ORIGINAL RESEARCH

STUDY IN EVALUATING THE CONE CHARACTERISTICS AND KERATOMETRIC VALUES OF KERATOCONUS AT VARIOUS STAGES

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Abstract
Introduction: The major aim to evaluate the characteristics of the cone and the keratometric values of keratoconus at its various stages. A non-inflammatory condition with ectatic corneal disorder that is characterised by the corneal protrusion and thinning that could possibly lead to corneal irregularity which could possibly results in reduced visual acuity. **Materials and Methodology:** The study had been carried out in 110 cases with 195 eyes that are reported in an eye clinic during the stipulated study time. Corneal topography is eventually monitored by and placebo topographer based on the reflection system from cornea. And the corneal topographer that had been used include oculus 3M.The topographical monitoring of the cone patterns based on the image of the tangential map pf oculus topographer. **Results:** This retrospective study was conducted in 110 cases wherein 195 eyes were evaluated and all of them were diagnosed with keratoconus. The average patient age was estimated around 25.21 ± 11.45 years ranging from 10 to 60 years old among which eighty five cases out of 110 cases were presented with bilateral keratoconus. **Conclusion:** a newer, more descriptive and various clinical useful multi-parameter staging for keratoconus progression by using the patients natural history, cone's keratometry, decentration and thickness Since there were no correlations were found to be inconclusive in establishing a correlation between the other cone characteristics that include corneal locations topographical patterns, morphology and the stage of keratoconus.
Keywords: keratoconus, cone deceneration, cone location

Introduction
A non-inflammatory condition with ectatic corneal disorder that is characterised by the corneal protrusion and thinning that could possibly lead to corneal irregularity which could possibly results in reduced visual acuity.[1] The reported prevalence of this non-inflammatory condition among the general population that hugely varies from 45 – 240 per one lakh and it is relatively higher among those candidates who were screened for refractive surgeries. In majority of the cases, this condition is relatively bilateral and is mostly diagnosed during their second or third decade of their lives.[2,3] The confirmatory diagnosis of this keratoconus based on the biomicroscopic findings majorly include corneal thinning, striae, fleischer's ring, munson's sign and could eventually results in corneal hydrops. Based on the keratometric readings, distorted mines and cone size, this keratoconus could be classified efficiently.[4]
Analysing the corneal topography in view of its curvature, shape and corneal elevation and is represented on a colour-coded scale. This topography alone could not lead to a direct & a confirmatory diagnosis since it has to be attributed along with clinical signs, symptoms and

optical coherence tomography scans. Therefore these diagnostic tools could possibly help to differentiate it from other conditions such as normal irregular astigmatism and other corneal dystrophies.5,6 Since there are chances that this condition gradually progresses through various phases and hence the clinicians possibly monitor those changes in the physical and other optical characteristics which are possibly used in classifying the condition. The major cone characteristics that are observed during the various phases of keratoconus can be classified based on their topography or morphology. The various topographical characteristics include cone location, apex decentration and topographical corneal patterns.[7] Morphological variations could be identified by analysing the apex of the cone which relatively represents the maximal corneal protrusion. Cones had been divided into three types based on the location that include nipple, oval and globus cones. Therefore this study aims to evaluate the characteristics of the cone and the keratometric values of keratoconus at its various stages.

Materials And Methodology

After obtaining the adequate permission from the ethical committee of Chintpurni Medical College Pathankot, the study had been carried out in 110 cases with 195 eyes that are reported in an eye clinic during the stipulated study time. Corneal topography is eventually monitored by and placebo topographer based on the reflection system from cornea. And the corneal topographer that had been used include oculus 3M.The topographical monitoring of the cone patterns based on the image of the tangential map pf oculus topographer.

The various morphological variations a were majorly classified into three groups that include nipple, oval or globus.8 The cone variations were relatively recognised and were measured in millimetres with the major criteria include corneal steepening which was marked by two points. The staging of keratoconus in each eye was then classified in dioptres according to Collaborative Longitudinal Evaluation of Keratoconus (CLEK) grading system where in k-readings revealed <45.00D if mild, 45.00D – 52.00D if moderated and >52.00D if advanced.

Results

This retrospective study was conducted in 110 cases wherein 195 eyes were evaluated and all of them were diagnosed with keratoconus. The average patient age was estimated around 25.21 ± 11.45 years ranging from 10 to 60 years old among which eighty five cases out of 110 cases were presented with bilateral keratoconus.

The association between the stage, apical decentration, morphology, location and topographical patterns was evaluated using statistical tests. $P<0.05$ is considered to be statistically significant.

Table – 1: Frequency of distribution based on the K-readings staging

Staging	Frequency
Stage – 1	12
Stage – 2	63
Stage – 3	120

Table – 2: Stage of keratoconus and cone characteristics

Cone characteristics	P – value	N (eyes)
Apical decentration	0.044	195
Location	0.322	195
Morphology	0.571	195
Topographical patterns	0.071	195

Discussion

Keratoconus was identified to be the leading aetiology of corneal transplantation across the various developed countries since it is a non-inflammatory ectatic disorder that usually manifests at puberty when the cornea takes a conical shape due to a gradually progressive thinning of the corneal stroma. It is almost always a bilateral and asymmetrical condition that could possibly leads to irregular astigmatism and high myopia and consequently leading to the significant visual impairment.[9] Correlation analysis in this study showed an association between the stage of keratoconus and cone apical decentration. So the K-reading between 45D and 52D clearly showed that cone is seemed to have located outside the central zone of cornea. Few studies were in concordance with the findings obtained in this study.[10,11]

The evaluation of the results to find an association between the stage of keratoconus and the cone topography were seemed to be inconclusive. The cone is found to be steeper as the keratoconus disease progresses which merely suggesting a irregular corneal surface. Moreover, clinically the topographical findings were seemed to be helpful in diagnosing the various incipient stages and in differential diagnosis from other forms of corneal defects. This study showed no association between the stage of keratoconus and the cone morphology and this finding is in correlation with the results obtained by *Sinjab*.[12] Additionally, there might various other diseases such as rosacea, eczema or allergic conjunctivitis associated with different pathological conditions might produce corneal changes as evident in keratoconus therefore a identifying the disease through its morphological pattern quite challenging. Moreover, corneal rubbing has proved to the key factor in causing the epithelial injuryand continuous keratocyte apoptosis thus causing reduced number of keratocytes and release of various degradative enzymes.[13]

The analysis of cone characteristics to the practitioner could be an effective tool in enhancing the approach to management of the condition. The entire cone's location; topography and morphology appear to be quite complex in characteristics to observed a linear association for the multifactorial aetiological influences on the cone. Corneal thickness spatial profile and percentage increase in thickness have been found to varying between keratoconic corneas and the normal corneas[14] thus indicating that corneal thinning is invariably related to keratoconus development.

Staging keratoconus is a inevitable important tool for the study of its natural history, the likelihood of success and advisability of any new and emerging treatment options and outcome comparisons between them. Keratoconic cone features, i.e., steepening, decentration, and thinnest pachymetry, though undoubtedly interrelated, may need to be teased out individually. We hope that our staging system could facilitate such studies in the near future. Temporal cones are generally considered much less common than inferior cones, but lack of definitive criteria for designating one has been a disadvantage, possibly affecting proper assessment of effective treatment options for them.[15]

Conclusion

To conclude, a newer, more descriptive and various clinical useful multi-parameter staging for keratoconus progression by using the patients natural history, cone's keratometry, decentration and thickness Since there were no correlations were found to be inconclusive in establishing a correlation between the other cone characteristics that include corneal locations topographical patterns, morphology and the stage of keratoconus.

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