THE COMPARISON OF SHAPE FACTOR AND MEAN TORIC KERATOMETRY BETWEEN PTERYGIUM AND NORMALS

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ABSTRACT

Introduction: The aim of this paper is to identify the changes in overall anterior corneal curvature between unilateral primary pterygium and normal adults utilizing shape factor and mean toric keratometry. **Methods:** A total of 60 participants comprise of 30 unilateral primary pterygium eyes from 30 pterygium patients and 30 normal adults were recruited in this study. Diagnosis and classification of primary pterygium were done by a consultant ophthalmologist (KMK). Standard optometric examinations were performed in all participants. Shape factor (SF) and toric mean keratometry (TKM) were objectively measured using a corneal topographer. Three measurements based on best image quality for SF and TKM were taken by single operator in a same visit. Difference for both SimK and CIM parameters between primary pterygium and normal groups were determined via independent T-test. **Results:** Overall mean and standard deviation (n = 60) of SF and TKM were found higher in primary pterygium group (0.79 ± 0.09 and 49.09 ± 5.42 D) compared to normal (0.37 ± 0.09 and 44.73 ± 2.02 D) respectively. Independent T-test results showed significance difference in SF and TKM values between primary pterygium groups and normal (both $P < 0.001$). **Conclusions:** Both SF and TKM can be used as a tool in describing early changes of pterygium on the anterior corneal surface. Advance pterygium could induce significant increment in both SF and TKM.

KEYWORDS: pterygium; morphology; shape factor; toric mean keratometry; corneal curvature

INTRODUCTION

Pterygium is defined as an abnormal growth wing-shaped fibrovascular tissue that encroaches from the conjunctiva and progress towards the cornea (Chui et al., 2011; Manzar and Mahar, 2013). Previous works had reported that pterygium are more commonly in tropical countries with high ultraviolet (UV) ray exposures (Chui et al., 2011; Liu et al., 2013; Marmamula et al., 2013; Maharjan et al., 2014). Pterygium has been closely associated with induced corneal astigmatism, which occurs due to pterygium development into the cornea. During this process, it induces visual disturbance due to changes on the anterior corneal curvature (Zare et al., 2010). However, it is worth to note that clinically not all pterygium caused reduction in visual performance. Theoretically, large size or long pterygium would induce significant astigmatism; however based on our clinical observation, we found that small pterygium size could give similar effects. We postulate this could happen due to its morphology (fleshiness) as described in Tan's classification of pterygium (Tan et al., 1997).

This classification is based on three (3) types or grades known as type I - atrophy, type II - intermediate and type III - fleshy. This classification is based on loss of translucency of pterygium tissue which relates to increased fleshiness that could signify abnormal fibrovascular growth of pterygium. There are several characteristics been proposed in evaluating pterygium. Pterygium are assessed based on several methods such as by estimating its fleshiness appearance (Mohd Radzi et al., 2017; Tan et al., 1997), length (Lin and Stern, 1998; Mohammad-Salih and Sharif, 2008; Gumus et al., 2011), size (Farhood and Kareem, 2012; Kheirkhah et al., 2012; Altan-Yaycioglu et al., 2013; Vives et al., 2013) and based on its extension in comparison with the corneal size (Zare et al., 2010; Mohammad-Salih and Sharif, 2008; Gumus et al., 2011).

Irregularity of an ocular surface can be assessed objectively via corneal curvature assessment using specific corneal indices. Commonly, Simulated-K (SimK) is used to describe corneal irregularities in form of corneal astigmatism. However, SimK is only reliable in describing changes in corneal curvature within central 5mm of cornea. With regards to pterygium, changes in corneal curvature starts at peripheral cornea which is immeasurable using standard visual assessment. Shape factor (SF) is a measurement of corneal asphericity (eccentricity) (Calossi 2007). SF is an index which describes the shape of the cornea relative to a perfect sphere. While, Mean Toric Keratometry (TKM) is an index which represents the average variation of the apical curvature of the corneal meridians (Gatinel et al., 2011). This study aims to evaluate the effects of primary pterygium on changes in overall anterior corneal curvature utilizing SF and TKM indices.

METHODS

Thirty unilateral primary pterygium eyes from 30 patients and 30 normal adults were recruited from a University eye-specialist from January to June 2017. All participants in this study were selected based on specific criteria as previously described (Mohd Radzi et al., 2017; Azemin et al., 2014; Che Azemin et al., 2014; Che Azemin et al., 2015). Diagnosis and classification of primary pterygium were performed by a single consultant ophthalmologist (KMK). The study was conducted according to recommendation of the tenets of Declaration of Helsinki and approved by the International Islamic University Malaysia (IIUM) research ethical committee (IREC) (IIUM/310/G13/4/4-125). Written and informed consent were obtained from all participants prior any procedures performed.

All participants undergo standard optometric examination comprises of dry refraction, slit-lamp examination and fundus examination. Then, each participant's average Shape Factor (SF) and Mean Toric Keratometry (TKM) indices were objectively measured using Zeiss ATLAS™ 995 corneal topographer (Zeiss Meditec, Inc, Dublin, USA). Three measurements were taken and the measurement with the best image quality was taken as the SF and TKM value. These measurements were done by single operator and performed on the same visit. All data were then been exported to statistical software. Similar procedures were repeated for the normal non-pterygium adults.

Statistical analyses were performed using IBM SPSS (Predictive analytics software) (Version 19, SPSS Inc., Chicago, IL, USA). Independent T-test was employed to evaluate the difference between both primary pterygium and normal groups for both SF and TKM parameters. A significance level of $P < 0.05$ was set as the confidence level.

RESULTS

The analysis include 60 participants, where 60% (n = 36) were men. Normality testing was evaluated using ratio of skewness and kurtosis (George and Mallery, 2010), with ± 2.50 was taken as normal distribution. Normality testing showed all data were normally distributed for both groups.

The mean of SF and TKM for normal group were 0.37 ± 0.09 and 44.73 ± 2.02 D respectively. In contrast, primary pterygium group showed higher values of both SF and TKM with 0.79 ± 0.09 and 49.09 ± 5.42 D compared to normal group. Independent T-test results revealed significance differences between normal and primary pterygium groups for both parameters (both $P < 0.05$). All results were summarized in Table 1 below.

Table 1 Comparison of SF and TKM values between primary pterygium and normal group (n = 60)

Corneal Index	Group		P-value*
	Primary pterygium (Mean ± SD)	Normal (Mean ± SD)	
SF	0.79 ± 0.09	0.37 ± 0.09	P < 0.001
TKM (D)	49.09 ± 5.42	44.73 ± 2.02	P < 0.001

SD: Standard Deviation
D: Dioptres
SF: Shape Factor
TKM: Toric Mean Keratometry
*: Independent T-test (Significance level set at 0.05)

DISCUSSION

This study aims to evaluate the effects of primary pterygium on overall anterior corneal curvature utilizing two (2) corneal parameters (SF and TKM). We employed similar number of samples for both normal and primary pterygium group (n = 30) and our study revealed that primary pterygium group showed decrease in SF and increase in TKM indices.

Corneal shape can be described as either prolate or oblate. Corneal shape is not completely round, but it is less spherical or more towards elliptical shape, which resembles a prolate shape (Torquetti and Ferrara, 2010). Commonly, SF is interpreted as positive and negative where a positive SF usually indicates the central cornea is steeper than the periphery. On contrary, a negative SF value indicates steepening of corneal periphery compared to central cornea. In pterygium patients, the corneal shape shifted from prolate (positive) towards oblate (negative). This shifting process could be explained as decrement of SF values would signify the peripheral and mid-peripheral corneal region were compressed; which indirectly increases the toricity of the central cornea. However, SF mainly describing changes in corneal curvature qualitatively rather than quantitatively. Hence, SF is applicable in determining whether a corneal surface is regular or irregular.

TKM index adopts elevation data and comparisons are made between the toric reference and the actual cornea. Commonly, this index helps best in contact lens fitting with involvement of significant astigmatism. However, in case of significant induced-corneal astigmatism such as in pterygium, it is rarely TKM index been used to describe the changes in anterior corneal curvature. Thus, this present study would like to highlight its importance in describing peripheral corneal ocular pathology such as pterygium. This study found that TKM values between normal and pterygium patients were statistically significant ($P < 0.05$), with pterygium is higher compared to normal. This could be explained by changes in toricity between all corneal meridians due to corneal compression at periphery which give rise to higher average variation of corneal curvature.

To the best of our literature search, information on SF and TKM related to pterygium evaluation is scarce. Thus, this current study would like to highlight that both SF and TKM are able to describe changes on the corneal curvature from an overall corneal perspective, rather than evaluating it based on central corneal region. In this study, it has been demonstrated that changes on the corneal curvature can be determined by not just evaluating it from its morphology such as size, width and extension of pterygium (Lin and Stern, 1998; Mohammad Salih and Sharif, 2008; Manzar and Mahar, 2013), this changes can also be described using full-scale corneal index such as SF and TKM. Corneal topography is an essential tool in describing and measuring corneal curvature.

CONCLUSION

SF and TKM are useful in describing early changes on anterior corneal curvature in pterygium patients and predict the regularity of anterior corneal curvature.

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DECLARATION OF INTEREST

The authors report no conflicts of interest

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