



Anterior Chamber OCT Changes Following Penetrating Keratoplasty

A thesis

Submitted for partial Fulfillment of Master Degree in
Ophthalmology

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2018

ACKNOWLEDGEMENTS

After giving all thanks to *ALLAH*, I would like to acknowledge the contribution of the following people and organizations to my Master's thesis.

Supervisor Committee Faculty at the Department of Ophthalmology at Ain Shams University:

I have been particularly fortunate to have been associated with three of my idols and sincerely appreciate their efforts on my behalf. And I would like to express my deepest gratitude for their continuous help throughout the whole work, their kind supervision and advice, and their kind support.

Prof. Dr. Nadia Mohamed Ismail El Mowafy;
Professor of ophthalmology

A. Prof. Dr. Mona Mohamed El-Fiky; Assistant
Professor of ophthalmology

A. Prof. Dr. Hazem Mohamed Omar Rashed;
Assistant Professor of ophthalmology,

Librarians:

Mrs. Rasha Mohamed from the Ain Shams university department of Ophthalmology continued medical education center provided with valuable research assistance and I am deeply thankful for her role in preparation of this work.

Moral and spiritual support:

I am deeply thankful for the encouragement and prayers of my family who persevered with me through every step of the work.

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LIST OF ABBREVIATIONS

AC	Anterior chamber
ACA	Anterior Chamber Angle
ANSI	American National Standards Institute
AOD	Angle Opening Distance
ASOCT	Anterior Segment Optical Coherence Tomography
CF	Counting Finger
GON	Glaucomatous Optic Neuropathy
HM	Hand Motion
I	Inferior
IOP	Intraocular pressure
ITC	Iridotrabecular Contact
LASIK	laser Assisted In Situ Keratomileusis
LED	light Emitting Diode
N	Nasal
OCT	Optical coherence tomography
ONH	Optic Nerve Head
PAS	peripheral anterior synechia
PKP	Penetrating keratoplasty
POAG	Primary Open Angle Glaucoma
RADAR	Radio Detection And Ranging
RSOD	Rapid Scanning Optical Delay
S	Superior
SD	Spectral Domain
SLD	Super Luminescent Diode
T	Temporal
TD	Time Domain
TIA	Trabecular Iris Angle
TICL	Trabecular Iris Contact Length
TISA	Trabecular Iris Space Area
UBM	Ultrasound biomicroscopy

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ABSTRACT

Background: penetrating keratoplasty (PKP) is performed for a wide spectrum of corneal disorders. Glaucoma due to pupillary block or synechial angle closure or aqueous misdirection is a major complication after keratoplasty. Peripheral anterior synechia (PAS) is recognized as one of the risk factors for graft rejection and may occasionally cause intraocular pressure (IOP) elevation, it is important to evaluate anterior chamber (AC) angle in eyes after PKP

Aim of the Work: to document OCT changes in the anterior chamber angle after PKP for different pathologies.

Patients and Methods: this prospective non-randomized study included 10 eyes of 10 patients undergoing penetrating keratoplasty (PKP) for a variety of indications. The patients age ranged from 20 to 60 years.

Results: the mean postoperative IOP was higher (15.4 ± 4.03 mmHg) than preoperative IOP (12.5 ± 2.46 mmHg), but this difference was not statistically significant [P value = 0.088]. The postoperative mean Temporal TISA was lower (0.24 ± 0.08 mm²) than preoperative Temporal TISA (0.3 ± 0.1 mm²). This difference was statistically significant [P value = 0.015]. The postoperative mean Nasal TISA was lower (0.26 ± 0.1 mm²) than preoperative Nasal TISA (0.34 ± 0.15 mm²). This difference was statistically significant [P value = 0.010]. The postoperative mean IOP in infectious keratitis was higher (16.14 ± 4.63 mmHg) than postoperative mean IOP in keratoconus (13.67 ± 1.53 mmHg), but this difference was not statistically significant [P value = 0.565].

Conclusion: there is an increase in IOP post PKP but the difference was not statistically significant. There is narrowing in angle post PKP. The difference was statistically significant in temporal and nasal angles but not statistically significant in superior and inferior angles. The mean IOP was higher in infectious keratitis than keratoconus but the difference was not statistically significant. There is no correlation between corneal diameter and the changes in IOP and angle measurements.

Keywords: Penetrating Keratoplasty - Anterior Segment OCT – Angle Changes

INTRODUCTION

Penetrating keratoplasty (PKP) is performed for a wide spectrum of corneal disorders, including corneal scarring, keratoconus, aphakic and pseudophakic bullous keratopathy, Fuchs' endothelial dystrophy, and other corneal dystrophies (**Ramsay *et al*, 1997**). It has the highest rate of success amongst all organ transplants being avascular and immuno-privileged tissue (**Brandt *et al*, 2005**).

PKP is still associated with significant complications including graft rejection, graft dehiscence. Glaucoma due to pupillary block or synechial angle closure or aqueous misdirection is a major complication after keratoplasty (**Harris *et al*, 1988**). Sustained intraocular pressure (IOP) elevation may result in endothelial cell decompensation with corneal graft failure and loss of vision (**Wagoner *et al*, 2009**).

Potential mechanisms for such pressure elevation include retained viscoelastic material, hemorrhage, malignant glaucoma, uveitis, pupillary block, secondary angle closure glaucoma, trabecular meshwork collapse, steroid-induced effects, and preexisting glaucoma (**O'Day DG, 1997**).

Because peripheral anterior synechia (PAS) is recognized as one of the risk factors for graft rejection and may occasionally cause intraocular pressure (IOP) elevation, it is important to evaluate anterior chamber (AC) angle in eyes after PKP (**Memarzadeh *et al*, 2007**).

Optical coherence tomography (OCT) is a high-resolution cross-sectional imaging modality initially developed for retinal imaging. Anterior segment OCT (ASOCT) imaging was first described in 1994 by Izatt *et al*, using the same wavelength of light as retinal OCT, namely 830 nm (**Izatt *et al*, 1994**).

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This wavelength is suboptimal for imaging the angle due to limited penetration through scattering tissue such as the sclera. OCT imaging of the anterior segment with a longer wavelength of 1310 nm was developed later on and had the advantages of better penetration through sclera as well as real-time imaging at 8 frames per second (**Radhakrishnan *et al*, 2001**).

In 2010, *Karadag et al*, reported that intraocular pressure increases in the early postoperative period occurred in 5.5% of eyes and chronically elevated intraocular pressure was found in 16.6% of eyes.

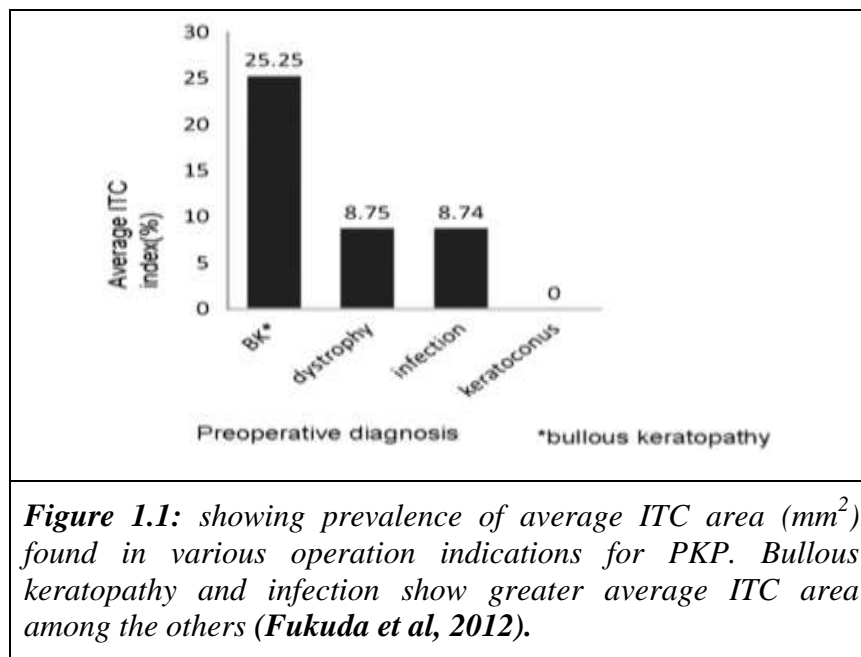
The incidence of raised IOP was 2% in non-inflammatory group (GROUP 1) e.g keratoconus, corneal dystrophy, and corneal ectasia compared with 7.9% incidence in inflammatory group (GROUP 2) e.g corneal abscess, traumatic scar and herpetic keratitis in early postoperative period. In late postoperative period, the incidence was 4.6% in non-inflammatory group compared with 24.8% in inflammatory group (**Karadag et al, 2010**).

		Group 1		Group 2		
Preoperative IOP	≤21	306	100.0%	435	98.2%	χ^2 : 5.58
	>21	0	0.00%	8	1.8%	$P = 0.018$
Early IOP	≤21	300	98.0%	408	92.1%	χ^2 : 12.3
	>21	6	2.0%	35	7.9%	$P = 0.0001$
Late IOP	≤21	292	95.4%	333	75.2%	χ^2 : 53.7
	>21	14	4.6%	110	24.8%	$P = 0.0001$
IOP, intraocular pressure.						

Table 1.1: Showing the prevalence of IOP in group 1 (non-inflammatory) compared with group 2 (inflammatory) (**Karadag et al, 2010**).

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In 2012, Fukuda et al, examine Iridotrabecular Contact (ITC) as a peripheral anterior synechia (PAS) of patients who underwent PKP. ITC was observed in 46.7% of eyes. The prevalence of ITC was the highest in eyes having bullous keratopathy, whereas the ITC area and ITC index were the largest in eyes having bullous keratopathy or infectious keratitis preoperatively. No ITC was found in eyes with keratoconus (**Fukuda et al, 2012**) (**Figure 1.1**).



Fukuda et al, found that prevalence and area of ITC were greater in pseudophakic or aphakic eyes compared with phakic eyes. large graft size was associated with a higher amount of ITC. Combined surgeries were also associated with great amounts of ITC compared with PKP operation alone (**Fukuda et al, 2012**).

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	Prevalence of ITC, n (%)	Average ITC Index, %	Average ITC Area, mm ²
Phakia	3/14 (21.4)	7.9	2.1
Pseudophakia/aphakia	18/27 (66.7)	21.7	7.5
<i>P</i>	0.009*	0.014†	0.012†
PKP+ECCE	10/13 (76.9)	29.0	11.3
PKP	11/28 (39.2)	10.7	2.75
<i>P</i>	0.043*	0.021†	0.022†
PKP once	11/30 (36.7)	12.3	3.9
PKP twice or more	10/11 (90.9)	27.8	9.7
<i>P</i>	0.004*	0.009†	0.002†
Graft size <7.75 mm	4/13 (30.8)	16.5	7.6
Graftsize ≥7.75 mm	16/22 (72.7)	20.1	5.8
<i>P</i>	0.032*	0.041†	0.040†
* χ^2 test.			
†Mann-Whitney <i>U</i> test.			
ECCE, extracapsular cataract extraction.			

Table 1.2: showing the association of ITC, ITC index, ITC area with each parameter (Fukuda et al, 2012).