https://doi.org/10.4038/jcosl.v28i1.57

Research article

Axial length measurements in same sized DALK grafts – new insights

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The Journal of the College of Ophthalmologists of Sri Lanka 2021; 28: 29-31

Abstract

Introduction: *At the Sri Jayawardenapura General Hospital (SJGH), Deep Anterior Lamellar Keratoplasty (DALK) for keratoconus is performed by a single surgeon with graft sizing done on vertical corneal height and same-sized grafting done for all patients.*

Method: *A single centre cross-sectional descriptive study was conducted from 01. 01. 2020 to 01. 04. 2020 at the SJGH. Patients who had completed two years of follow up after DALK for keratoconus had refraction, topography and biometry on a planned hospital visit.*

Results: *The study included 71 patients (97 eyes). Mean age at surgery was 23.9 years; standard deviation (SD) – 6.9 years. The mean, postsurgical duration was 63.1 months (SD=23.4) and refractive SE was – 1.18 D (SD=1. 88). Hyperopic SE was seen in 21.5% of eyes. Mean axial length (AXL) was 23.50 mm (SD=1.16) and mean anterior chamber depth (ACD) was 3.578 mm (SD=0.36 mm). Mean AXL had significant negative correlation with SE (r= -0.676, P=0.000). ACD was correlated with average topographic keratometry (P=0.048). Mean topographic cylinder was -3.237 D (SD=1.85).*

Conclusion: *Axial length measurements should be performed in pre operative work up in DALK. Patients with short eyes need to be counseled for postoperative hyperopia. Vitreous length may be a better measurement than axial length as it may not be affected by changes in ACD in keratoconus.*

Key words: Keratoconus, Keratoplasty, Axial length

Background

Deep anterior lamellar keratoplasty is now preferred over penetrating keratoplasty for patients with keratoconus which is difficult to manage with conservative methods. Keratoconus patients have a myopic astigmatism. Most post operative patients are hyperopic at the beginning but end up with myopic refraction, whilst some patients end up with hyperopia.

Problem with hyperopia is, that it is difficult to tolerate and patient have problems with both near and distance vision. Also management is difficult with available options in comparison to myopia.

Can we pre-operatively predict patients who are more likely to develop hyperopia? Those patients can be counselled and if possible, take steps to minimize the hyperopia by altering the surgical technique. Final refraction depends on corneal power, lens and axial length. In patients with keratoconus corneal dimensions are altered. Therefore, axial length becomes a more important factor. The role of preoperative axial length in predicting post operative refractive outcomes in deep anterior lamellar keratoplasty patients is described in this study.

Objectives

1. To assess the refractive outcomes of deep anterior lamellar keratoplasty patients after 2 years.
2. To assess the association between post operative refractive outcome and axial length/vitreous length in deep anterior lamellar keratoplasty patients.

Methodology

Study was done at Sri Jayewardenepura General Hospital (SJGH). Deep Anterior Lamellar Keratoplasty (DALK) for keratoconus is performed by a single surgeon. Graft sizing done on vertical corneal height and same-sized grafting done for all patients.

Study design – Single center cross sectional descriptive study conducted from 01. 01. 2020 to 01. 04. 2020 at SJGH.

Inclusion criteria – Patients who had completed two years of follow up after DALK for keratoconus were enrolled.

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Refraction, topography and biometry were done on a planned hospital visit. Axial length measurement and Biometry performed by using IOL Master 700 machine (Carl Zeiss Meditec AG, Germany).

Approval was taken from the Ethics Review Committee, Sri Jayewardenepura General Hospital.

Results

The study included 71 patients (97 eyes). Mean age at surgery was 23.9 years; SD ± 6.9 years. The mean, postsurgical duration was 63.1 months SD ± 23.4.

93 out of 97 patients had visual acuity of 6/12 or better.

Visual acuity	Number of patients
6/6	**27**
6/9	**53**
6/12	**13**
6/18	3
6/24	1
Total	97

Mean axial length (AXL) was 23.50 mm (SD=1.16). Mean anterior chamber depth (ACD) was 3.578 mm (SD=0.36 mm). Mean AXL had significant negative correlation with SE (rp=0.000). Mean vitreous length was 16.22mm (SD 1.014). Mean topographic cylinder was -3.237 D (SD=1.85).

Axial length and postoperative spherical equivalent

Axial length	Mean spherical equivalent
Less than 22 mm	**+1.96D**
22 mm to 23.5 mm	-0.44D
23.5 mm to 25 mm	-1.7D
More than 25 mm	-4D

Refractive outcomes of patients with axial length less than 22 mm

Axial length	Post operative spherical equivalent (after 2 years)
19.98 mm	+2.63D
20.06 mm	+2.75
21.59 mm	+0.5

Axial length and post operative spherical equivalent

There was a statistically significant difference in spherical equivalent for the axial length less than 23.5 mm and more than 23.5 mm group $p<0.001$ (23.5 mm is the mean axial length of study population). Numerically axial length less than 22 mm group showed around +2D hyperopia. Since there were only 3 patients in this group unable to compare in a statistical test.

Vitreous length

In keratoconus anterior chamber depth anatomy is distorted. Therefore, vitreous length is more independent variable from disease process. Mean vitreous length 16.22 mm with SD of ±1.01

When two groups created with this mean value (vitreous length less than and more than 16.22 mm) statistically significant difference seen in mean spherical equivalent ($p<0.001$) of two groups. With lower vitreous length associated with higher plus spherical equivalent.

Discussion and conclusion

In keratoconus anterior chamber depth anatomy is distorted. Therefore, vitreous length is more independent variable from the disease process. Javadi *et. al.* reports that posterior segment length was more important than graft-host disparity in the final SE. This study shows that a vitreous length of more than 16 mm should have 0.25 mm oversizing of graft and a vitreous length of 16 mm or less should have a 0.50 mm oversized grafts. The choice for vitreous length as the parameter instead of AXL and ACD was because the vitreous length would not change with the surgery – the authors' hypothesis.

This study has highlighted the importance of performing axial length measurements in preoperative work up in DALK. Patients with short eyes need to be

counselled for postoperative hyperopia. There may be a place for altering graft size (larger grafts) than the host trephine in patients with short axial lengths. Vitreous length may be a better measurement than axial length as it may not be affected by changes in ACD in keratoconus. Further studies are needed to assess preoperative axial length/ vitreous length measurements and post operative axial length measurements and refractive outcomes and their relationship to preoperative values. Through these we can find a scientific way to optimize post operative refractive outcomes of deep anterior lamellar keratoplasy patients.

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Javadi *et. al*. reports that posterior segment length was more important than graft-host disparity in the final SE.