K-study

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INTRODUCTION

Temporal keratometry is an additional test not done in a routine contact lens fitting. Temporal keratometry is measured to help predict the amount of myopia reduction that can be obtained through fitting a patient with orthokeratology.[1] The purpose of this study is to investigate the temporal keratometry measurement used when fitting orthokeratology. By comparing the temporal keratometry measurements taken on a conventional Bausch and Lomb keratometer to temporal measurements done on the EyeSys corneal topographer. The computer assisted topographer was chosen because other studies have shown the topographer to be very similar in central curvature readings and even more descriptive in peripheral curvature readings.[2,3,4]

METHODS

Ten randomly chosen patients with normal corneas and refractive errors between -5.00D and +1.00D, with less than 1.00D of corneal astigmatism, had central and temporal keratometry readings taken. They then had their corneas mapped on the EyeSys topographer. After taking a central keratometry reading, a measurement of temporal K's was taken by having the patient fixate the nasal horizontal plus sign on the front of the keratometer. Estimates of the amount of myopia reduction that can be obtained are done by multiplying the difference between the central and temporal keratometry readings by two. For example, if a patient has central K's (horizontal) of 45.00D and temporal K's of 43.00D, the difference is 2.00D. Multiply the 2.00D by two and the total amount of myopia reduction predicted for this example would be 4.00D.

There are two types of color scales available on the EyeSys topographer for displaying corneal surface power. The absolute scale has fixed dioptric increments that extend over a range of 9 to 99D. The increments are smaller in the 35D to 50D range. A particular color always corresponds to the same dioptric power. This makes the absolute scale useful in comparing different corneas or in comparing the same cornea over several examinations. The normalized scale uses a smaller number of colors to cover the power range of an individual cornea. Therefore, the range of dioptric power between colors varies directly with the size of the cornea's dioptric power range.[5] The EyeSys allows

one to move the cursor anywhere on the map to determine that location's dioptric power. The absolute scale was chosen for this study, because any area of a normal cornea will be broken down into a larger dioptric range, thus providing a more precise temporal keratometric reading.

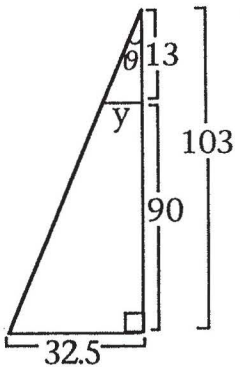
The temporal dioptric power on the topographer was taken at 4.10mm +/-0.08mm. By using some simple geometry, one can see this corresponds to the power measured on the temporal cornea by having the patient fixate the nasal cross on the keratometer. Using a right triangle with the sides: Adjacent = the 90mm distance between the patient's cornea and the front of the keratometer, plus the 13mm distance from the cornea to the center of rotation of the eye, Opposite = the 32.5mm distance between the cross and the central fixation on the front of the keratometer.

Using the tangent function:

$$\tan \theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$\tan \theta = \frac{32.5}{103} \rightarrow \theta = \tan^{-1} \frac{32.5}{103} = 17.51°$$

$$\tan \theta = \frac{y}{103} \rightarrow y = 13 \tan (17.51°) = 4.10\text{mm}$$



FINDINGS

For comparison and reliability, the mean difference in the central K's of the two instruments was +0.20D. The central mean difference in K's found in other studies that used steel balls and human eyes to compare the two instruments is 0.25D.[2]

	Central Keratometry	– Central Topographer	=
1)	43.25	43.10	+0.15
	43.50	43.00	+0.50
2)	43.87	43.77	+0.10
	44.00	43.66	+0.34
3)	44.62	43.83	+0.79
	43.37	43.15	+0.22
4)	42.18	41.97	+0.21
	42.50	42.29	+0.21
5)	44.25	44.40	-0.15
	44.25	43.54	+0.71
6)	43.62	43.54	+0.08
	43.62	43.25	+0.37
7)	41.44	41.61	-0.17
	41.87	41.92	-0.05
8)	43.25	43.83	-0.58
	43.62	43.60	+0.02
9)	43.25	43.43	-0.18
	43.75	43.32	+0.43
10)	45.12	44.88	+0.24
	45.75	45.00	+0.75
Mean Difference			+0.20
Median Difference			+0.21
Standard Deviation			0.34

The mean difference in temporal K's taken at 4.10mm on the keratometer and the topographer was 0.58D steeper for the topographer. The median difference was 0.64D steeper for the topographer. The standard deviation was 0.53D. The difference between the central mean and the temporal mean is 0.78D.

	Temporal Keratometry	— Temporal Topographer	=
1)	42.75	42.33	+0.42
	42.00	42.85	-0.85
2)	42.50	43.15	-0.65
	43.37	43.20	+0.17
3)	41.37	42.58	-1.21
	41.75	42.37	-0.62
4)	42.25	41.90	+0.35
	41.87	42.57	-0.70
5)	42.12	42.82	-0.70
	41.62	42.75	-1.13
6)	42.37	42.94	-0.57
	42.25	42.56	-0.13
7)	40.06	41.15	-1.09
	40.87	41.36	-0.49
8)	41.82	43.15	-1.33
	42.18	42.72	-0.54
9)	41.37	42.36	-0.99
	42.25	42.00	+0.25
10)	42.12	43.33	-1.21
	42.62	43.03	-0.40
Mean Difference			-0.58
Median Difference			-0.64
Standard Deviation			0.53

DISCUSSION

Comparing the keratometer and the topographer, the topographer measured 0.20D flatter centrally. While at the same time the topographer measured 0.58 steeper at 4.10mm temporal. The overall difference going from the central to the temporal measurements found the topographer to measure 0.78D steeper. While both instruments are useful in measuring the temporal eccentricity characteristics of the cornea, a mean difference of 0.58D at 4.01mm temporal is a significant amount. This can be demonstrated by applying the formula that is used to predict the amount of myopia reduction when fitting orthokeratology. The mean difference between the keratometer and the topographer shows the keratometer predicts 1.65D more myopia reduction.

	(Central Keratometer − Temporal Keratometer)2	(Central Topographer − Temporal Topographer)2 =	Difference in Myopia Reduction Predicted
1)	1.00	1.54	-0.54
	3.00	0.30	+2.70
2)	2.74	1.42	+1.32
	1.26	0.92	+0.34
3)	6.50	2.50	+4.00
	5.24	1.56	+3.68
4)	-0.14	0.14	-0.28
	1.26	-0.56	+1.82
5)	4.26	3.16	+1.10
	5.26	1.58	+3.68
6)	2.50	1.20	+1.30
	2.74	1.40	+1.34
7)	2.76	0.92	+1.84
	2.00	1.12	+0.88
8)	2.86	1.36	+1.50
	2.88	1.76	+1.12
9)	3.76	2.14	+1.62
	3.00	2.64	+0.36
10)	6.00	3.10	+2.90
	6.26	3.96	+2.30
Mean Difference			+1.65
Median Difference			+1.42
Standard Deviation			1.26

CONCLUSIONS

Both the keratometer and the topographer are useful instruments in describing corneal characteristics such as eccentricity. It appears that the temporal keratometer measurement is only an indicator, not an exact predictor of corneal eccentricity. The numbers in this study are small (only 20 eyes) and further study may be helpful.

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