

**COMPARISON OF VISUAL ACUITY AND CONTRAST SENSITIVITY BETWEEN
UNILATERAL PRIMARY PTERYGIUM AND NORMAL ADULTS UTILIZING
COMPUTERIZED M&S SMART SYSTEM II**

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ABSTRACT

Introduction: This paper aimed to describe variation in oculo-visual function between unilateral primary pterygium and normal adults using computerized M&S Smart System II. **Methods:** A total of 120 participants comprise 60 unilateral primary pterygium eyes from 60 pterygium patients and 60 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. Oculo-visual function parameters were taken based on the best-corrected visual acuity (BCVA) and contrast sensitivity (CS) which was subjectively measured using computerized M&S Technologies Smart System II. Both measurements were done by single operator and performed on the same visit. Difference for both BCVA and CS parameters between primary pterygium and normal groups were determined via independent T-test. **Results:** Overall mean and standard deviation ($n = 120$) of BCVA and CS were found lower in primary pterygium group ($0.73 \pm 0.22 \text{ LogMAR}$ and $45.00 \pm 10.49\%$) compared to normal ($0.12 \pm 0.05 \text{ LogMAR}$ and $6.40 \pm 0.81\%$) respectively. Independent T-test results showed significance difference in BCVA and CS values between primary pterygium groups and normal (both $P < 0.001$). **Conclusions:** Reduction of oculo-visual function in pterygium patient is expected compared to normal. Both BCVA and CS can be used as indicator for surgical excision and prediction in early sign of reduction in visual performance.

KEYWORDS: pterygium; morphology; Best-corrected visual acuity; contrast sensitivity; corneal curvature

INTRODUCTION

Pterygium is defined as a wing-shaped abnormal growth of fibrovascular tissue that emerges from the conjunctiva and progress towards the cornea (Manzar and Mahar, 2013; Mohd Radzi et al., 2017). Previous works had reported that pterygium is more commonly in people who have had chronic ultraviolet (UV) ray exposures and those who live near the equator (Chui et al., 2011; Liu et al., 2013). It is also an established fact that pterygium is closely associated with induced irregular corneal astigmatism; as pterygium invades into the cornea, it may cause 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 of pterygium would induce significant astigmatism; however our clinical observation revealed that small pterygium size could give similar effects. It is postulated that this could happen due to its morphology (fleshiness) as described in Tan's classification of pterygium (Tan et al., 1997).

Currently, there are several clinical gradings that have been suggested in assessing pterygium. It can be assessed based on several approaches such as by evaluating its fleshiness appearance (Mohd Radzi et al., 2017; Tan et al., 1997), length (Mohammad-Salih and Sharif, 2008), size (Kheirkhah et al., 2012; Altan-Yaycioglu et al., 2013; Vives et al., 2013) and based on its extension relative to the corneal size (Zare et al., 2010; Mohammad-Salih and Sharif, 2008). Specifically for this study, Tan's classification of pterygium was adopted. Tan et al. (1997) proposed a classification of pterygium based on its clinical appearance (Figure 1). 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.

Irregularity of an ocular surface would give rise to reduction in visual quality. Visual quality is commonly measured using best-corrected visual acuity (BCVA) and contrast sensitivity (CS). BCVA is defined as a measurement of visual function which describes the sensitivity of optical, retinal and neural functions of the eye (Ferris and Bailey, 1996). In other words, BCVA represent the precision and perceptiveness of the central vision. With regards to pterygium, numerous works (Mohammad-Salih and Sharif, 2008), its size (Kheirkhah et al., 2012; Altan-Yaycioglu et al., 2013; Vives et al., 2013) had proved that progression of pterygium would induced corneal astigmatism based on measurement of anterior corneal curvature.

However, contrast sensitivity (CS) is defined as a measurement of visual function specifically on variation in luminance, used to distinguish between finer and finer increments of luminance from the background (Pelli and Bex, 2013). Although both of CS and BCVA measures visual functions, CS differs from BCVA as it incorporates both size and contrast in its evaluation, while BCVA focused on letter size, which represent acuity. Previous studies (Oh and Wee, 2010; Malik et al., 2014) had stated that relying only on BCVA in measuring visual performance is insufficient; they suggested that inclusion of CS in visual assessment is important. Based on our literature search, conflicting evidences found which regarding effects of both BCVA and CS in primary pterygium. Hence, this study aims to evaluate the effects of primary pterygium on changes in oculovisual function utilizing BCVA and CS. This is important to evaluate whether both BCVA and CS changes do occur simultaneously in patient with pterygium or only BCVA is affected.

METHODS

Total of 120 participants comprises of 60 unilateral primary pterygium eyes from 60 patients and 60 normal adults were recruited in this study who visits a University eye-specialist in order to display a wide range of severity of pterygium patients. All participants in this study were selected based on specific criteria as previously described (Mohd Radzi et al., 2017; CheAzemin 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 was obtained from all participants prior to any procedures performed.

Contrast sensitivity (CS) and VA were measured using MandS Technologies Smart System II (SSII, Park Ridge, IL, USA). Both measurements were done by single operator and performed on the same visit. Both BCVA and CS were measured using the MandS Smart System II (MSSS-II; MandS Technologies Inc, Niles, IL, US) in a dim room with standardized luminance of 85 cd/m² and colour temperature of 3300K as suggested by the manufacturer guideline (MandS Smart System II Use and Operation Guide, 2011) and previous works (Mohd Radzi et al., 2017; McClenaghan, Kimura and Stark, 2007). MandS Smart System II (MSSS-II; MandS Technologies Inc, Niles, IL, US) was employed in measuring CS as it was found comparable with the gold-standard Pelli-Robson chart (Chandrakumar et al., 2013).

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 BCVA and CS parameters. A significance level of $P < 0.05$ was set as the confidence level.

RESULTS

The analysis include 120 participants, where 63.3% (n = 76) 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 normal data distribution for both groups.

The mean of BCVA and CS for normal group were (0.12 \pm 0.05)LogMAR and 6.40 \pm 0.81 % respectively. In contrast, primary pterygium group showed lower values of BCVA and CS with (0.73 \pm

0.22LogMAR and $45.00 \pm 10.49\%$) respectively. Independent T-test results revealed that there were significant 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 BCVA and CS values between primary pterygium and normal group (n = 120)

Corneal Index	Group		P-value*
	Primary pterygium (Mean \pm SD)	Normal (Mean \pm SD)	
BCVA (LogMAR)	0.79 \pm 0.09	0.37 \pm 0.09	P < 0.001
CS (%)	49.09 \pm 5.42	44.73 \pm 2.02	P < 0.001

SD: Standard Deviation

LogMAR: Logarithm of the Minimum Angle of Resolution

BCVA: Best-corrected Visual Acuity

CS: Contrast Sensitivity

*: Independent T-test (Significance level set at 0.05)

DISCUSSION

This study aims to evaluate the effects of pterygium on the oculovisual function using two visual performance indicators which are BCVA and CS. Decrease in BCVA indicates lower visual performance due to reduction in clarity and sharpness of central vision. BCVA represent the actual visual performance of the eye. To achieve optimum vision, several conditions have to be met such as a smooth and adequate tear film function, corneal transparency and no obstruction in any of the refractive component of the eye. With regards to pterygium patients, BCVA would provide information on the progression or impact of the disease, prediction on the visual performance and also treatment options. Based on our findings, there was significant reduction in BCVA in pterygium group compared to normal ($P < 0.05$), in agreement with previous works (Oh and Wee, 2010; Malik et al., 2014). This could happen due to several reasons such as the physical properties of pterygium itself. Its size (Jaffar, Dukht and Rizvi, 2009), encroachment on the cornea (Lin and Stern, 1998) and fleshiness appearance (Tan et al., 1997) could be the cause of the reduction in BCVA. However, it should be noted that BCVA variations of pterygium shape would also play a role. Small and long pterygium could affect more compared to small and short pterygium.

Decrease in CS can lead to a loss of spatial awareness and mobility as well as an increase in the risk of accidents. Although CS is associated with other ocular pathologies such as cataract, diabetic retinopathy and glaucoma; it is rarely been associated with pterygium. This study findings showed that significant reduction in CS was noted in pterygium group compared to normal ($P < 0.05$), in agreement with previous works (Oh and Wee, 2010; Malik et al., 2014). However, recent study (Sandra et al., 2014) reported that no significant changes were found between these groups. This could happen due to several reasons. Firstly, the samples reported in previous study (Sandra et al., 2014) were mainly short and small size. This could affect the reading as CS was measured in primary gaze, thus small pterygium might not obstruct the central vision. Therefore, BCVA and CS were not significant could be due to the progression of pterygium does not reach the central 5 mm of the cornea. Secondly, our findings could suggest the whitish appearance of pterygium which gives rise to obscured episcleral vessels could be due to presence of fibrovascular proliferative disorders (Touhami et al., 2005; Ribatti et al., 2007; Džunic et al., 2010). Excessive proliferative growth of pterygium could induce corneal compression which may also lead to reduction in BCVA.

In view with evaluation of pterygium based on its fleshiness appearance, it is postulated that the translucence appearance of pterygium can be taken as prediction of visual performance in pterygium or in suspected pterygium patient. This is due to the nature of CS which commonly affected before reduction in BCVA occurs. In pterygium, BCVA was reduced mainly if it is obstructing the central 5 mm of the central cornea. However, CS could reduce earlier than BCVA as pterygium translucence appearance is based on its type; type I - atrophy, type II - intermediate and type III - fleshy. Our postulation is the type I could be the key in differentiating between the effect of BCVA and CS due to commonly in clinical setting, this group usually does not complaint of reduction in acuity (BCVA) but mostly on the quality which related to CS. Nonetheless, it is worth to note that this study did not evaluate the different level of pterygium with levels of CS and BCVA. Perhaps in future evaluation of CS could be done in evaluating pterygium rather than relying solely on BCVA.

CONCLUSION

Contrast sensitivity (CS) assessment is recommended to be performed in pterygium patient. Reduction in BCVA and CS could be related to the types of pterygium which associated with its translucence appearance.

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DECLARATION OF INTEREST

The authors report no conflicts of interest

REFERENCES

1. Manzar, N., Mahar, P.S. (2013). Pterygium recurrence related to its size and corneal involvement. *J CollPhysicians Surg Pak.*23(2):120-123.
2. MohdRadzi, H., MohdZulfaezal, CA., Khairidzan, MK., MohdIzzuddin, MT., Norfazrina, AG., TengkuMohd, TS. (2017). Prediction of changes in visual acuity and contrast sensitivity function by tissue redness after pterygium surgery. *Curr. Eye. Res.*42(6):852-856.
3. Liu, L., Wu, J., Geng, J., Yuan, Z., Huang, D. (2013). Geographical prevalence and risk factors for pterygium: a systematic review and meta-analysis. *BMJ Open.* 3:e003787. doi:10.1136/bmjopen-2013-003787
4. Chui, J., Coroneo, M.T., Tat, L.T., Crouch, R., Wakefield, D., DiGirolamo, N. (2011). Ophthalmic pterygium: A stem cell disorder with premalignant features. *Am. J. Pathology.* 178(2):817-827.
5. Zare, M., Zarei-Ghanavati, S., Ansari-Astaneh, M.R., Baradaran-Rafiee, A., Einolahi, B. (2010). Effects of pterygium on ocular aberrations. *Cornea.* 29(11):1232-1235.
6. Mohammad-Salih, P.A.K., Sharif, A.F.M.D. (2008). Analysis of Pterygium Size and Induced Corneal Astigmatism. *Cornea.* 27:434-438.
7. Kheirkhah, A., Safi, H., Nazari, R., Kaghazkanani, R., Hashemi, H., Behrouz, M.J. (2012). Effects of pterygium surgery on front and back corneal astigmatism. *Int.Ophthalmol.* 32:251-257.

8. Altan-Yaycioglu, R., Kucukerdonmez, C., Karalezli, A., Corak, F., Akova, Y.A. (2013). Astigmatic changes following pterygium removal: comparison of 5 different methods. *Indian J.Ophthalmol.* 61(3):104-108.
9. Vives, P.P., Castanheira, A.M.C.M., Mora, G.J., Margarit, S.L., Encina, D.M., Garcia, I.S. (2013). Topographic corneal changes in astigmatism due to pterygium's limbal-conjunctival autograft surgery. *J.Emmetropia.* 4:13-18.
10. Tan, D.T., Chee, S.P., Dear, K.B., Lim, A.S. (1997). Effect of pterygium morphology on pterygium recurrence in a controlled trial comparing conjunctival autografting with bare sclera excision. *Arch.Ophthalmol.* 115:1235-1240.
11. Ferris, F.L., Bailey, I. (1996). Standardizing the measurement of visual acuity for clinical research studies. *Ophthalmology.* 103(1):181-182.
12. Pelli, D.G., Bex, P. (2013). Measuring contrast sensitivity. *Vision Res.* 90:10-14.
13. Oh, J.Y., Wee, W.R. (2010). The effect of pterygium surgery on contrast sensitivity and corneal topographic changes. *ClinOphthalmol.* 4:315-319.
14. Malik, A., Arya, S.K., Sood, S., Sarda, S.B., Narang, S. (2014). Effect of pterygium on contrast sensitivity. *IntOphthalmol.* 34(3):505-509.
15. CheAzemin, M.Z., MohdTamrin, M.I., Hilmi, M.R., Mohd Kamal, K. (2015). GLCM texture analysis on different color space for pterygium grading. *ARPN J. Eng. Appl. Sci.* 10:6410-6413.
16. M&S Technologies Inc. (2011). M&S Smart System II Use and Operation Guide. Illinois:IMP-0706.
17. McClenaghan, N., Kimura, A., Stark, L.R. (2007). An evaluation of the M&S Technologies Smart System II for visual acuity measurement in young visually-normal adults. *Optom. Vis. Sci.* 84:218-223.
18. Chandrakumar, M., Colpa, L., Reginald, Y.A., Goltz, H.C., Wong, A.M.F. (2013). Measuring Contrast Sensitivity Using the M&S Smart System II versus the Pelli-Robson Chart. *Ophthalmology.*120(10):2160-2161.
19. George, D., Mallery, M. (2010), *SPSS for Windows Step by Step, A Simple Guide and References*, 11thEds., Pearson, Boston:95-105.
20. Touhami, A., Di Pascuale, M.A., Kawatika, T., Del Valle, M., Rosa Jr, R.H., Duvony, S., Tseng, S.C.G. (2005). Characterisation of myofibroblasts in fibrovascular tissues of primary and recurrent pterygia. *Br. J.Ophthalmol.* 89:269-274.
21. Ribatti, D., Nico, B., Maxia, C., Longo, V., Murtas, D., Mangieri, D., et al. (2007). Neovascularization and mast cells with tryptase activity increase simultaneously in human pterygium. *J. Cell.Molec. Med.*11(3):585-589.
22. Džunic, B., Jovanović, P., Veselinović, D., Petrović, A., Stefanović, I., Kovačević, I. (2010). Analysis of pathohistological characteristics of pterygium. *Bosn. J. Basic. Med. Sci.* 10(4):307-313.
23. Sandra, S., Zeljka, J., Zeljka, V., Kristian, S., Ivana, A. (2014). The influence of pterygium morphology on fibrin glue conjunctival autografting pterygium surgery. *Int. Ophthalmol.* 34(1):75-79.