

**Comparative study of surgically induced astigmatism
after 23 Gauge sutureless vitrectomy versus after 20
Gauge vitrectomy using radial and circumferential
sclerotomies**

Thesis

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List of Abbreviations

(ATR) Against the rule

(BCVA) Best corrected visual acuity

(BSS) Balanced salt solution

(cpm) Cuts per minute

(Fig.) Figure

(G) Gauge

(GAGs) Glycosaminoglycans

(IOP) Intraocular pressure

(MVR) Micro-vitreo-retinal

(n) Number

(PG) Proteoglycan

(PPV) Pars plana vitrectomy

(SD) Standard deviation

(SIA) Surgically induced astigmatism

(TSV) Transconjunctival sutureless vitrectomy

(VISC) Vitreous infusion suction cutter

(WTR) With the rule

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Introduction

Introduction

History of Pars Plana Vitrectomy Surgery

In 1971, *Machemer et al*, described the use of a 17-gauge vitreous cutter, with a diameter of 1.5 mm through a 2.3 mm scleral incision. This instrument, the vitreous infusion suction cutter (VISC), consisted of an inner and outer tube. The outer tube was stationary with an opening, inside which, was the rotating opening of the inner tube with sharp edges. Suction was applied to the inner tube to draw vitreous into the openings and the rotating sharp edge would cut the material. The instrument was connected to a rheostat to alter rotation speed, an infusion system, and a syringe that allowed manual application of suction. This was utilized in an eye with vitreous hemorrhage secondary to diabetic retinopathy (*Machemer et al, 1971*).

The approach was modified in 1974, with the introduction of a 20-gauge vitrector (0.9 mm diameter) by *O'Malley and Heintz*(*O'Malley C, Heintz RM.,1975*). This was the origin of the three port, pars plana sclerotomy system that became the gold standard in vitrectomy surgery. It involved the creation of three access ports with a 1.4 mm linear sclerotomy. This was undertaken with a micro- vitreo-retinal (MVR) blade. One port had an infusion line sewn into place, while the remaining two were utilized for introduction of a light source and a vitreous instrument such as a cutter. At the completion of the procedure, these ports were traditionally closed with an absorbable suture (*O'Malley C, Heintz RM., 1975*).

In 1996, *Chen* described a technique for creating a self- sealing, pars plana sclerotomy. This involved an initial scleral incision based 6

mm posterior to the limbus, creating a scleral flap that was theoretically self-sealing (*Chen,1996*).

Kwok et al, described a variation on this method with an initial radial incision, still placed 3-4 mm behind the corneoscleral limbus. They used a 20-gauge round body hypodermic needle rather than a MVR blade (*Kwok et al, 1999*).

De Juan and Hickingbotham devised and introduced a range of 25-gauge instruments in 1990 for use through conventional sclerotomies (*De Juan and Hickingbotham, 1990*).

However, it was only in 2002, with the advent of the microcannulae array, that the 25-gauge transconjunctival sutureless vitrectomy (TSV) system was introduced by *Fujii et al* (*Fujii et al, 2002*). This was followed by the introduction of a 23-gauge system by *Eckardt* in 2005. Initially, both 23- and 25-gauge systems were available with a limited gamut of intraocular instruments. However, as the techniques rapidly became widely utilized, almost all intraocular instruments have been developed and made available for sutureless vitrectomy systems (*Eckardt,2005*).

The benefits of sutureless vitrectomy, regardless of the instrument gauge, are similar to those experienced with sutureless cataract phacoemulsification. A decrease in intraoperative time, patient discomfort (suture and nonsuture related), and postoperative inflammation has been reported (*Chen E., 2007*), (*Rizzo S, et al, 2006*). There have also been reports of less surgery induced astigmatism and more rapid visual recovery (*Tewari A, et al, 2008*), (*Yanyali A, et al, 2005*).

Several studies have shown that the corneal contour is significantly changed by 20 gauge standard vitrectomy, inducing postoperative astigmatism, the induced astigmatism is usually transient and returns to base line level by one to four months after surgery. The increase in post operative astigmatism may be attributed to the scleral cautery and suturing at the entry port (*Domniz YY, et al, 2001*).

As with standard pars plana vitrectomy, sutureless vitrectomy has inherent complications. These include iatrogenic retinal breaks, lens touch, cataract progression, and ocular hypertension. The fact that the sclerotomies are not sutured at the end of the procedure has led to an incidence of wound leak and subsequent ocular hypotony (*Fujii, et al, 2002*), (*O' Reilly P. and Beatty S., 2007*).

Concerns have been made regarding the possibility of an increase in incidence of endophthalmitis related to sutureless procedures, including vitrectomy (*Mamalis N, et al, 2002*).

Aim of work

Primary outcome:-

-TO compare the surgically induced astigmatism following 23 gauge sutureless vitrectomy versus after 20 gauge conventional vitrectomy (radial versus circumferential 20 gauge sclerotomies).

Secondary outcome:-

- Incidence of post-operative hypotony.
- Incidence of post-operative infection.
- Success rate of achieving the goal of vitrectomy.

Review of Literature

Chapter 1:-

Anatomy of the sclera

The sclera is the main part of the outer coat of the eye, is roughly spherical and forms just under five-sixths of the fibrous external tunic. It consists almost entirely of collagen, within a lesser amount of ground substance material than in the cornea, contains scanty fibrocytes (sclerocytes) and is relatively avascular. Like the cornea it is comparatively tough and protects the intraocular contents from injury and mechanical displacement. Its mechanical strength also serves to contain the intraocular pressure and at the same time prevents deformations of the globe by resisting the stresses and strains induced by contractions of the extraocular muscles.

MECHANICAL PROPERTIES

The intraocular pressure causes a stretching of the scleral collagen and thus this tissue is always under slight tension. Although the distensibility of the sclera is poor it is often described as viscoelastic, because it exhibits the typical biphasic response of such materials when suddenly deformed. Scleral deformation is thus accompanied by an elastic component, which results in a rapid but very brief lengthening, followed by a viscid component which results in a slow stretching. In children with infantile glaucoma this slow scleral stretching in response to a sustained increase in intraocular pressure results in the buphthalmic globe. In later life the amount that the sclera stretches in response to changes in intraocular pressure is not in direct proportion to pressure rise, because rigidity of sclera increases with stretch. However, expansion and thinning of the sclera (but not the cornea) is a feature of progressive myopia (*St Helen, et al, 1961*).

DIMENSIONS:

The dimensions of the scleral sphere vary in the adult human eye but on average the coronal diameter lies between 22 and 24 mm, with that in males being 0.5 mm larger than in females. At birth the anteroposterior diameter is 16-17 mm, increasing to 22.5 mm by the age of 3 years and reaching full adult dimension by the age of 13 years (*Sorsby, A. and Sheridan, 1960*). Scleral thickness varies, being thickest (1 mm) near the optic nerve, thinning progressively to 0.6 mm at the equator, and thinnest (0.3 mm) at the rectus muscle insertions. However, the tendons of these muscles effectively increase scleral thickness to 0.6 mm, and from this point to the limbus there is a gradual increase in thickness to 0.8 mm. It is generally thought that the sclera thins with increasing age (*Vannas, S. and Teir, H., 1960*), but some authorities dispute this and relate apparent changes in thickness to age-related differences in distension and water content (*Weale, R.A., 1982*).

TRANSPARENCY:

In adults the sclera is normally white, and its visible anterior portion is referred to as the 'white' of the eye. It is also usually opaque, although some diffuse light does enter the globe through the sclera. This relative translucency allows the location of intraocular tumours by transillumination through the globe, when the dense tumour casts a dark shadow. The opacity of the sclera is related in part to its water content of about 68%: if the water content falls below 40% or rises above 80% then the sclera becomes lucent. This is in contrast to the cornea where increased hydration invariably leads to a loss of transparency (*Weale, R.A., 1982*).

If, as in childhood, the sclera is thin or if there is a pathological alteration in scleral hydration, then the resultant changes in optical qualities result in the sclera appearing blue or blue-grey.

The coloration may be generalized (as in the eyes of the newborn), focal (for instance beneath the bulbar insertions of the rectus muscles where the sclera is thinnest), or as a transient effect of drying and thinning of the sclera during surgery. In each case there is an increase in the amount of light falling on, and therefore absorbed by, the underlying uvea. The blue hue is imparted by the greater scattering of shorter wavelengths by the scleral collagen (*Weale, R.A., 1982*).

SCLERAL ORGANIZATION :

The sclera is composed of compact interlacing bundles of collagen, some elastic tissue, and a smaller quantity of ground substance than found in the cornea (table 1). Elastic fibres interlace with the collagen bundles and arc largely in the lamina fusca, next to the choroid. They are found at the limbus, lamina cribrosa and are sparse at the equator (*Weale, R.A., 1982*).