P<0.001), while no significant differences were observed in CD between both groups at each visit (**Table (2)** , **Fig (1**).

Post-operative Belin parameters

Parameter C was significantly higher in group 1 than group 2 at preoperative, 3 months, 6 months and 12 months between both groups (all P<0.001), while, parameters A, B and D- were insignificantly different (**Table 3**).

Post-operative tomographic data

Repeated measures ANOVA within visits and between groups were done. ARC, PRC, posterior average K, TCT, BAD-D, Prog, ARTmax, K max, ISV, IVA, IHA and IHD- were statistically significant different within visits in each group, compared to the preoperative one (all P<0.001). Significant changes were observed in CCT, BAD-D, ARTmax, IVA, IHA and IHD- between groups (all P<0.001), while, no significant changes were observed in other parameters (**Table 4**, **Fig 2-4**).

There were significant negative correlations between K max and ARC at 3 months (r =-0.476, p <0.001), 6 months (r =-0.673, p < 0.001) and 12 months (r =-0.639, p < 0.001). There were also significant negative correlations between ARC and average K (r =-0.961, p <0.001), and between PRC and average posterior K readings (r = -0.920, p <0.001). There was negative correlation between Prog and TCT at 3 months (r =-0.713, p <0.001), 6 months (r =-0.699, p <0.001) and 12 months (r =-0.693, p <0.001).

There was positive correlation between BAD and Prog at 3 months (r =0.844, p <0.001), 6 months (r =0.826, p <0.001) and 12 months (r =0.820, p <0.001). There was positive correlation between ARTmax and TCT at 3 months (r =0.825, p <0.001), 6 months (r =0.860, p <0.001) and 12 months (r =0.849, p <0.001) (**Table 5**).

Table (1): Baseline (pre-operative) characteristics of the studied groups

	Group1 (n=73)	Group2 n=74)	P value
Demographic data			
Age (years)	23.64 ± 5.7	24.96 ± 6.43	0.192
Sex Male	6 (15.8%)	6 (16.2%)	0.971
Female	32 (84.2%)	31 (83.8%)	
Clinical refraction and keratometr			
Sphere (diopters)	-2.04 ± 1.47	-2.33 ± 1.67	0.265
Cylinder (diopters)	-1.14 ± 0.87	-1.02 ± 0.98	0.408
SE (diopters)	-2.64 ± 1.45	-2.85 ± 1.74	0.426
UCVA # (decimal)	0.2 (0.1-0.4)	0.2 (0.1-0.4)	0.769
BDVA # (decimal)	1(0.8-1)	1(0.825-1)	0.237
K1 front (diopters)	43.5 ± 1.6	43.3 ± 1.8	0.438
K2 front (diopters)	44.8 ± 1.6	44.4 ± 1.9	0.277
K1 back (diopters)	-6.17 ± 0.27	-6.19 ± 0.27	0.778
K2 back (diopters)	-6.48 ± 0.27	-6.51 ± 0.31	0.564
CCT (µm)	٥١٤.٠٨±27.03	545.43±26.22	**< 0.001***
Belin ABCD parameters			
A **Stage 0**	69 (94.52%)	68 (91.89%)	0.745
Stage 1	4 (5.48%)	6 (8.11%)	
B **Stage 0**	67 (91.78%)	63 (85.14%)	0.185
Stage 1	5 (6.85%)	11 (14.86%)	
Stage 2	1 (1.37%)	0 (0%)	
C **Stage 0**	59 (80.82%)	74 (100%)	**< 0.001***
Stage 1	14 (19.18%)	0 (0%)	
D **Stage 0**	39 (53.42%)	51 (68.92%)	0.053
Stage 1	34 (46.58%)	23 (31.08%)	

All data presented as mean (±SD), #: Data presented as median (IQR), UCVA: Uncorrected visual acuity, BDVA: Best distant visual acuity, SE: Spherical equivalent, K1: Flat keratometry, K2: Steep keratometry (front and back) in diopters, CCT: Central corneal thickness, N: Number, *: Significant as P value ≤0.05

Table (2): Subjective PRK haze grade assessment

	Grade	Group1 (n=73)	Group2 (n=74)	P value
Post-operative 3 months	0 (clear)	65 (89%)	64 (86.5%)	0.766
	0.5	4(5.5%)	6 (8.1%)	
	1	4 (5.5%)	4 (5.4%)	
Post-operative 6 and 12 months	0 (clear)	73 (100%)	74 (100%)	---
	0.5	0	0	
	1	0	0	

	Group 1				**Group 2**				**P within visits**	**P between groups**
Ant. CD	Pre-operative	3 months	6 months	12 months	Pre-operative	3 months	6 months	12 months		
0-2 mm	19.29± 1.6	17.77±1.7	17.69±1.8	17.71±1.8	19.16±2.3	17.84±2.1	17.95±1.6	17.85±2	**<0.001***	0.646
2-6 mm	17.33± 1.3	15.78±1.5	15.81±1.7	15.85±1.4	17.13±1.9	15.95±2	16.14±1.5	16.12±1.9	**<0.001***	0.465
6-10 mm	16.67± 2.9	15.78±2.8	15.74±3.0	15.66±2.4	16.52±3.2	15.91±3.2	15.89±2.6	15.84±3	**<0.001***	0.849

CD: Corneal densitometry in grayscale units, Ant: Anterior corneal layer (120 µm), *: Significant as P value ≤0.05

Table (3): Belin ABCD parameters

	Belin A				**Belin B**			**Belin C**			**Belin D**		
		Group 1	Group 2	P	Group 1	Group 2	P	Group 1	Group 2	P	Group 1	Group 2	P
Pre-operative	Stage 0	69 (94.52 %)	68 (91.89 %)	0.745	67 (91.78 %)	63 (85.14 %)	0.185	59 (80.82 %)	74 (100%)	< **0.001***	39 (53.42 %)	51 (68.92 %)	0.053
	Stage 1	4 (5.48 %)	6 (8.11 %)		5 (6.85 %)	11 (14.86 %)		14 (19.18 %)	0 (0%)		34 (46.58 %)	23 (31.08 %)	
	Stage 2				1 (1.37 %)	0 (0%)							
Post-operative 3 months	Stage 0	73 (100%)	74 (100%)	---	70 (95.89 %)	71 (95.95 %)	0.548	7 (9.59 %)	29 (39.19 %)	< **0.001***	39 (53.42 %)	51 (68.92 %)	0.053
	Stage 1	0 (0%)	0 (0%)		3 (4.11 %)	2 (2.7%)		25 (34.25 %)	27 (36.49 %)		34 (46.58 %)	23 (31.08 %)	
	Stage 2							37 (50.68 %)	16 (21.62 %)				
	Stage 3							4 (5.48 %)	2 (2.7%)				
Post-operative 6 months	Stage 0	73 (100%)	74 (100%)	---	71 (97.26 %)	73 (98.65 %)	0.619	5 (6.85 %)	32 (43.24 %)	< **0.001***	39 (53.42 %)	51 (68.92 %)	0.053
	Stage 1	0 (0%)	0 (0%)		2 (2.74 %)	1 (1.35 %)		26 (35.62 %)	27 (36.49 %)		34 (46.58 %)	23 (31.08 %)	
	Stage 2							38 (52.05 %)	14 (18.92 %)				
	Stage 3							4 (5.48 %)	1 (1.35 %)				
Post-operative 12 months	Stage 0	73 (100%)	74 (100%)	---	70 (95.89 %)	72 (97.3 %)	0.681	6 (8.22 %)	33 (44.59 %)	< **0.001***	39 (53.42 %)	51 (68.92 %)	0.053
	Stage 1	0 (0%)	0 (0%)		3 (4.11 %)	2 (2.7%)		30 (41.1 %)	27 (36.49 %)		34 (46.58 %)	23 (31.08 %)	
	Stage 2							32 (43.84 %)	13 (17.57 %)				
	Stage 3							5 (6.85 %)	1 (1.35 %)				

Table (4): Post-operative tomographic data

	Group 1 (n=73)				**Group 2 (n=74)**				**P within visits**	**P between groups**
	Pre-operative	3 months	٦ months	١٢ months	Pre-operative	٣ months	٦ months	١٢ months		
ARC	7.63±0.27	8.07±0.9	8.15±0.42	8.12±0.4	7.67±0.32	8.18±0.38	8.16±0.38	8.15±0.38	**<0.001***	0.494
PRC	6.25±0.26	6.32±0.26	6.31±0.26	6.32±0.27	6.23±0.28	6.33±0.42	6.31±0.29	6.31±0.27	**<0.001***	0.940
Posterior average K	-6.33±0.26	-6.30±0.24	-6.31±0.25	-6.31±0.25	-6.35±0.28	-6.32±0.28	-6.31±0.27	-6.31±0.26	**<0.001***	0.802
TCT	510.4±27	450.85±34	451.66±33	453.41±33	542.23±27	479.49±39	481.65±39	484.12±38	**<0.001***	**<0.001***
BAD-D	1.43±0.58	2.74±0.8	2.66±0.72	2.62±0.72	1.06±0.51	2.32±1	2.21±0.9	2.11±0.88	**<0.001***	**<0.001***
Prog	1.06±0.14	1.7±0.35	1.69±0.33	1.67±0.32	1.02±0.1	1.63±0.34	1.59±0.31	1.56±0.3	**<0.001***	0.068
ARTmax	391.9±74	235.96±61	233.53±56	239.29±58	429.92±60	260.85±72	269.69±69	275.07±69	**<0.001***	**<0.001***
K max	45.21±1.6	44.04±1.8	44±1.8	44.07±1.7	44.97±2	43.77±2	43.77±2	43.79±1.9	**<0.001***	0.394
ISV	18.58±5.4	22.67±9.8	22.38±9.4	22.21±9.4	16.64±4.4	20.74±10.1	20.58±9.3	20.58±9.2	**<0.001***	0.157
IVA	0.13±0.06	0.19±0.1	0.19±0.1	0.19±0.1	0.1±0.04	0.15±0.07	0.16±0.07	0.16±0.07	**<0.001***	**0.012***
IHA	5.6±4.47	7.55±6.09	7.58±6.13	7.34±6.23	3.92±2.97	5.27±5.62	5.8±5.47	6.5±5.54	**<0.001***	**0.024***
IHD	0.011 (0.008-0.015)	0.013 (0.008-0.019)	0.014 (0.007-0.019)	0.013 (0.009-0.019)	0.008 (0.006-0.01)	0.008 (0.006-0.015)	0.009 (0.007-0.015)	0.01 (0.008-0.015)	**<0.001***	**0.003***

All data presented as mean (±SD), #: Data presented as median (IQR), TCT : Thinnest location in µm, ARC: Anterior radius of curvature, PRC: Posterior radius of curvature, BAD-D: Belin Ambrosio ectasia display, Prog: thickness progression index, ARTmax : Maximum Ambrosio relational thickness, K max: Maximum keratometry, ISV: Index of surface variance, IVA: Index of vertical asymmetry, IHA: Index of height asymmetry, IHD: Index of height decentration, N: Number, *: Significant as P value ≤0.05

Table (5): Correlations

		3 months	6 months	12 months
K max and ARC	r	-0.476	-0.673	-0.639
	P value	< 0.001*	< 0.001*	< 0.001*
	CI 95%	-0.592 to -0.341	-0.752 to -0.573	-0.725 to -0.531
TCT and Prog	r	-0.713	-0.699	-0.693
	P value	< 0.001*	< 0.001*	< 0.001*
	CI 95%	-0.785 to -0.624	-0.773 to -0.605	-0.769 to -0.599
BAD-D and Prog	r	0.844	0.826	0.820
	P value	< 0.001*	< 0.001*	< 0.001*
	CI 95%	0.789 to 0.884	0.767 to 0.872	0.759 to 0.867
TCT and ARTmax	r	0.825	0.860	0.849
	P value	< 0.001*	< 0.001*	< 0.001*
	CI 95%	0.766 to 0.871	0.811 to 0.897	0.797 to 0.889
ARC and K average	r	-0.961	-0.956	-0.956
	P value	< 0.001*	< 0.001*	< 0.001*
PRC and back K average	r	-0.913	-0.920	-0.925
	P value	< 0.001*	< 0.001*	< 0.001*

*: Significant as P value ≤0.05

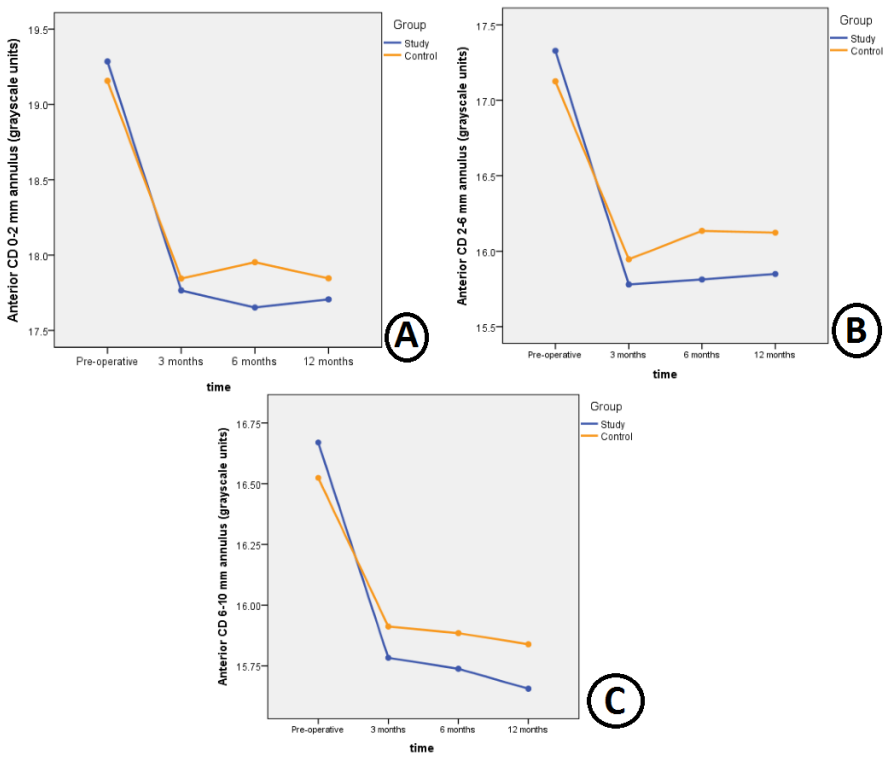
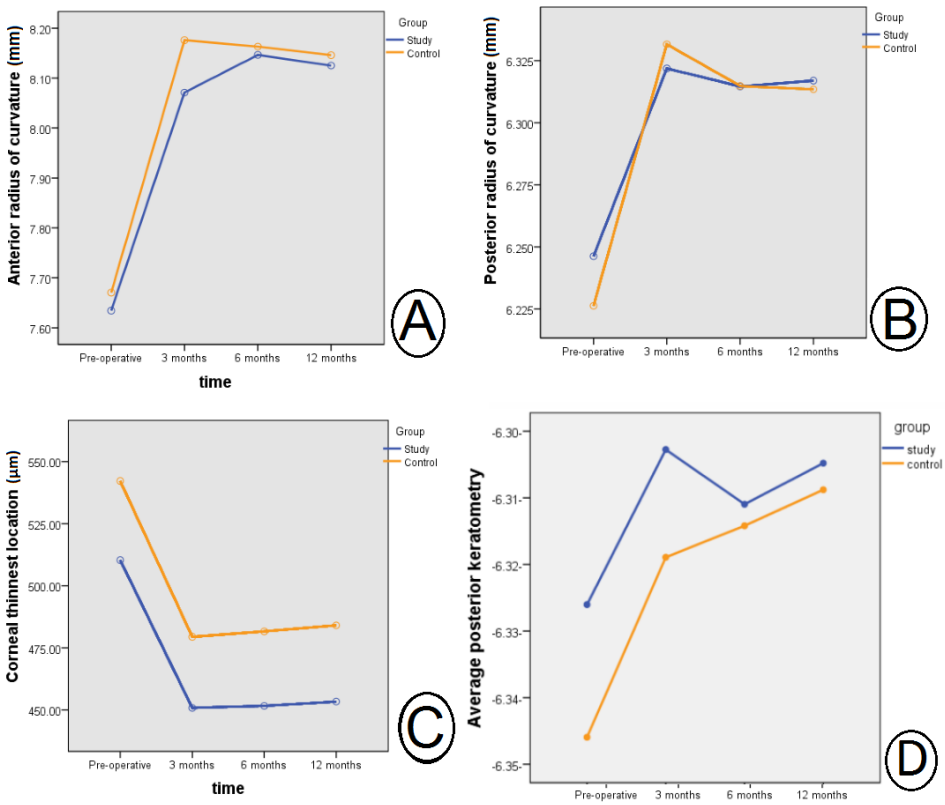


Figure (1): Corneal densitometry (anterior layer) of both groups



Figure(2): (A) Anterior, (B) posterior radius of curvature, (C) thinnest location and (D) posterior k reading

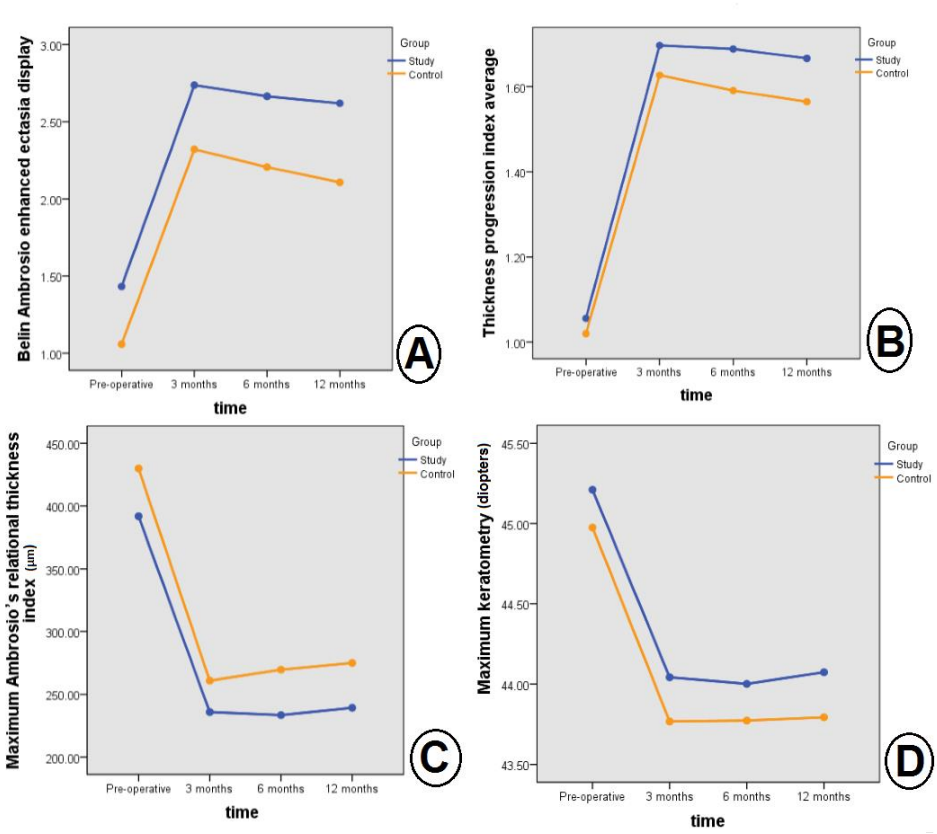


Figure (3): Tomographic changes between groups, (A) BAD-D, (B) Prog, (C) ARTmax and (D) K max

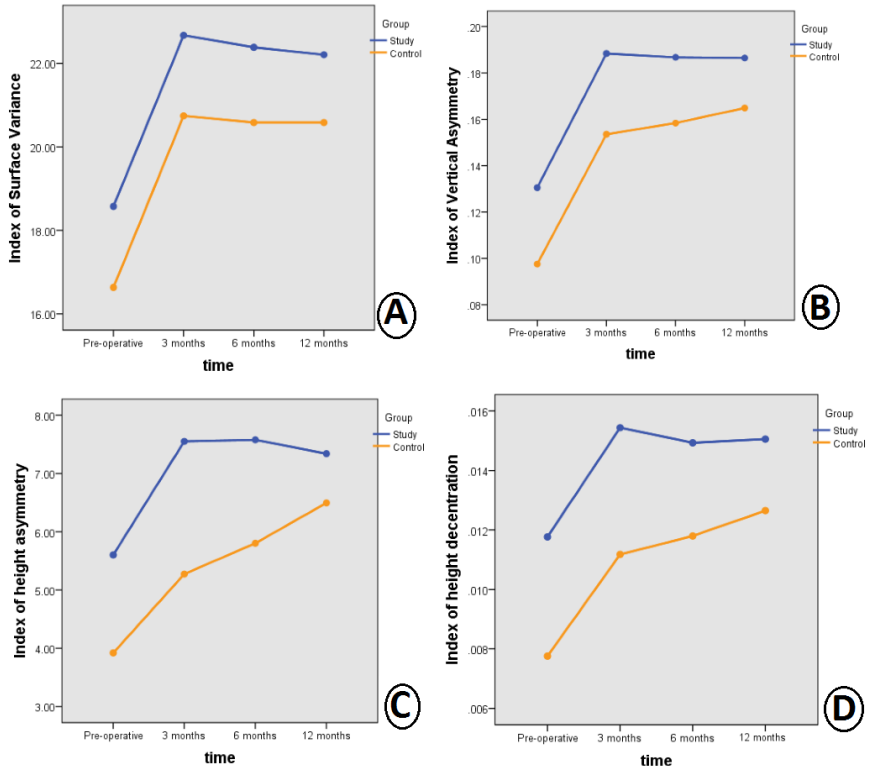


Figure (4): Tomographic indices between groups, (A) ISV, (B) IVA, (C) IHA and (D) IHD

Discussion

Our study was the first to use Belin ABCD display after PRK. We reported significant longitudinal changes in corneal densitometry (CD) and tomographic parameters post-PRK within both healthy and suspicious cornea groups, with notable differences between the groups. While uncorrected visual acuity (UCVA) improved significantly in both groups without intergroup differences, the suspicious cornea group exhibited persistently higher Belin ABCD parameter "C" values across all follow-up visits ($P< 0.001$). Additionally, significant changes were observed in central corneal thickness (CCT), BAD-D score, ARTmax, and indices of asymmetry (IVA, IHA, and IHD) between the groups- highlighting greater structural irregularities in the suspicious cornea group post-PRK (all $P<0.001$). Despite these changes, corneal haze resolved by 6 months in all cases, and CD reductions were similar across groups- suggesting comparable recovery patterns in anterior corneal clarity. These findings underscore the differential impact of PRK on tomographic and densitometric features in healthy versus suspicious corneas over a one-year follow-up.

Parameter A showed iatrogenic regression [ARC increased around 0.5 mm] and parameter C showed iatrogenic progression [TCT decreased around 60 µm] due to laser surface correction then stability through 3 follow-up visits. Parameter B showed slight regression [PRC slightly increased around 0.08 mm] after PRK then stability through 3 follow-up visits. Parameter D showed no change. Belin ABCD display was a useful tool in ectasia progression detection. No post-PRK ectasia detected after one year follow-up in the study.

Belin ABCD display had good sensitivity and specificity in ectasia progression detection [24, 25]. Several studies had used the ABCD grading system to classify KC patients and detect ectasia progression [26-29]. Any change in two ABCD parameters above 80% CI (confidence interval) or one ABCD parameter above 95% CI would be defined as a progressive ectasia [24]. Our study performed PRK and used Belin ABCD display to detect ectatic progression but there was no ectasia case in all candidates for one year through 3 follow-up visits.

The new staging system better reflects the anatomical changes seen in keratoconus and can be used to screen for ectatic progression [30], be employed to detect earlier change and additionally to show efficacy of new treatment modalities, such as crosslinking [18, 31-33]. Longitudinal studies on structural changes following cross-linking (CXL) treatment evaluated ABCD dynamics. Grisevic et al.[28] (12-month follow-up), Yekta et al.[29] (6-month follow-up) and Saglik et al.[34] (12-month follow-up)- had used changes in the ABCD progression display to report on CXL efficacy. Grisevic et al.[28] and Yekta et al.[29] concluded no progression after CXL, but Saglik et al.[34] - showed minimal progression in parameter B and C.

Alzahrani et al.[35] showed slight progression in parameter B and C. Flockerzi et al.[26] reported that early keratoconus (KC) rather became manifest in the posterior than the anterior corneal curvature. Adding a biomechanical parameter (hysteresis) to the ABCD keratoconus staging system may detect abnormalities before tomographic changes [36].

Corneal densitometry (CD) could represent a useful objective measurement of postoperative mild corneal haze [37]. Corneal densitometry has an excellent repeatability in refractive surgery candidates for areas below 10 mm annulus [38, 39]. In this study, corneal densitometry significantly decreased about 2 grayscale units (GSU) after PRK then became stable through 3 follow-up visits for one year. The increase in densitometry in the central zone could be useful in detecting subclinical ectatic condition [40, 41]. There was no ectasia case detected in our study. Similar to our study, Poyales et al.[42] and Khattak et al.[43] found that anterior CD decreased about 2 GSU in the first 3 months after PRK.

The present study had limitations, including the small sample size, short follow-up duration and being single-centered. Long-term follow-up is important to obtain precise postoperative results as most post-PRK case reports happened after more than one year [6, 44-51]. Future studies with larger sample sizes are needed to verify the study findings further and increase the reliability of the study findings.

Conclusion

Belin ABCD progression display and anterior corneal densitometry- are useful tools to monitor tomographic changes in cornea after PRK procedures.

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