

CANALOPLASTY
PROMISING SURGICAL MANAGEMENT
OF GLAUCOMA

ESSAY

SUBMITTED FOR PARTIAL FULFILLMENT OF MASTER DEGREE IN
OPHTHALMOLOGY

BY

ALAA EL-SAYED EL-TOUKHY
M.B., B.CH.

SUPERVISED BY

PROF. DR.: TAREK MOHAMMED ABDULLAH

PROFESSOR OF OPHTHALMOLOGY
FACULTY OF MEDICINE, AIN SHAMS UNIVERSITY

ASS. PROF. DR.: KHALID HAMDY MAHMOUD

ASSISTANT PROFESSOR OF OPHTHALMOLOGY
FACULTY OF MEDICINE, AIN SHAMS UNIVERSITY

FACULTY OF MEDICINE
AIN SHAMS UNIVERSITY
CAIRO - EGYPT

2013

ACKNOWLEDGMENT

Prof Dr.

TAREK ABDULLAH

Ass Prof Dr.

KHALID HAMDY

My family

My teachers

And colleagues

To all who taught me a litter

Thank you

CONTENTS

Title		Page
Contents		I
List of figures		III
List of Tables		VI
List of Abbreviations		VII
Introduction		1
Aim of work		5
Chapter 1	Anatomy of the angle	6
Chapter 2	Physiology of aqueous formation and outflow	21
Chapter 3	Primary open angle glaucoma	26
Chapter 4	Indications of surgery	44
Chapter 5	Canaloplasty operation	50
Chapter 6	Complications of canaloplasty	71
Chapter 7	Results of Canaloplasty	78
Chapter 8	What to do Canaloplasty or Trabeculectomy?	89

Summary	99
References	101
Arabic summary	

LIST OF FIGURES

Figure	Title	Page
Figure 1	Anterior Chamber Angle Anatomy	8
Figure 2	Layers of the Trabecular Meshwork	10
Figure 3	The canal of Schlemm.	11
Figure 4	Aqueous outflow pathways	14
Figure 5	Connections of the Ciliry Muscle with the T M	17
Figure 6	Circulation and Drainage of Aqueous Humor	19
Figure 7	Production of aqueous humor	23
Figure 8	Active transport of aqueous humor.	24
Figure 9	Circulation of the Aqueous Humor.	27
Figure 10	Example of SC measurements with SD-OCT	33
Figure11	H and E–stained corneal specimen	34
Figure 12	Glaucomatous disc cupping	38

Figure 13	Axonal damage	41
Figure 14	Subconjunctival injection of anesthetics	54
Figure 15	The superficial flap is dissected	55
Figure 16	The deep scleral flap	56
Figure 17	A side-port incision is made to lower IOP	57
Figure 18	Dilation of the ostiae	58
Figure 19	microcatheter iStent and cut section in it	59
Figure 20	The microcatheter inserted in ostia.	60
Figure21	After 360° cannulation, a 10-0 polypropylene suture is tied to the distal tip of the microcatheter	61
Figure 22	The suture is locked under tension to distend the inner wall of Schlemm's canal	62
Figure 23	Ultrasound biomicroscopy (80 MHz) of the chamber angle.	63
Figure24	Watertight closure of the superficial flap with seven interrupted 10-0 nylon sutures	64
Figure 25	Closed conjunctival flap.	65

Figure26	No bleb formation 2 months after canaloplasty	66
Figure27	Changes of mean IOP after canaloplasty	81
Figure 28	A horizontal image of anterior segment optical coherence tomography	81
Figure 29	Kaplan-Meier analysis for IOP	82

LIST OF TABLE

table	Title	Page
Table 1	Postoperative complications in canaloplasty	82

LIST OF ABBREVIATIONS

AC	anterior chamber
BCVA	best-corrected visual acuity
CA	carbonic anhydrase
CC	collector channel
CIGTS	Collaborative Initial Glaucoma Treatment Study
CV	coefficient of variation
DM	Descemet's membrane
DMD	Descemet membrane detachment
FD-OCT	Fourier-domain optical coherence tomography
ICC	intraclass correlation coefficient
IOP	Intra ocular pressure
MD	mean deviation
MHC	major-histocompatibility-complex
Nd:YAG	neodymium:yttrium-aluminum-garnet
OVD	ophthalmic viscosurgical device
p	p value
POAG	primary open-angle glaucoma

SD	Standard deviation
SC	Schlemm's canal
SD-OCT	spectral-domain optical coherence tomography
(Na⁺/ K⁺ ATPase)	sodium-potassium-activated adenosine triphosphatase
TM	trabecular meshwork
UBM	ultrasound biomicroscopy
VA	visual acuity
WDR36	T-cell activation WD repeat-containing protein

INTRODUCTION

Open angle glaucoma is a disease which results in optic nerve damage with subsequent visual field loss due to ineffective drainage of aqueous humor through the eye's natural aqueous outflow channels. (*Jones et al., 2005*)

Open angle glaucoma is typically treated first with topical drops followed by surgical intervention if there is no response. The gold standard for the surgical treatment of glaucoma has historically been trabeculectomy with the use of antifibrotic agents. The trabeculectomy procedure serves to create a bypass route for the aqueous humor to drain out the eye and into a subconjunctival vascular network. despite, trabeculectomy procedure can effectively lower the intraocular pressure (IOP), it is associated with the risk of intra operative and post operative complications. (*Borisuth et al., 2011*)

Post surgical hypotony and a lifetime risk of blebitis are two of the most serious postoperative complications after a trabeculectomy procedure which opened the door widely for a new surgical technique which can avoid these complications. (*Jampel et al., 2005*)

Increasing interest in blebless surgery has led to innovative surgical procedures aimed at rejuvenating the natural trabeculo canalicular outflow pathway and to avoid shunting aqueous to a

non physiological drainage site. Circumferential catheterization with suture tensioning of Schlemm's canal has emerged as a safe and effective way to surgically treat open angle glaucoma that is less likely to result in postoperative hypotony. (*Anand et al., 2006*)

Typically, a fornix based conjunctival incision is created to allow for a superficial scleral flap followed by a deeper inner scleral flap to attain access to Schlemm's canal. The first flap is approximately 50% thick and the subsequent deeper flap is fashioned to expose and unroof Schlemm's canal. The canal's ostia are then viscodilated to allow for insertion of the micro catheter. The lighted tip allows for the surgeon to visualize the cannulation of Schlemm's canal for 360 degrees while the injector allows for simultaneous injection of viscoelastic every two clock hours as the catheter is advanced. After complete circumferential catheterization of the canal the distal tip of the catheter emerges at the scleral cut down at which point a 10-0 polypropylene suture is tied to the tip. The micro catheter is then retracted pulling the suture in the canal. The suture is then cut away from the micro catheter and seated against the inner wall of Schlemm's canal and tied in a loop. Tension is then placed on the suture to maintain an inward radial force on the trabecular meshwork. High-resolution ultrasound biomicroscopy is then utilized to visualize the amount of distention placed on trabecular meshwork in order to assess suture tensioning. Once adequate tension is obtained, the suture is

secured with locking knots. The descemetic window which was partially created while fashioning the deep scleral flap is now enlarged anteriorly. The deep scleral flap is then excised and the superficial flap is sutured watertight to limit bleb formation. The conjunctiva is then re approximated to limbus. (*Godfrey et al., 2009*)

Canaloplasty with suture tensioning of Schlemm's canal is a minimally invasive way to surgically treat open angle glaucoma. Further, this procedure results in lower intraocular pressure (IOP) without the formation of a conjunctival bleb. (*Gedde et al., 2007*)

However, canaloplasty is not without limitations. The surgery is technically challenging and there is definitely a steep learning curve. In addition, not all patients with glaucoma are surgical candidates for canaloplasty. The procedure is contraindicated in eyes with angle recession, neovascular glaucoma, chronic angle closure, narrow angle glaucoma, and patients with previous ocular surgery that would prevent circumferential catheterization of Schlemm's canal. (*Feiner and Piltz-Seymour, 2013*)

Finally; canaloplasty with suture tensioning of Schlemm's canal appears to offer the glaucoma specialist a surgically effective way to treat open angle glaucoma by restoring the natural outflow pathway of the eye without the formation of a bleb or the complications associated with trabeculectomy. Therefore,

canaloplasty seems to be a viable surgical option in patients with early open angle glaucoma and promising filtering surgery for more severe stages of the disease. (*Musch et al., 2009*)

Aim of the work

The aim of this work is to evaluate canaloplasty operation as a new surgical management of open angle glaucoma compared with subsclearal trabeculectomy regarding effectiveness, rate of complications, as a combined surgery with phacoemulsification and learning curve considering skills acquainting with the technique.