To Determine the Sensitivity and Specificity of Retinoscopy in Diagnosis of Keratoconus

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ABSTRACT

Background: Keratoconus is a common ectatic disease of the cornea results in deterioration in the quality of vision. Corneal topography is currently considered the gold standard test for diagnosing keratoconus. At present, corneal tomography machines are found only in specialized eye clinics, are expensive and require expert interpretation. When it comes to population based screening for the disease, there is a need for a cheap, accessible, portable, and simple tool. All of these prerequisites are fulfilled by retinoscopy.
Objectives: To determine the sensitivity and specificity of retinoscopy in diagnosis of keratoconus using the Galeli G4 Dual Scheimpflug as the Gold Standard comparison.
Methods: A Cross-Sectional study done in patients of age between 10-30 years, referred to OPD with keratoconus, keratoconus suspect, eye discomfort, frequent change of glasses, or with astigmatism or refractive surgery, were screened for the presence of scissoring reflex. Patient then underwent Corneal topography. Diagnosis of keratoconus was made by calculating KISA% index using corneal topography indices . The results of retinoscopy and Galeli Topography were compared to assess the sensitivity and specificity of the test.
Results: A total of 61 patients with a mean age of 19.55±5.786 (range 10–30 years) comprising 120 eyes were included. There were 62 eyes diagnosed with keratoconus and using the Amsler–Krumeich classification, 43.5%, 41.9%, 11.3%, and 3.2% of the eyes had stage I, II, III, and IV, respectively. Sensitivity, specificity, positive predictive value, and negative predictive value of retinoscopy were 91.9%, 75.9%, 80.3%, and 89.8%, respectively.
Conclusion: Retinoscopy appears to be a highly sensitive diagnostic tool for detecting keratoconus. Such a test could be implemented in population based screening for keratoconus.
Keywords: keratoconus, retinoscopy scissor reflex, screening, epidemiology, corneal topography.

INTRODUCTION:

Keratoconus is a bilateral progressive ectatic disease of the cornea characterized by thinning, steepening, and protrusion leading to deterioration in the quality of vision.[1] Corneal protrusions which causes high myopia and irregular astigmatism, has an impact on visual quality.[2] Visual acuity declines as the condition advances, which results in visual distortion and substantial vision loss.[4,5]It commonly manifests itself in the second decade of life, typically at puberty,[3] however it has also been found to develop earlier,[6] and later in life, and it typically progresses until the fourth decade of life, when it usually stabilizes.[3]

The prevalence of the disease varies between different geographical areas and ethnicity.[7-9] In general population the prevalence of keratoconus range from 50-2300 per 100000.[10] Disease associated with keratoconus include atopy, vernal keratoconjunctivitis, retinitis pigmentosa, Leber congenital amaurosis, eye rubbing, hard contact lens wear, mirtal valve prolapse, Down syndrome and non-inflammatory connective tissue disorders such as Ehlers-Danlos syndrome and osteogenesis imperfect.[11-15]

In early stages of the disease, the patient is usually asymptomatic. Visual acuity declines as the condition advances, which results in visual distortion and substantial vision loss. Although there is no cure for this degenerative disease but it can be controlled conservatively by the use of spectacles or contact to help with vision. Collagen cross linking, the use of intacts and penetrating keratoplasty are the surgical procedures to manage the disease.[16,17]

Corneal topography based on the principles of placido disc and Scheimpflug imaging, is the most sensitive means of assessing corneal shape and is a most sensitive method of detecting and confirming the diagnosis of keratoconus. Corneal topography is considered gold standard approach for diagnosing and monitoring keratoconus.[3,18.19] It enables for the early diagnosis of subclinical KC, also known as forme fruste or KC suspicious as well as the grading of disease severity using color coded topographic map of the corneal surface and different parameters. On the basis of these indexes, several quantitative approaches have been created. KISA% as described by Rabinowitz/Rasheed is used to diagnose keratoconus. KISA% is consists of four topography indices and is usually applied to topography axial map.

KISA% = [(K) × (I-S) × (AST) × (SRAX) × 100]/300

Several classifications have been introduced to stage keratoconus. The Amsler –Krumeich (AK) system continues to be the most popular system.[21,22]

Corneal topography machines are now only available in specialized eye clinics, are somewhat costly and non-portable, and require expert interpretation. When it comes to population based screening of keratoconus, low cost, easily accessible, portable and easy equipment is required. All of these needs are met by retinoscope.[20]

Retinoscopy in keratoconus often exhibits scissoring reflex due to irregular astigmatism. Although such a tool has been utilized in the field of ophthalmology for over a century, little research has been done on its usefulness in detecting keratoectasia. However it can also be useful in screening for keratoconus in the population.[20] The purpose of this study is to determine the sensitivity and specificity of retinoscopy in diagnosis of keratoconus using the Galeli G4 Dual Scheimpflug as the Gold Standard comparison.

MATERIALS AND METHODS:

This study was conducted after approval from Institutional Review Board of Alshifa Trust Eye Hospital, Pakistan, under the declaration of Helsinki. It was a cross sectional study

conducted in a tertiary eye care center, in the corneal department of Al-Shifa Trust Eye Hospital (ASTEH) Rawalpindi from July 2021 to December 2021.

Inclusion Criteria:

Patient between the ages of 10 and 30 years who were referred with keratoconus suspect or keratoconus, frequent changes of glasses, ocular discomfort, with astigmatism and for refractive surgery were included in this study.

Exclusion Criteria:

Participants were excluded from study if they had any history of significant ocular trauma, previous intraocular disease, previous ocular surgery, current active eye disease, corneal scaring or pterygium, patient who had worn soft contact lenses in the last 7 days or hard contact lenses in the last 14 days.

Clinical Evaluation:

Participants having visual problems visited to OPD of ASTEH and referred to cornea department for further examination. Eligible participants were examined for the presence of scissoring reflex (either present or absent). The participants were then proceed for testing their vision using LOGMAR chart, refraction tests, corneal topography and full slit lamp examination. A diagnosis of keratoconus by Galeli topography was made if the value of KISA% index was 100% or exceed it.

Statistical analysis:

For Statistical analysis, SPSS (Statistical Package for Social Sciences) version 26 was used. Data analysis was carried in two phases, descriptive analysis followed by inferential statistics. For Descriptive analysis, Categorical data was presented in the form of frequency and percentage. Mean, standard deviation and ranges were reported for continuous variables.

For Inferential analysis, diagnostic testing (2 × 2 contingency table) was applied to calculate the Sensitivity, Specificity, Positive Predictive Value and Negative Predictive Value of retinoscopy in comparison with Galeli Topography (Gold standard) with 95% of confidence interval.

RESULTS:

Descriptive data:

The study enrolled 61 patients with 120 eyes, 2 eyes were excluded due to positive history of ocular surgery. Both the genders were included in the study. Majority of the participants were male N=67 (55.8%) while remaining were female N= 53 (44.2%). Mean age of participants was 19.55±5.786 ranging from 10-30 years. Out of 61 participants, N=65(54.2%) belonged to rural areas and N=55(45.8%) to urban areas. About N=9 (75%) of these patients were students whereas N=22(18.3%) were employed and N=8 (6.7%) were unemployed. Spectacle history was positive in N=96(80%) and N=54(45%) have positive history of frequent changes of glasses as depicted in table 1 Rubbing habits was common in N=85(70.8%). Ocular allergy was present in N=25(20.8%) of subjects.

Ocular history	Frequency(f) N=120	Percentage (%)
Spectacle/contact lens		
Positive	96	80%
Negative	24	20%
Frequent changes of glasses		
Positive	54	45%
Negative	66	55%
Rubbing		
Positive	85	70.8%
Negative	35	29.2%
Ocular allergy		
Present	25	20.8%
Absent	95	79.2%

Visual acuity was measured with and without glasses using Snellen chart and is converted into Log MARas . Spectacle refraction is converted into spherical equivalent which is mentioned in the table 2.

Table 2: Visual Status

Visual Acuity	Minimum	Maximum	Mean	SD
VAsc	0.00	1.30	0.8333	0.27935
VAcc	0.00	1.00	0.2442	0.25431
SE	-17.50	0.00	-4.2218	4.85603

Amsler–Krumeich classification was used to classify the eyes with keratoconus. Using Amsler-Krumeich classification, 43.5%, 41.9%%, 11.3%, and 3.2% of eyes with keratoconus had stage I, II, III, and IV, respectively (Table 3).

Table 3: Classification of Eyes with Keratoconus According to the Amsler-Kromtech Classification

Stage	No. %
I	27(43.5%)
II	26(41.9%)
III	7(11.3%)
IV	2(3.2%)

Inferential Results:

When the scissoring reflex assessment by retinoscopy was compared with that assessed by Galeli Topography Sensitivity, Specificity, Positive Predictive Value and Negative Predictive Value were 91.9%, 75.9%, 80.3% and 89.8%. Two × Two contingency table showing the number of eyes with scissoring reflex and Galeli topography (KISA%) along with validity statistics is given below (Table 4).

Table 4: Two X Two Contingency Table showing the number of eyes with scissoring reflex vs. Galilei topography(KISA%); PPV(Positive Predictive Value), NPV (Negative Predictive Value)

		Galilei (KISA %)			
		Positive	Negative	Total	
Retinoscopy Scissor Reflex	Positive	57	14	71	PPV80.3%
	Negative	5	44	49	NPV89.8%
	Total	62	58	120	
		Sensitivity 91.9%	Specificity 75.9%		

5.0. DISCUSSION:

Using Amsler-Krumerich classification, majority of eyes are classified as having early keratoconus. Retinoscopy is found to have sensitivity of 91.9% and specificity of 75.9% when compared with Galeli topography (KISA %). The streak retinoscopy is one of the most important tool in ophthalmology for objective refraction. A scissoring reflex seen using streak retinoscopy has been a crucial step in diagnosing keratoconus in population based screening programs for keratoconus.

Haitham Al-Mahrouqi *et al.* investigate the validity and reliability of retinoscopy in screening for keratoconus using the rotating Pentacam Scheimpflug camera as the gold standard comparison. They found sensitivity and specificity of retinoscopy were 97.7% / 79.9% respectively. They concluded that Retinoscopy appears to be a very sensitive and reliable test for detecting keratoconus including early disease.[20]

Goebels *et al.* evaluated the diagnostic potential of retinoscopy as compared to Pentacam and Ocular Response Analyzer. Although the study found that there was poor congruence between the 3 tools in staging keratoconus, retinoscopy was found to have an overall sensitivity/specificity of 94.0% / 80.0% compared with Pentacam and 84.4% / 79.1% compared with Ocular Response Analyzer. Retinoscopy, however, showed a clear clinical use in confirming the diagnosis of keratoconus.[25] Minor differences between our study and above mentioned study may be due to different diagnostic criteria used for both studies.

Other studies indirectly assessed the presence of the scissoring reflex in keratoconus patients. A study conducted in Iran by Hassan Hashemi *et al.* which they screened university students, they found that 25 out of the 26 cases with keratoconus had a scissoring reflex.[23]

Naderan *et al.*, from Iran, evaluated 371 clinic patients with keratoconus and found that a scissoring reflex was present in only 64% of patients. The discrepancy in the results may be because of the different stages of keratoconus, variation in the number of patients screened, the level of experience of the

investigators, and the method used to assess the scissoring reflex.[24]

This study may be limited by relatively small number of patients due to short time duration, which affected the precision estimates. Moreover the study was hospital based so data was collected conveniently. Furthermore, unlike tomographic corneal imaging, which is more machine dependent, the retinoscope is operator dependent machine so early stages of keratoconus are likely to be overlooked by untrained optometrist. As keratoconus is a bilateral disease, the result is more likely to be biased by the first eye examined.

CONCLUSION:

Retinoscopy appears to be a highly sensitive and reliable diagnostic tool for detecting keratoconus. Such a test could be implemented in population based screening for keratoconus. It would be easier to diagnose keratoconus in the general population using retinoscopy as a screening test and topographic corneal imaging for confirmation in eyes with a positive or suspect scissoring reflex. Using such a technology would allow for the screening of a bigger and more geographically diverse population, as well as a reduction in the number of patients who would require topographic corneal imaging.

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