# Ectasia Risk Score System and Practical Subjective Scoring System in Screening of Keratorefractive Surgery Candidates

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**Abstract:**

**Background:** Corneal ectasia is a sight-threatening complication of excimer laser refractive surgery with progressive thinning of the cornea, estimated between 0.04% and 0.6%. **Aim of the work:** Evaluate the sensitivity, specificity, and accuracy of ectasia risk score system and the practical subjective scoring system (PS3) in screening keratorefractive surgery candidates. **Patients and methods:** This retrospective study was included 226 eyes at Ebsar Eye Center, Benha, Egypt, subjects divided into 5 groups based on pre-operative Pentacam and prevalence of post Lasik ectasia. Group 1-2 included 100 eyes, group 3 no eyes found to meet it group 4 included 4 eyes, group 5 included 22 eyes. Group 1: Patients with grade 1 keratoconus, were not enrolled in keratorefractive surgeries. Group 2: had normal tomography, were enrolled for keratorefractive surgeries, and no postoperative ectasia. Group 3: Preoperative normal tomography, had keratorefractive surgeries, with postoperative ectasia. Group 4: preoperative abnormal tomography, had keratorefractive surgeries, with ectasia. Group 5: had abnormal tomography with keratorefractive surgeries, with ectasia. Complete ophthalmological examination including auto refractometer and subjective refraction examination, Slit lamp bio microscopy, ophthalmoscopy. Corneal topography was done by Pentacam HR, and repeated twice for each eye. Topographic analysis was obtained for each eye. **Results:** Positive correlations between groups regarding PS3 Thinnest local, preop thickness, profile map shape, inter eye interpretation score, preop Ant Km, no significant differences regarding PS3 Ant Km. **Conclusion:** Both ERSS and PS3 are sensitive, specific, and accurate in screening keratorefractive surgery candidates.

**Keywords:** Ectasia, PS3, score, ERSS, keratorefractive.

## Introduction:

Ectasia, progressive steepening, and thinning of the cornea are uncommon but serious complications of excimer laser corneal refractive surgery that reduce uncorrected and often corrected distance visual acuity (CDVA). They occur commonly after laser in situ keratomileusis (LASIK) and infrequently after photorefractive keratectomy (PRK). Keratectasia has a reported prevalence of 1/2,500. It is characterized by progressive corneal steepening and thinning, increasing astigmatism, and declining visual acuity **(1).**

Factors that have been reported to place an individual at increased risk for developing corneal ectasia after LASIK include preoperative topographic abnormality, low residual stromal bed thickness, young age, thin corneas, and high myopia. The most significant and best described risk factors are topographic abnormality and reduced residual stromal bed thickness, although some patients have developed ectasia without either of these factors **(2).**

Ectatic changes can occur as early as one week after LASIK or be delayed for up to several years after the initial procedure. Histologic findings suggest that post-LASIK keratectasia results in collagen fibril thinning and a decreased interfibrillar distance within the residual stromal bed (RSB) **(3).**

Different risk scoring systems were proposed for facilitating the prediction of patients who are at risk of ectasia progression after LASIK. **Randleman** **(4)** and coworkers developed the ectasia risk score system (ERSS) based on a retrospective case-control study, considering some parameters – such as preoperative topography, RSB thickness, age, preoperative corneal thickness, and degree of myopia – to better identify patients with a high risk for ectasia. The intraoperative corneal thickness should be measured if the variability of flap thickness is likely to put a patient at risk for ectasia **(5).**

The ERSS was validated by a second study, which confirmed abnormal corneal topography and age as the most important variables for predicting ectasia risk Even though the ERSS represented an advance on the ability to detect ectasia risk, there were

still 8% of false negatives, and 6% of false positives in the original studies [(6).]

Clinical and topographical findings of ectasia are often indistinguishable from those of keratoconus. To date, no method can definitively diagnose patients with ectasia. A practical task for clinicians is to improve the sensitivity of screening methods for identifying patients with mild keratoconus to prevent iatrogenic keratectasia [(7).]

The Practical Subjective Scoring System (PS3) was first introduced by Mazen Sinjab [(13)] for a better practical approach of corneal tomography as the first step of candidate selection. The system is therefore based on tomographic findings and classifies the ectasia risk factors into low (normal), moderate (suspicious), and high-risk factors in terms of laser-based refractive surgery.

It is essential to exclude sources of false findings before applying the PS3 to avoid overestimation or underestimation. In other words, all the steps of avoiding and recognizing the false findings should be mastered to be able to apply the PS3 and avoid exclusion of suitable candidates (overestimation) or include improper candidates (underestimation). [(13)]

## Patients and Methods:

This retrospective cohort clinical study carried out on 226 eyes, were at Ebsar Eye Center, Benha, Egypt through the duration from September 2019 to May 2021. The subjects were divided into 5 groups based on their pre-operative normal or abnormal Pentacam and prevalence of post LASIK ectasia or not. Each of groups 1-2 included 100 eyes, group 3 no eyes found to meet it, group 4 included 4 eyes, group 5 included 22 eyes. Group 1: Patients with grade 1 keratoconus (Amsler-Krumeich) who were not enrolled in keratorefractive surgeries. Group 2: Patients with preoperative normal tomography who were enrolled for keratorefractive surgeries, and did not develop postoperative ectasia. Group 3: Patients with preoperative normal tomography who were enrolled for keratorefractive surgeries, and developed postoperative ectasia. Group 4: Patients with pre-operative abnormal tomography who were enrolled for keratorefractive surgeries, and developed postoperative ectasia. Group 5: Patients with preoperative abnormal tomography who were enrolled in keratorefractive surgeries, and did not develop postoperative ectasia, after exclusion of those with severe dry eye,

corneal scar, severe allergic conjunctivitis, a history of eye surgery, glaucoma, cataract, a history of herpes simplex keratitis, pregnancy, breast-feeding, thyrotoxicosis, hypothyroidism, and use of certain medications, such as Accutane.

A written consent form approved by Local Ethical Research Committee in Benha Faculty of Medicine was obtained from every participant prior to study initiation.

All participants in this study were subjected to full history taking including age, sex, work, past medical history, past surgical history, Complete ophthalmological examination was done for every subject, including auto refractometer and subjective refraction examination, Slit lamp bio microscopy, ophthalmoscopy. Corneal topography was obtained using the Pentacam HR, which combines a slit illumination system and a rotating Scheimpflug camera. Corneal topography measurement was repeated twice for each eye. Topographic analysis was obtained for each eye.

**Statistical analysis:**

Data were analyzed using IBM SPSS software package version 20 (Armonk, NY, IBM Corp.). Qualitative data were described using number and percent. The Kolmogorov-Smirnov test was used to verify the normality of distribution. Quantitative data were described using range (minimum and maximum), mean, and standard deviation. Chi-squared test was used to compare the three groups according to categorical variables. Significance of the obtained results (P value) was judged at the 5% level.

## Results:

- There were no significant differences between the studied groups as regard side. P value was 1.0. **(Table1)**
- There were no significant differences between the studied groups as regard PS3 Ant Km. P value was 0.85. **( Figure 1)**
- There were positive correlations between the studied groups as regard PS3 Thinnest local. P value was <0.001. **(Figure 2)**
- There were positive correlations between the studied groups as regard Inter eye interpretation score. P value was <0.001. **(Table 2)**
- There were positive correlations between the studied groups as regard preop Ant Km. P value was 0.001. **( Figure 3)**

- There were positive correlations between the studied groups as regard preop I/S and S/I. P value was <0.001. **( Figure 4)**
- There were positive correlations between the studied groups as regard preop thinnest local. P value was <0.001. **(Figure 5)**
- There were positive correlations between the studied groups as regard preop SRAX. P value was <0.001. **(Figure 6)**
- Positive correlations between the studied groups as regarddifferent parameters, P value was <0.001**(Table 3&Figure 7)**

Table (1): Comparison between the studied groups according to side.

| | | | | | | | | | stical | P value |
|---|---|---|---|---|---|---|---|---|---|---|
| | No | % | No | % | No | % | No | % | | |
| Rt | 50 | 50.0 | 50 | 50.0 | 2 | 50.0 | 11 | 50.0 | FET= 0.0 | 1.0 |
| Lt | 50 | 50.0 | 50 | 50.0 | 2 | 50.0 | 11 | 50.0 | | |
| Total | 100 | 100 | 100 | 100 | 4 | 100 | 22 | 100 | | |

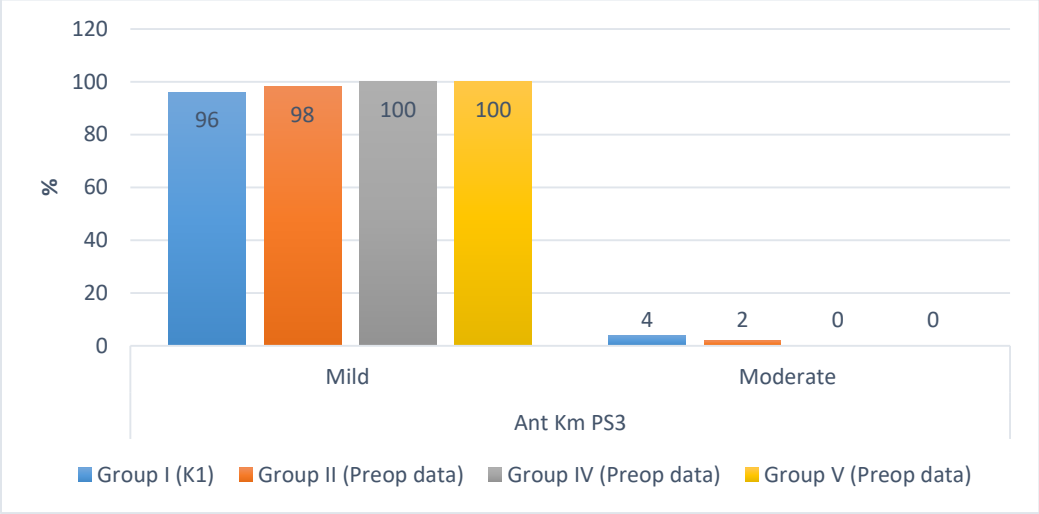


**Fig.(1):** Comparison between the studied groups according to PS3 ant km.

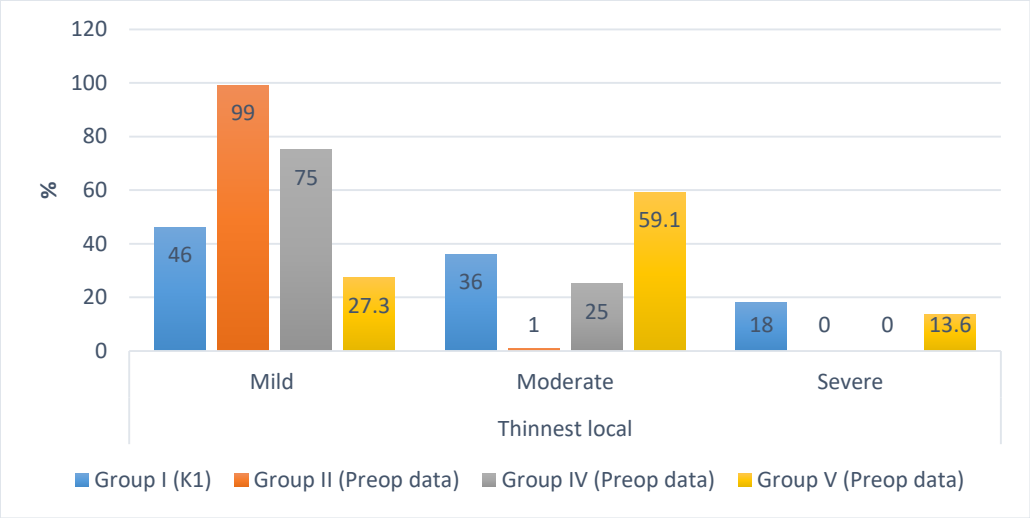


**Fig.(2):** Comparison between the studied groups according to PS3 thinnest local.

**Table (2):** Comparison between the studied groups according to Inter eye interpretation score

| Inter eye interpolation score | Group I (K1) | | Group II (Preop data) | | Group IV (Preop data) | | Group V (Preop data) | | Statistical test | P value |
|---|---|---|---|---|---|---|---|---|---|---|
| | No | % | No | % | No | % | No | % | | |
| 0 | 13 | 26.0 | 24 | 48.0 | 0 | 0.0 | 1 | 9.1 | X2= 35.3 | 0.002** |
| 1 | 11 | 22.0 | 23 | 46.0 | 1 | 50.0 | 4 | 36.4 | | |
| 2 | 11 | 22.0 | 3 | 6.0 | 1 | 50.0 | 3 | 27.3 | | |
| 3 | 10 | 20.0 | 0 | 0.0 | 0 | 0.0 | 3 | 27.3 | | |
| 4 | 4 | 8.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | | |
| 5 | 1 | 2.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | | |
| Total | 50 | 100 | 50 | 100 | 2 | 100 | 11 | 100 | | |
| Inter eye interpolation score | Mean | ±SD | Mean | ±SD | Mean | ±SD | Mean | ±SD | F= 10.14 | <0.001** |
| | 1.68 | 1.38 | 0.58 | 0.61 | 1.50 | 0.71 | 1.73 | 1.01 | | |

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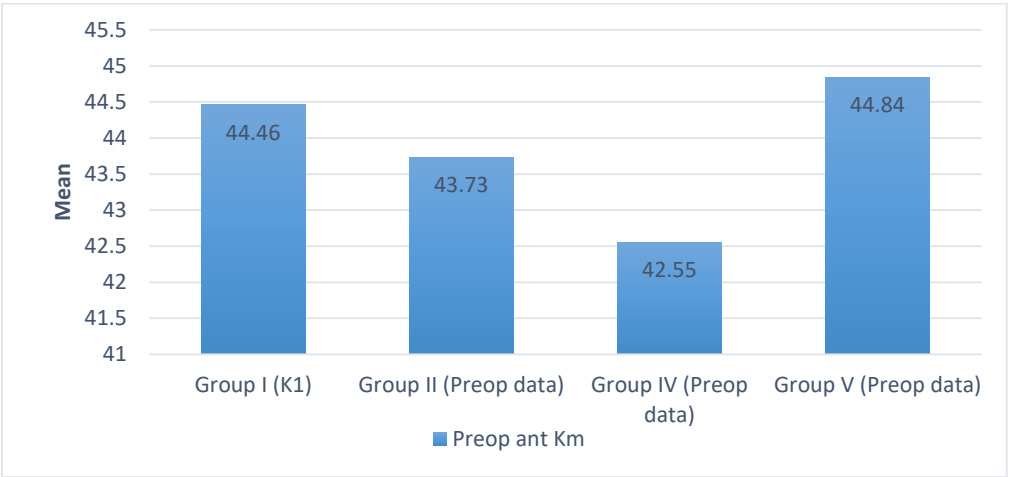


**Fig.(3):** Comparison between the studied groups according to preop ant Km

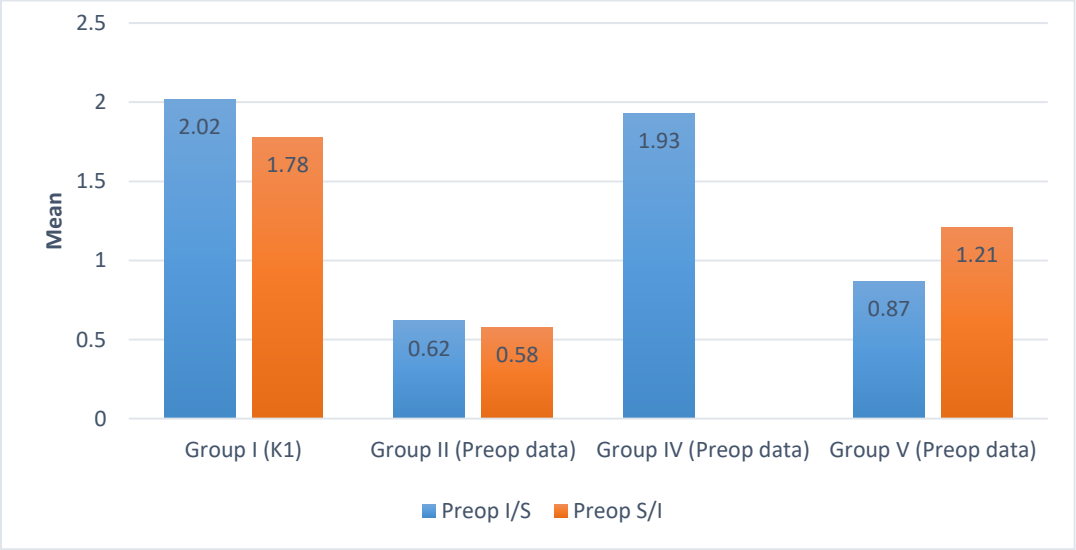


**Fig.(4):** Comparison between the studied groups according to preop I/S and S/I

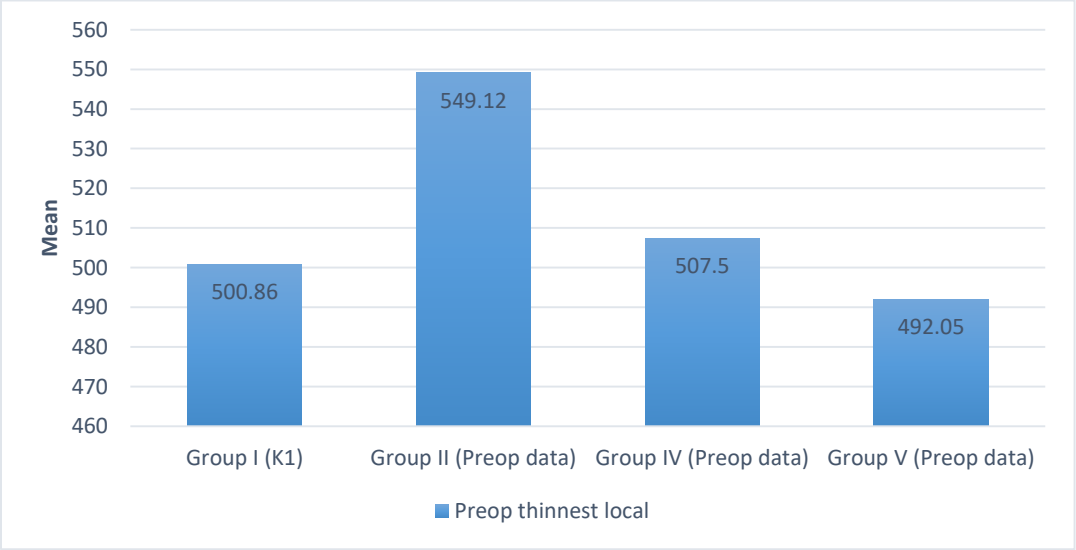


**Fig.(5):** Comparison between the studied groups according to preop thinnest local

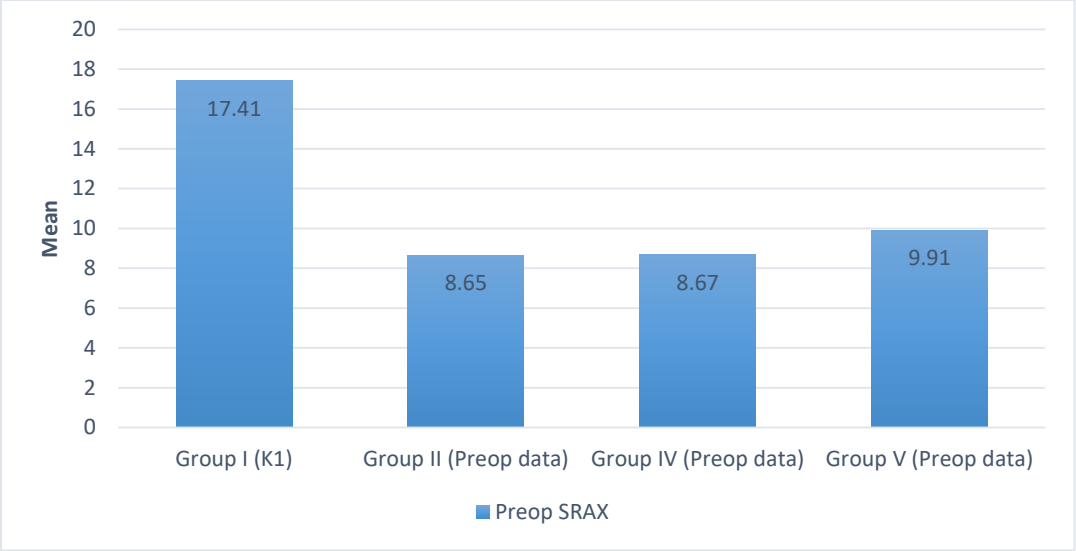


**Fig.(6):** Comparison between the studied groups according to preop SRAX

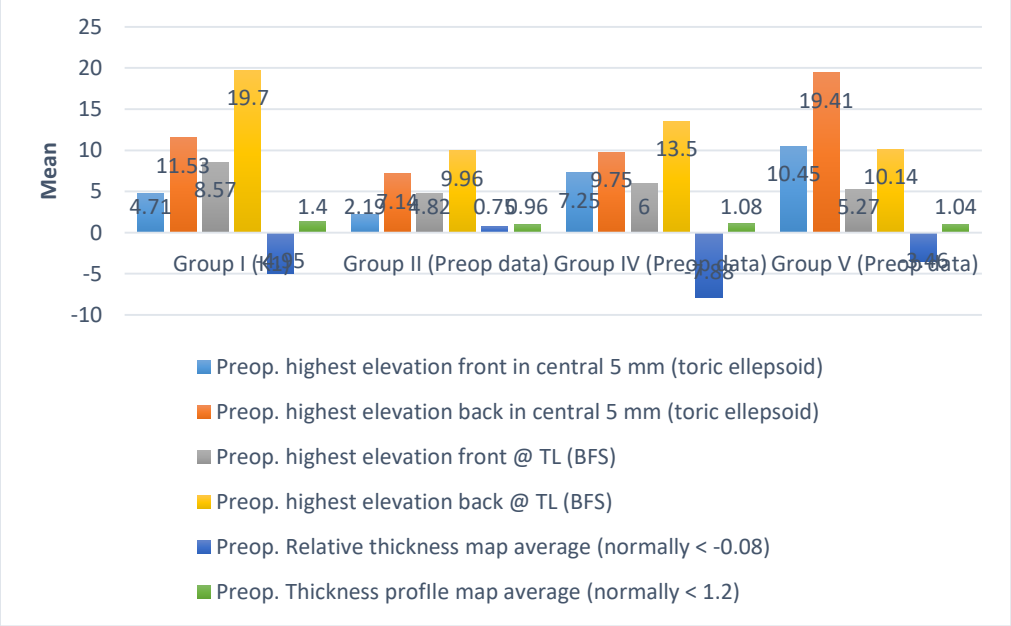


**Figure 7** show positive correlations between the studied groups as regard - P value was <0.001

**Table (3):** Comparison between the studied groups according to different parameters

| | **Group I (K1)** | | **Group II (Preop data)** | | **Group IV (Preop data)** | | **Group V (Preop data)** | | Statistical test (f) | P value |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **±SD** | **Mean** | **±SD** | **Mean** | **±SD** | **Mean** | **±SD** | | |
| Preop ant K1 | 43.41 | 1.89 | 43.07 | 1.62 | 42.0 | 2.43 | 43.98 | 1.20 | 2.67 | 0.049* |
| Preop ant K2 | 45.50 | 2.0 | 44.40 | 1.71 | 43.10 | 2.37 | 45.70 | 1.15 | 8.72 | <0.001** |
| Preop ant Km | 44.46 | 1.86 | 43.73 | 1.60 | 42.55 | 2.39 | 44.84 | 1.06 | 5.52 | 0.001** |
| Preop I/S | 2.02 | 1.25 | 0.62 | 0.41 | 1.93 | 0.29 | 0.87 | 0.73 | 15.04 | <0.001** |
| Preop S/I | 1.78 | 1.35 | 0.58 | 0.53 | | | 1.21 | 0.66 | 16.4 | <0.001** |
| Preop SRAX | 17.41 | 5.78 | 8.65 | 5.60 | 8.67 | 6.35 | 9.91 | 5.33 | 42.41 | <0.001** |
| Preop thinnest local | 500.86 | 34.79 | 549.12 | 25.69 | 507.5 | 23.73 | 492.05 | 18.73 | 52.86 | <0.001** |
| Preop. highest elevation front in central 5 mm (toric ellepsoid) | 4.71 | 2.86 | 2.19 | 1.18 | 7.25 | 1.5 | 10.45 | 7.11 | 48.79 | <0.001** |
| Preop. highest elevation back in central 5 mm (toric ellepsoid) | 11.53 | 5.08 | 7.14 | 2.65 | 9.75 | 3.2 | 19.41 | 11.64 | 35.97 | <0.001** |
| Preop. highest elevation front @ TL (BFS) | 8.57 | 4.31 | 4.82 | 2.25 | 6.0 | 2.83 | 5.27 | 2.33 | 22.20 | <0.001** |
| Preop. highest elevation back @ TL (BFS) | 19.7 | 10.64 | 9.96 | 4.80 | 13.5 | 6.46 | 10.14 | 3.92 | 27.52 | <0.001** |
| Preop. Relative thickness map average (normally < -0.08) | -4.95 | 5.10 | 0.75 | 4.48 | -7.88 | 0.66 | -3.46 | 3.45 | 27.47 | <0.001** |
| Preop. Thickness profIle map average (normally < 1.2) | 1.40 | 0.49 | 0.96 | 0.12 | 1.08 | 0.21 | 1.04 | 0.14 | 29.21 | <0.001** |
| Inter eye interpolation score | 1.68 | 1.38 | 0.58 | 0.61 | 1.50 | 0.71 | 1.73 | 1.01 | 10.14 | <0.001** |

**Table (4):** Comparison between the studied groups according to pachymetry and elevation indices

| | Group I | | Group II | | Group IV | | Group V | | Statistical test (f) | P value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | ±SD | Mean | ±SD | Mean | ±SD | Mean | ±SD | | |
| thinnest location thickness | 500.86 | 34.79 | 549.12 | 25.69 | 507.5 | 23.73 | 492.05 | 18.73 | 52.86 | <0.001** |
| highest elevation front in central 5 mm (toric ellepsoid) | 4.71 | 2.86 | 2.19 | 1.18 | 7.25 | 1.5 | 10.45 | 7.11 | 48.79 | <0.001** |
| highest elevation back in central 5 mm (toric ellepsoid) | 11.53 | 5.08 | 7.14 | 2.65 | 9.75 | 3.2 | 19.41 | 11.64 | 35.97 | <0.001** |
| highest elevation front @ TL (BFS) | 8.57 | 4.31 | 4.82 | 2.25 | 6.0 | 2.83 | 5.27 | 2.33 | 22.20 | <0.001** |
| highest elevation back @ TL (BFS) | 19.7 | 10.64 | 9.96 | 4.80 | 13.5 | 6.46 | 10.14 | 3.92 | 27.52 | <0.001** |
| Relative thickness map average | -4.95 | 5.10 | 0.75 | 4.48 | -7.88 | 0.66 | -3.46 | 3.45 | 27.47 | <0.001** |
| Thickness profile map average | 1.40 | 0.49 | 0.96 | 0.12 | 1.08 | 0.21 | 1.04 | 0.14 | 29.21 | <0.001** |

**p≤0.001 is statistically highly significant *p<0.05 is statistically significant

χ2 Chi square test F One way ANOVA test

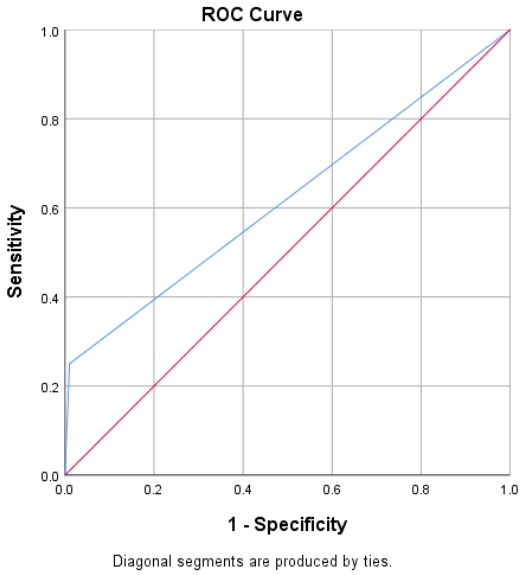


Figure (7): Specificity and sensitivity of PS3

**Table (5):** Comparison between group II and IV according to PS3 ectasia risk score factors

| | **Group II** | | **Group IV** | | **Statistical test (st t)** | **P value** |
|---|---|---|---|---|---|---|
| | Mean | ±SD | Mean | ±SD | | |
| **Preop ant K1** | 43.07 | 1.62 | 42.0 | 2.43 | 1.27 | 0.21 |
| **Preop ant K2** | 44.40 | 1.71 | 43.10 | 2.37 | 1.47 | 0.15 |
| **Preop ant Km** | 43.73 | 1.60 | 42.55 | 2.39 | 1.42 | 0.16 |
| **Preop I/S** | 0.62 | 0.41 | 1.93 | 0.29 | 5.33 | <0.001** |
| **Preop S/I** | 0.58 | 0.53 | | | | |
| **Preop SRAX** | 8.65 | 5.60 | 8.67 | 6.35 | 0.005 | 0.996 |
| **Preop thinnest location** | 549.12 | 25.69 | 507.5 | 23.73 | 3.18 | 0.002** |
| **Preop. highest elevation front in central 5 mm (toric ellepsoid)** | 2.19 | 1.18 | 7.25 | 1.5 | 8.35 | <0.001** |
| **Preop. highest elevation back in central 5 mm (toric ellepsoid)** | 7.14 | 2.65 | 9.75 | 3.2 | 1.92 | 0.058 |
| **Preop. highest elevation front @ TL (BFS)** | 4.82 | 2.25 | 6.0 | 2.83 | 1.02 | 0.31 |
| **Preop. highest elevation back @ TL (BFS)** | 9.96 | 4.80 | 13.5 | 6.46 | 1.43 | 0.16 |
| **Preop. Relative thickness map average** | 0.75 | 4.48 | -7.88 | 0.66 | 3.83 | <0.001** |
| **Preop. Thickness profIle map average** | 0.96 | 0.12 | 1.08 | 0.21 | 2.02 | 0.046* |
| **Inter-eye asymmetry score** | 0.58 | 0.61 | 1.50 | 0.71 | 2.09 | 0.042* |

**p≤0.001 is statistically highly significant *p<0.05 is statistically significant

t independent sample t-test

This table shows that there is a statistically significant difference between the studied groups (groups II and IV) regarding preoperative I/S (Higher in group IV), thinnest location thickness (significantly higher among group II), highest elevation front in central 5 mm (significantly lower among group II), relative thickness map average (lower in group IV)

This table shows that there is a statistically non-significant difference between the studied groups (groups II and IV) regarding preoperative anterior K1, K2, anterior Km, I/S, highest elevation back in central 5mm, highest elevation front @TL, highest elevation back @TL, thickness profile map average, and inter eye asymmetry score.

**Table (6):** Validity of PS3 in prediction of post lasik ectasia

| **PS3** | **Group IV (Preop data)** | | **Group II (Preop data)** | | **Statistical test** | **P value** |
|---|---|---|---|---|---|---|
| | No =4 | % | No =100 | % | | |
| +ve (>0.5) | 1 | 25.0 | 1 | 1.0 | FET= 2.47 | 0.08 |
| -ve (<0.5) | 3 | 75.0 | 99 | 99.0 | | |
| AUC | 0.62 | | | | | |
| 95% CI | 0.294-0.946 | | | | | |
| Cut-off point | 0.5 | | | | | |
| Sensitivity | 25.0 | | | | | |
| Specificity | 99.0 | | | | | |
| Positive Predictive Value | 50.0 | | | | | |
| Negative Predictive Value | 97.1 | | | | | |
| Accuracy | 96.2 | | | | | |

(FET) represents fisher exact test for Inter-group comparison of categorical data

This table shows that the sensitivity of PS3 in the prediction of post lasik ectasia is 25%, specificity is 99% and accuracy is 96.2%

**Table (7):** ERSS and PS3 Score in group IV

| | **Ectasia risk score** | | **PS3 score** | | **Statistical test (paired t)** | **P value** |
|---|---|---|---|---|---|---|
| | Mean | ±SD | Mean | ±SD | | |
| **Group IV** | 4.5 | 1.29 | 3.25 | 1.26 | 2.61 | 0.08 |

t independent sample t-test

This table shows that in group IV the mean score of ERSS is 4.5 ± 1.29 and the mean score of PS3 is 3.25 ± 1.26

## Discussion:

This study was designed to study the sensitivity, specificity, and accuracy of ectasia risk score system and the practical subjective scoring system (PS3) in screening keratorefractive surgery candidates.

In the current study, there were 49 male patients and 65 female patients, there were no significant differences between the studied groups as regard age and gender. P value was 0.69, and this was in agreement with [(3)] study in which a total of 97 patients (194 eyes) were included in the study to evaluate the ectasia risk score system in cancelled laser in situ keratomileusis (LASIK) candidates, with the mean age of 26.4 years (range: 18–50 years). Sex distribution was approximately equal (48 women and 49 men).

Abnormal preoperative topography remains the greatest independent risk factor for post-LASIK ectasia, although corneas with normal topographies preoperatively have also been reported to develop ectasia after LASIK [(8)].

When the ERSS was devised, topography was scored based on Placido indices and patterns only. Although Placidobased topography has been found to be a sensitive method of diagnosing keratoconus, Placido analysis and axial map interpretation rely on the subjective interpretation of the clinician and can be variable [(9)].

In the current study, there were positive correlations between the studied groups as regard preop thickness profile map shape. P value was <0.001, while previous reports on ERSS are incongruent. Previously, [(4)] stated that this system, which was developed from case reports of ectasia, was more sensitive compared to traditional screening strategies. In a subsequent study, [(4)] validated their risk scoring system by applying it on 50 previously unpublished ectasia cases matched to 50 normal eyes. The sensitivity and specificity of their scoring system for the initial and comparison populations were 91% and 92%, respectively.

The study [(8)] retrospectively evaluated ERSS in 36 eyes with post-LASIK ectasia. A low risk was seen in 25% of eyes. They reported the sensitivity of this method to be only 56% and concluded that ERSS can miss a significant proportion of patients at risk of

ectasia**.** The study[4] reported that unstable refractions may predict corneal ectasia after refractive surgery**.**

The study [3] study demonstrated that according to the Randleman ERSS for preoperative refractive surgery, 40 (20.6%), 46 (23.7%), and 108 (55.7%) eyes had low-, moderate-, and high-risk scores, respectively. The mean score was 4.5 ± 2.67. The mean manifest refraction spherical equivalent, central corneal thickness, and estimated RSB thickness were 4 (+0.5 to –15.5) D, 520 (439 to 608) μm, and 312.38 (61.5 to 424.12) μm, respectively. Refractive astigmatism ranged from 0.5 to 6.25 D. Corneal astigmatism ranged from 0.04 to 4.90 D. Internal astigmatism ranged from 0 to 2.25 D.

The study [10] study, demonstrated a highly prevalent risk factor that was suspected and abnormal topographic patterns were found in approximately 64% of patients. This was consistent with former reports. Nearly 50% of ectasia cases in [4] study and 69% in [8] study had abnormal topographies. ERSS relies exclusively on Placido-based images. Recent topographic systems apply other corneal imaging, including Orbscan II and Pentacam imaging. The limitations of ERSS include starting keratoconus from the posterior portion and the lack of assessment of posterior elevation [10][3]. In [11] study comparing the prevalence and odds ratios (ORs) of the PTA and ERSS in eyes with normal preoperative topography that developed ectasia postoperatively, the sensitivity of an ERSS score more than or equal to 4 was only 20%, with a specificity of 97%**.**

In [8] study, in which topography was subjectively classified as abnormal in 61.3% of ectatic eyes and 19.0% of control eyes, an ERSS score of more than or equal to 4 achieved sensitivity of 67.7% and specificity of 79.7%, when define those at risk of ectasia as an ERSS score of more than or equal to 3 (medium risk), the sensitivity would be higher at 90.3% but the specificity would be lower at 62.0%.

In [3] study, the mean RSB thickness of cancelled patients was 312 μm above the widely accepted 250 μm. Moreover, in [8] study, the average RSB was >250 μm. Therefore, it cannot be an isolated risk factor **.**

According to the ERSS, [8] study included 21 of the 31 ectatic eyes were classified as at high risk for ectasia (ERSS R4), giving a sensitivity of 67.7%. Twenty-eight ectatic eyes (90.3%) were classified as having a

moderate risk (ERSS R3). In the controls, 63 out of 79 eyes were classified as having a low to medium risk (ERSS %3), giving a specificity of 79.7%. Fourteen eyes (17.7%) had an ERSS score of 3, while 16 eyes (20.3%) had a score of 4 or more. The area under the ROC curve was 0.853.

In a study by the study [(12)] epithelial thickness measurements using very-high-frequency (VHF) digital US were found to be useful in keratoconus screening. The VHF digital US epithelium model was able to pick up keratoconus in half of the normal fellow eyes of patients with unilateral keratoconus in the study. This concept might prove useful as an adjunctive tool for ectasia risk screening in the future**.**

To our knowledge this is the first study that assess the practical subjective scoring system (PS3) in screening keratorefractive surgery candidates.

The Practical Subjective Scoring System (PS3), which classifies the tomographic risk factors into low (normal), moderate (suspicious), and high-risk factors in regard to laser-based refractive surgery. It is essential to exclude sources of false findings before applying the PS3 to avoid overestimation or underestimation. In other words, all the steps of avoiding and recognizing the false findings should be mastered to be able to apply the PS3 and avoid exclusion of suitable candidates (overestimation) or include improper candidates (underestimation) [(13)]**.** In the current study, there were no significant differences between the studied groups as regard PS3 Ant Km. P value was 0.85. The PS3 is designed for laser-based, rather than lens-based, refractive surgery. Moreover, it is tomography-based scoring system, which is a small part of the full clinical workup that the candidate must go through before making the right decision, it is graded as, no moderate- or high-risk factors in both eyes: all types of laser-based refractive surgery are possible, two moderate- or one high-risk factor in one eye: both eyes are not suitable for laser-based refractive surgery, and one moderate risk factor in one eye and the other eye is normal or has a moderate risk factor as well: both eyes are not suitable for LASIK [(13)]**.**

Index of surface variance (ISV) is a unit-less standard deviation of individual corneal sagital radii from the mean curvature. It is an expression of corneal surface irregularity. Therefore, it is not specific to ECDs because it is flagged in all other corneal irregularities, such as scars, dry eye, contact lens-induced warpage, ocular surface

diseases [13]. In the current study, there were positive correlations between the studied groups as regard preop I/S and S/I. P value was <0.001.

The anterior sagital map is studied in terms of inferior, superior asymmetry, skewed radial axis (SRAX) index, and sagital curvature payerns. It is essential to differentiate between being an irregular cornea and being a cornea at risk based on the PS3. The cornea may be regular but at high risk and may be irregular but still within the low-risk range. For example, it is not uncommon to encounter keratoconus with a symmetric bowtie on the anterior curvature map. On the other hand, low-risk corneas may have some irregularities [13], in the current study, there were positive correlations between the studied groups as regard preop SRAX. P value was <0.001.

In group IV the mean score of ERSS is 4.5 ± 1.29 and the mean score of PS3 is 3.25 ± 1.26. The sensitivity of PS3 in the prediction of post lasik ectasia is 25%, specificity is 99% and accuracy is 96.2%, and the most important risk factor was the I/S index when the other ectasia risk factors appeared normal, and also the shape of corneal thickness curve was very sensitive.

In our study, the sensitivity of the PS3 seems low in predicting post lasik ectasia due to the following reasons: the number of cases of ectasia included in our study is still very low, and the PS3 is a tomographic system that does not consider other factors such as age, RSB, and PTA. Therefore, to get a real estimation of the PS3 sensitivity, it should be compared with similar systems and to increase the number of ectasia cases to the suitable research sample size to make our results more valid.

The coauthor professor Abdelmonem Hamed had developed an artificial intelligent interpreter program that includes all the previously published evidence-based ectasia risk factors including the D-value of the Belin/Ambrosio display, age of the patient, RSB, and PTA. It includes also the estimated postoperative mean K-reading that may affect the quality of vision after the LVC procedure. This Hamed's LVC interpreter program can be downloaded throughout a link incorporated in the published article. [14-15]

At the end of this study, more research multicenter studies are needed to effectively evaluate the preoperative ectasia risk factors.

## References:


1. **Zhu, W., Han, Y., Cui, C., Xu, W., Wang, X., Dou, X & Mu, G.** Corneal collagen crosslinking combined with phototherapeutic keratectomy and photorefractive keratectomy for corneal ectasia after laser in situ keratomileusis. Ophthalmic research. 2018; 59(3), 135-141

2. **Giri, P., & Azar, D. T.** Risk profiles of ectasia after keratorefractive surgery. Current opinion in ophthalmology 2017; 28(4), 337.

3. **Mohamadpour M, Khorrami-Nejad M, Kiarudi MY, Khosravi K.** Evaluating the Ectasia Risk Score System in Cancelled Laser In Situ Keratomileusis Candidates. J Ophthalmic Vis Res 2020;15:481–485

4. **Randleman JB, Trattler WB, Stulting RD.** validation of the ectasia risk score system for preoperative laser in situ keratomileusis screening. Am J Ophthalmol 2008;145:813–818

5. **Renato Ambrósio Jr, Isaac Ramos, Bernardo Lopes, Ana Laura Caiado Canedo, Rosane Correa and Frederico Guerra**. Assessing ectasia susceptibility prior to LASIK: the role of age and residual stromal bed (RSB) in conjunction to Belin-Ambrósio deviation index (BAD-D). Rev Bras Oftalmol. 2014; 73 (2): 75-80

6. **Spadea L, Cantera E, Cortes M, Conocchia NE, Stewart CW.** Corneal ectasia after myopic laser in situ keratomileusis: a long-term study. Clin Ophthalmol. 2012;6:1801-13.

7. **Saad A, Binder PS, Gatinel D.** Evaluation of the percentage tissue altered as a risk factor for developing post-laser in situ keratomileusis ectasia. J Cataract Refract Surg 2017;43:946–951.

8. **Chan CC, Hodge C, Sutton G.** External analysis of the Randleman ectasia risk factor score system: a review of 36 cases of post LASIK ectasia. Clin Experiment Ophthalmol 2010;38:335–340.

9. **Ramos IC, Correa R, Guerra FP, Trattler W, Belin MW, Klyce SD, et al.** Variability of subjective classifications of corneal topography maps from LASIK candidates. J Refract Surg 2013; 29:770–775

10. **Sorkin N, Kaiserman I, Domniz Y, Sela T, Munzer G, Varssano D.** Risk assessment for corneal ectasia following photorefractive keratectomy. J Ophthalmol 2017;2017:1-10

11. **Santhiago MR, Smadja D, Gomes BF, Mello GR, Monteiro MLR, Wilson SE, Randleman BJ.** Association between the percent tissue altered and postlaser in situ keratomileusis ectasia in eyes with normal preoperative topography. Am J Ophthalmol 2014; 158:87–95

12. **Reinstein DZ, Archer TJ, Urs R, Gobbe M, RoyChoudhury A, Silverman RH.** Detection of keratoconus in clinically and algorithmically topographically normal fellow eyes using epithelial thickness analysis. J Refract Surg 2015; 31:736–744.

13. **Sinjab, M. M.** Corneal Tomography in Clinical Practice (Pentacam System): Basics & Clinical Interpretation. Jaypee Brothers Medical Publishers. 2018


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