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Diagnosing Keratoconus: with the application of up-gaze and the keratometer

Abstract: The aim of this study was to investigate the role the keratometer has in aiding in the diagnosis of keratoconus, a corneal disorder characterized by most often by inferior steepening of the cornea. Keratometery readings were taken in straight and in up-gaze on nine previously diagnosed keratoconus patient of varying ages and sex. Six of the nine patients showed steepening in one or both meridians in up-gaze, while the remaining three showed flattening in both meridians. Along with slit lamp signs; Fleischer's ring, Vogt's straie, and corneal thinning, the keratometer adds another useful tool to help diagnose keratoconus.

Introduction: Keratoconus is a progressive, non-inflammatory disorder of the cornea characterized by corneal protrusion typically inferior to the center of the cornea. Keratoconus usually presents bilaterally, although not necessarily symmetric. The eye first affected is usually more severe in presentation[1]. It occurs in all ethnic groups with a slightly higher incidence in males[2]. The average onset is at 16 years of age and progresses until the third or fourth decade of life. Keratoconus affects 0.15%-0.65% of the general population[3]. The etiology of keratoconus is unknown. However, some studies suggest enzyme abnormalities in the corneal epithelium as a contributing factor, while others show evidence of eye rubbing and contact lens wear[4]. Patients report symptoms of decreased vision, photophobia, visual disturbances, and glare around lights.

Classification is based upon three different cone types; nipple, oval, and globe forms. The most common presentation is the nipple form. In this form, the cone is most often located centrally or decentered slightly inferiorly. The oval type has its apex decentered more inferiorly and is also larger in size. Lastly, the largest cone presentation, the globus form, may cover up to three fourths or the entire cornea[5]. As keratoconus progresses, the cone becomes displaced more inferiorly.

Ocular manifestations seen with the slit lamp include a ring of iron deposition, Fleischer's ring, demarcating the peripheral edge of the cone. Other findings include

whitish, vertical or oblique stress lines anterior to Descemet's membranes, Vogt's straie, which may appear near the apex of the cone. Through the use of high magnification it may also be possible to observe corneal thinning just inferior to the central cornea. The bulging of the lower lid in down gaze, Munson's sign, is also diagnostic of keratoconus. Most recently, corneal topography has been utilized to aid in the diagnosis of keratoconus. However, due to the high cost of this instrument, this tool is not always available to all practitioners. Therefore, the aim of this study is to investigate the role of the keratometer as a lower cost technique to help in diagnosing keratoconus.

Methods: Keratometry readings were taken in straight and up-gaze on nine previously diagnosed keratoconus patients of various ages and sex.

Results: Out of the nine patients on which keratometry readings were taken six of the patients showed steepening in one or both meridians in up-gaze, while the remaining three actually showed the inferior cornea with flatter readings (table 1). Of the three patients with flatting in inferior gaze one had been previously diagnosed with "atypical keratoconus flatting inferiorly." (patient 1).

Conclusion: The keratometer is useful in many cases to aid in the diagnosis of keratoconus. Several of the patients studied showed the characteristic steepening of the inferior cornea as seen through the measurements in up-gaze. However, this was not the case with all patients. This could have been due to the more common cone type, the nipple form, in which the cone is located more centrally. Also, the cone has been found to decenter inferiorly with age. A larger number of patients would need to be measured in up-gaze to see if this trend could be found using the keratometer. The keratometer has

a place in helping to diagnose keratoconus. Whether it's through the steepening of the cornea in up-gaze or through mire quality, the keratometer is a useful tool to supplement other findings such as Munson's sign, Fleicher's ring and corneal thinning seen in keratoconus.

Table 1.

50 y.o.	Straight:	O.D.	42.25@160, 42.12@070	Up-Gaze:	41.87@173, 40.25@083
		O.S.	43.50@180, 46.25@091		42.12@145, 40.87@053
26 y.o.	Straight:	O.D.	43.37@179, 47.62@089	Up-Gaze:	43.75@179, 49.00@089
		O.S.	43.87@179, 48.37@089		45.00@179, 52.00@089
28 y.o.	Straight:	O.D.	45.25@133, 43.87@044	Up-Gaze:	45.12@133, 41.25@044
		O.S.	41.87@141, 44.75@051		43.00@141, 43.62@051
24 y.o.	Straight:	O.D.	47.50@180, 48.00@090	Up-Gaze:	50.00@178, 43.00@088
		O.S.	49.00@008, 50.50@098		49.87@178, off scale
40 y.o.	Straight:	O.D.	50.75@135, 48.00@045	Up-Gaze:	47.25@170, 45.25@080
		O.S.	47.25@175, 47.25@085		44.25@005, 43.87@095
22 y.o.	Straight:	O.D.	47.25@180, 47.50@090	Up-Gaze:	43.75@180, 39.25@090
39 y.o	Straight:	O.D.	42.80@179. 42.37@089	Up-Gaze:	42.80@179, 42,30@089
		O.S.	42.80@020, 40.25@110		36.37@175, 44.50@080
41 y.o.	Straight:	O.D.	45.25@005, 44.00@095	Up-Gaze:	44.50@008, 45.87@100
		O.S.	47.87@020, 43.50@110		44.25@168, 52.0+@079
41 y.o.	Straight:	O.D.	46.50@160, 45.00@069	Up-Gaze:	46.50@160, 45.00@069
		O.S.	49.75@020, 43.50@112		51.50@171, 52.0+@079

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