Sutureless Vitrectomy

Essay submitted for partial fulfillment of The Master Degree in Ophthalmology

By

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> Cairo, Egypt 2011

Acknowledgement

First of all thanks to God for blessing this work until it came to light as part of his generous help throughout my life.

I would like to express my deepest thanks and gratitude to *Professor.Dr.\ Ahmed Darwesh*; Professor of ophthalmology, Ain shams university, for his help and guideness during the preparation of this work.

I am deeply in debt to *Ass. Professor. Dr.\ Mohamed Abd El Hakim*; Assistant Professor of ophthalmology, Ain shams university, for his great effort and help done in every step of my work.

Finally, I present my gratitude to my colleagues, family and friends for their support.

Introduction

The aim of this essay is to review the different aspects of sutureless trans-scleral vitrectomy as an innovative method of posterior segment surgery with the concentration on the technique, advantages and complications.

This review includes a background basic science and Pars plana vitrectomy review in aspects of indications, surgical technique and instrumentation.

Recent advances and future improvements will greatly influence the progress of micro incisional vitrectomy surgery.

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List of Abbreviations

AMD	Age-related Macular Degeneration
ARVO	Association for Research in Vision and Ophthalmology
AWG	American Wire Gauge
BIOM	Binocular Indirect ophthalmo-Microscopy
BSS	Balanced Salt Solution
C3F8	Perflouropropane
CME	Cystoid Macular Edema
CNV	Choroidal Neovascularization
CPM	Cut Per Minute
ERM	Epi-Retinal Membrane
EIOS	Erect Image Biocular Indirect Ophthalmo-Microscopy
EVS	Endophthalmitis Vitrectomy Study
\mathbf{G}	Gauge
HA	Hyaluronic Acid
IOL	Intra Ocular Lens
IOP	Intra Ocular Pressure
ILM	Internal Limiting Membrane
IR	Infra Red
MIVS	Micro-Incision Vitrectomy Surgery
MVR	Micro Vitreo-Retinal
OCT	Optical Coherence Tomography
PDR	Proliferative Diabetic Retinopathy
PPV	Pars Plana Vitrectomy
PVD	Posterior Vitreous Detachment
PVR	Proliferative Vitreoretinal Retinopathy
SF6	Sulphur hexafluride
t-PA	Subretinal tissue plasminogen activator
TSV	Trans-Scleral Vitrectomy
UBM	Ultraspund Biomicoscopy
$\mathbf{U}\mathbf{V}$	Ultra Violet
VISC	Vitreous Infusion Suction Cutter
VMT	Vitro-Macular Traction

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CHAPTER ONE

BASIC SCIENCES

RELATED TO

THE VITREOUS BODY

EMBRYOLOGY OF THE VITREOUS BODY

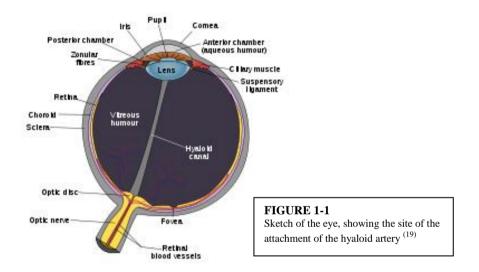
1. STRUCTURAL CONSIDERATIONS:

In the early stages the optic cup is mainly occupied by the lens vesicle. As the cup grows, the space formed is filled by a system of fibrillar material, presumably secreted by the cells of the embryonic retina. Later, with the penetration of the hyaloid artery [Figure 1-1], more fibrillar material, apparently organizing from the cells of the wall of the artery and other vessels, contributes to filling the space. The combined mass is known as the **primary vitreous.** (1)

The **secondary vitreous** develops later, appearing at the end of the sixth week, and is associated with the increasing size of the vitreous cavity, and the regression of the hyaloid vascular system. The main hyaloids artery remains for some time, but it eventually disappears and leaves in its place a tube of primary vitreous surrounded by the secondary vitreous, running from the retrolental space to the optic nerve (area of Martegiani). The tube is called Cloquet's canal; this is not a liquid filled canal, but simply a portion of differentiated gel devoid of collagen fibrils.

The term **tertiary vitreous** is related to the fibrillary material, which develops as the suspensor fibrils, the zonules, of

the lens. During childhood the vitreous undergoes significant growth. The length of the vitreous body in the newborn eye is approximately 10.5 mm, and by the age of 13 years, the actual length of the vitreous increases to 16.1 mm in the male. In the absence of refractive changes, the mean adult vitreous is 16.5 mm. (2)



2. MOLECULAR AND CELLULAR CONSIDERATION:

The two main components of the vitreous, collagen and hyaluronic acid, are produced in the primary and secondary vitreous. In the primary vitreous, however, there is initial production of substances other than hyaluronic acid such as galactosaminoglycans; later hyaluronic acid becomes the main constituent. (3)

The primary vitreous contains cells that differentiate in the secondary vitreous as hyalocytes and fibroblasts. The hyalocytes production believed to be involved in the are gylcosaminoglycans, especially hyaluronic acid, a non-sulfated glycosaminoglycan. (3)

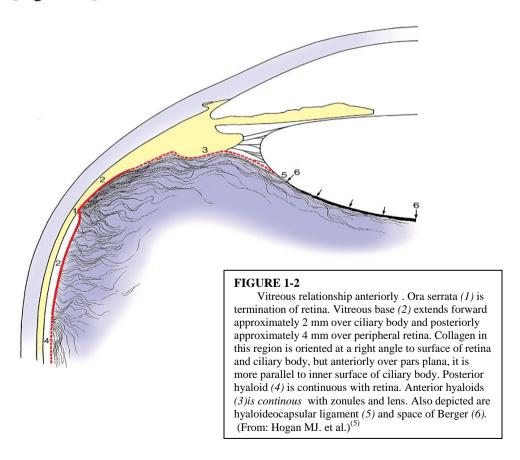
Although the function of the fibroblasts is not known exactly, they are probably involved in the formation of collagen. The retina may also be a source of collagen synthesis. (1) (4)

ANATOMY OF THE VITREOUS BODY

The **vitreous chamber** is filled with the gel-like vitreous body and occupies the largest portion of the globe. It is bounded on the front by the posterior surface of the lens and the retrozonular portion of the posterior chamber. Peripherally and posteriorly, it is bounded by the pars plana of the ciliary body, the retina, and the optic disc. All surfaces that interface with the vitreous are basement membranes. The center of the anterior surface contains the **patellar fossa**, an indentation in which the lens sits. (5)

1. THE VITREAL ATTACHMENTS:

The vitreous forms several attachments to surrounding structures. The strongest of these is the vitreous base, located at the ora serrata. The other attachments (in order of decreasing strength) are to the posterior lens, to the optic disc, at the macula, and to retinal vessels. The vitreous base, the most extensive adhesion, extends 1.5 to 2 mm anterior to the ora serrata, 1 to 3 mm posterior to it, and several millimeters into the vitreous (6) [Figure 1-2].



The vitreal fibers that form the base are embedded firmly in the basement membrane of the nonpigmented epithelium of the ciliary body and the internal limiting membrane of the peripheral retina. (7)

The hyaloideocapsular ligament (of Weiger), or retrolental ligament, forms an annular attachment 1 to 2 mm wide and 8 to 9 mm in diameter between the posterior surface of the lens and the anterior face of the vitreous. (6) This is a firm attachment site in young persons, but the strength of the bond diminishes with age. Within the ring formed by this ligament is a potential space, the retrolental space (of Berger), which is present because the lens and vitreous are juxtaposed but not joined. (5) The peripapillary adhesion around the edge of the optic disc also diminishes with age. The annular ring of attachment at the macula is 3 to 4 mm in diameter. The attachment of the vitreous to retinal blood vessels consists of fine strands that extend through the internal limiting membrane to branch and surround the larger retinal vessels. (8) These strands may account for hemorrhages that occur when there is vitreal traction on the retina. The nature of the attachment between the vitreous and the retinal internal limiting membrane remains uncertain. It is unlikely that fibrils from the posterior vitreous insert into the internal limiting membrane. (9)

2. VITREOUS ZONES:

The vitreous can be divided into zones that differ in relative density. The outermost zone is the vitreous cortex, the intermediate zone is inner to the cortex, and the center zone is occupied by Cloquet's canal.

A) Vitreous Cortex

The vitreous cortex, also called the hyaloid surface, is the outer zone. It is 100µm wide, and it is composed of tightly packed collagen fibrils, some of which run parallel and some perpendicular to the retinal surface. (10) The anterior cortex lies anterior to the base and is adjacent to the ciliary body, posterior chamber, and lens. The posterior cortex extends posterior to the base and is in contact with the retina. It contains transvitreal channels that appear as holes—the prepapillary hole, the premacular hole, and prevascular fissures. The prepapillary hole can sometimes be seen clinically when the posterior vitreous detaches from the retina. (6) The premacular hole, a weak area, may be a region of decreased density rather than an actual hole. The *prevascular fissures* provide the avenue by which fine fibers enter the retina and encircle retinal vessels. (8)

B) Intermediate Zone

The **intermediate zone** contains fine fibers that are continuous and unbranched and that run anteroposteriorly. (6) These fibers arise at the region of the vitreous base and insert into the posterior cortex. (The peripheral fibers parallel the cortex, whereas the more central fibers parallel Cloquet's canal. Membrane like condensations, called vitreous tracts, may be differentiated as areas that have differing fiber densities [Figure 1-31. (10)

C) Cloquet's Canal

Cloquet's canal, also called the hvaloid channel or the **retrolental tract,** is located in the center of the vitreous body. (5) It has an S shape; rotated 90 degrees with the center dip downward, and is the former site of the hyaloid artery system, which was formed during embryologic development.

Cloquet's canal arises at the retrolental space. Its anterior face is approximately 4 to 5 mm in diameter. (5) It terminates at the area of Martegiani, a funnel-shaped space at the optic nerve head that extends forward into the vitreous to become continuous with the canal. (6)