INTRODUCTION

Pars plana vitrectomy has brought about a paradigm shift and revolutionized retinal surgery since its introduction by Machemer et al in 1971. With the established safety and efficacy of this technique, the indications have expanded with gratifying results. Conventional 20 gauge vitrectomy involves making three sclerotomy ports after a limited conjunctival dissection followed by suturing these sclerotomies and conjunctiva at the end of the procedure. The quest to find ways to shorten surgical time and to minimize trauma to the eye led to the development of the first 20G transconjunctival sutureless approach in 1996 by Chen et al. The introduction of 23, 25 and the recently introduced 27G vitrectomy systems have reduced surgical time and improved patient comfort enabling early rehabilitation.

The basis of a sutureless pars plana sclerotomy was to stabilize the intraocular pressure (IOP) during surgery with a truly closed system as well as reduce the surgical time by removing the need for sutured wound closure. Wound and suture related complications, such as leakage, irritation, and scleral pigmentary changes could also be avoided. Concerns regarding wound competence in a sutureless procedure have seen the modification of the conventional straight incision to techniques such as angled, beveled, oblique and scleral tunnel incisions. However, an incomplete armamentarium and overflexible instrumentation coupled with increased risk of postoperative hypotony, endophthalmitis and compromised fluidics have limited the application of these new systems. Another limiting factor was the increased cost incurred on instrumentation. In contrast, a 20G system has sturdy instruments and excellent fluidics albeit longer surgical times due to suturing and additional suture related complications. Also, the retinal surgeon desires a single vitrectomy system that could deal with varied surgical situations, such as lensectomy for advanced nuclear sclerosis/membranectomy of thick papillary membranes, advanced proliferative diabetic retinopathy with extensive fibrovascular proliferation, advanced proliferative vitreoretinopathy, management of a dropped nucleus (grade IV) or retained intraocular foreign body (IOFB). 20G sutureless vitrectomy system combines the superior fluidics and stability of 20G instruments along with the reduced surgical times and improved patient comfort of the 23, 25G systems. The purpose of this review is to summarize the available information on 20G transconjunctival sutureless vitrectomy and evaluate its role in modern-day vitreous surgery supplemented with our personal experience.

WOUND CONSTRUCTION IN 20G SUTURELESS VITRECTOMY

Chen described a scleral tunnel technique after limited conjunctival dissection followed by insertion of the...
microvitreoretinal (MVR) blade into the vitreous cavity at the base of the tunnel. Yeshuran described the creation of a modified sutureless sclerotomy using a MVR blade. In the first stage of sclerotomy construction, a 19G MVR blade was advanced inside the sclera for approximately 2.5 mm at a 20° angle. It was then rotated into a vertical position, and the vitreous cavity was penetrated.

Gotzaridis described a technique in which the MVR blade was introduced into the conjunctiva-sclera in a beveled direction. The technique began with diathermy of the conjunctiva with a “short neck” wide-tip diathermy probe. The diathermy was broad and intense. The diathermy probe was applied like “ironing clothes” (press and stretch the conjunctiva over the sclera). The conjunctiva became thin or very thin, and sometimes an opening was created with a gradually thinning rim that was sealed with the underlying sclera. The visible end point of the conjunctival burn was a white circle the size of at least 4 to 5 mm in diameter. The adhesion between the conjunctiva and the sclera prevented bleeding and inflation of the subconjunctival space with infusion fluid. A 20-gauge MVR blade was used to create a combined conjunctivoscleral incision in the inferotemporal quadrant. A self-retaining 4 mm infusion blade was used to create a combined conjunctivoscleral incision at the point of the conjunctival burn was a white circle the size of at least 4 to 5 mm in diameter. The adhesion between the conjunctiva and the sclera prevented bleeding and inflation of the subconjunctival space with infusion fluid. A 20-gauge MVR blade was used to create a combined conjunctivoscleral incision in the inferotemporal quadrant. A self-retaining 4 mm infusion cannula (DORC International—Dutch Ophthalmic Research Center, Zuidland, The Netherlands) was used in this port without a suture. At the end of the operation, a single 8-0 vicryl (polyglactin 910) suture was used to close the conjunctiva and sclera together.

Patil et al described a technique in which a fornix-based conjunctival and tenons flap was recessed by 4 mm. A partial thickness (1/2-2/3 depth) scleral incision 2 to 3 mm in length was made 2.0 mm from the limbus. An angled bevel up crescent blade was used to create a 2.0 mm scleral pocket posteriorly. This approximated the entry into the eye to about 4mm from the limbus. The MVR blade was passed through the scleral pocket and rotated to 60° before entering the vitreous cavity. The conjunctiva was approximated and diathermized at the end of the operation.

In the technique described by Lafetá et al, incisions were made radially at 3 mm from the limbus and tunnels were made limbus-parallel. The procedure was initiated using a 20-gauge bent stiletto (45° angle; 0.9 mm; Blumenthal; BD Visitec) that was inserted at a 10° angle through the conjunctiva, without displacement. The instrument set included one infusion inserter that measured 11.5 mm, one infusion trocar measuring 8.5 mm with a 4.0 mm intraocular extension, two blunt trocar-inserters, measuring 10.0 mm with a 4.0 mm intraocular extension, to place the 6.5 mm trocars. At the end, the eye was pressurized at 20 mm Hg and the infusion was closed before removing the two trocars from the superior quadrants. Then, the infusion was reopened, increasing the eye pressure for a few seconds with simultaneous cotton-tip massage at the entry ports in order to close the tunnels.

Saad et al described making a small conjunctival incision over the site of the intended sclerotomy. The sclerotomies were then constructed with a 20 gauge MVR blade introduced in the sclera at a 10° angle, 1.5 mm from the limbus in aphakic or pseudophakic eyes or 2 mm from the limbus in phakic eyes to create a 2 mm long half-thickness scleral incision. The MVR blade was then rotated 90° to the eye and introduced in the mid-vitreous cavity in the normal way at the intended site of entry (3.5 mm from the limbus in aphakic or pseudophakic eyes or at 4 mm in phakic eyes) and withdrawn. The superior sclerotomies were fashioned in an anteroposterior direction perpendicular to the limbus. The infusion line sclerotomy was fashioned in a circumferential direction parallel to the limbus, and the infusion line was held in place with a preplaced 7.0 vircyl suture. The intraocular instruments were introduced in the same manner as the MVR blade by passing into the scleral incision first and then rotated to 90° before entering the vitreous cavity. Cautery was applied to the edge of the scleral incision to shrink the scleral fibers and help in closing the external opening of the sclerotomy when necessary. The conjunctiva was closed over the sclerotomy with an absorbable suture.

Of the currently available options, 20-gauge non-trocar or trocar systems hold the possibility of providing some of the advantages of smaller-gauge systems without the need to adopt a lot of newer instrumentation in switching to transconjunctival sutureless surgery. Sclerotomies with the Claes 20 gauge vitreotomy system (DORC International, Zuidland, Netherlands) are created using a two-step procedure; a regular 20-gauge microvitreoretinal knife is inserted at an estimated angle of 10° to 20° using the DORC fixed footplate; then the trocar is inserted. The DORC system is equipped with a high speed pneumatic vitrectome with closest aspiration port to the tip enabling increased aspiration flow and instrument stiffness. The new generation trocar design enhances smooth insertion and is equipped with a unique closure valve that creates a closed surgical field with constant intraocular pressure without the need for closure plugs. For insertion of the Synergetics One-Step Surgical System (Synergetics, O’Fallon, MO), the bladed trocar inserter is used. The flexible cannula of the Synergetics system tends to self-seal during surgery.

**Tissue Glue for Scleral and Conjunctival Closure After 20G Vitrectomy**

Batman et al demonstrated successful closure of both, the sclerotomy sites as well as the conjunctival peritomy, using fibrin tissue glue (Tisseel, Baxter AG Industries, Vienna, Austria). After cannulae were removed, each of the entry site was closed with one drop of fibrin glue that was immediately applied over the edges of the sclerotomy. The edges were opposed gently with forceps for 45 seconds for firm adhesion. Excess sealant was excised with scissors. The wound was checked for leakage by applying pressure to the edges of incision with a sponge. Then, three or four drops of fibrin glue were spread on the bare sclera near the limbus 360° and the conjunctival was pressed into place.

Our preferred technique of 20G sutureless pars plana vitrectomy consists of creating three biplanar sclerotomies (Figs 1A and B), performing standard vitrectomy and at the end of the procedure, using fibrin glue at the lips of the...
sclerotomy sites (Figs 2A to D) and conjunctival peritomy for closure (Figs 3A to F). We have found this method to be very useful for the management of a wide range of pathologies. It also facilitates easy use of endotamponading agents whenever necessary. Ultrasound biomicroscopy (UBM) of these sclerotomy sites at six weeks postoperative follow-up also revealed a good healing pattern (Figs 4A and D).

RESULTS

Yeshurun et al\(^5\) reported that 33 out of the 35 eyes underwent uneventful operations and only two eyes required suture placement at the end of surgery (2.9% of sclerotomies). In the series by Gotzaridis et al\(^6\), only 3.5% patients suffered from postoperative hypotony, which normalized 3 days after operation. Lafeta et al\(^8\) reported no case of hypotony, choroidal
Figs 3A to F: After applying fibrin glue to the bare scleral over the temporal 180°, the edges of the conjunctival peritomy at the site of relaxing cuts are apposed using forceps (A) followed by apposition of the superior conjunctiva at the limbus (B) till it is adhered well (C). Fibrin glue is then applied to remaining bare sclera (D) and the cut ends of the conjunctiva on the opposite side are approximated (E) till a good seal is attained. Excellent conjunctival closure is achieved at the end of the procedure (F) over the entire 360°.

Figs 4A to D: Ultrasound biomicroscopy of sclerotomy sites reveals complete closure with no evidence of internal gaping or vitreous incarceration in the wound.
Table 1: Comparative table of studies on 20G sutureless vitrectomies

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of eyes</th>
<th>Technique</th>
<th>Suture (%)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milibak et al</td>
<td>17</td>
<td>PA tunnel 20G MVR blade</td>
<td>58</td>
<td>High rate of leakage</td>
</tr>
<tr>
<td>Kwok et al</td>
<td>25</td>
<td>Circumferential needle 20G needle</td>
<td>11</td>
<td>Suprachoroidal detachment and lens touch</td>
</tr>
<tr>
<td>Saad et al</td>
<td>25</td>
<td>AP tunnel with crescent blade</td>
<td>6</td>
<td>Traditional incision for infusion cannula</td>
</tr>
<tr>
<td>Jackson</td>
<td>30</td>
<td>Circumferential tunnel 20G MVR</td>
<td>14</td>
<td>High rate of leakage and other complications</td>
</tr>
<tr>
<td>Theeleen et al</td>
<td>21</td>
<td>Wedge-shaped sclerotomy 20G MVR blade</td>
<td>5</td>
<td>Leakage, if no. of instrument exchanges are more</td>
</tr>
<tr>
<td>Yeshurun et al</td>
<td>35</td>
<td>Circumferential oblique superior sclerotomies with 19G MVR blade</td>
<td>2.9</td>
<td>Traditional incision for infusion cannula</td>
</tr>
<tr>
<td>Patil et al</td>
<td>40</td>
<td>AP tunnel crescent blade</td>
<td>2.5</td>
<td>Traditional incision for infusion cannula</td>
</tr>
<tr>
<td>Lafeta et al</td>
<td>50</td>
<td>20G trocar system</td>
<td>0</td>
<td>Need a trocar system</td>
</tr>
<tr>
<td>Kim et al</td>
<td>164</td>
<td>Blade-like trocar</td>
<td>38</td>
<td>New synergistics one step surgical system used</td>
</tr>
</tbody>
</table>

Note: PA, Postero-anterior; AP, Antero-posterior.

detachment or endophthalmitis. Saad and Assi recently concluded from their experience of 183 sclerotomies performed, that 10 (6%) required suture placement. More recently, Kim et al reported that, in a series of 164 20G sutureless vitrectomies, suture placement at the end of the procedure was required in 63 patients (38%) to close leaking scleromies. In a comparative series of 21 consecutive eyes undergoing sutureless vitrectomy using self-sealing wedge-shaped pars plana sclerotomies, Thelan et al reported no cases of hypotony. 12 Batman et al in their study using fibrin glue to seal sclerotomies and conjunctiva reported complete conjunctival reattachment and no scleral wound leakage at the end of the surgical procedure and during the follow-up period. No adverse effects were seen with fibrin glue application at two months. Abnormal fibrous ingrowth was not detected at the sclerotomy sites by means of UBM in glue applied eyes. Patient comfort was significantly higher in eyes receiving glue application compared to those receiving vicryl sutures.

Table 1 shows the results of the recently published studies on 20G sutureless vitrectomies.

Possible complications of 20G vitrectomy include postoperative hypotony, choroidal detachments, conjunctival blebs, scleral flap necrosis or infection, vitreal incarceration and endophthalmitis.14-16

CONCLUSION

In conclusion, advantages of 23G TSV system include short procedure time, faster healing, less postoperative inflammation and allowance of high speed cutters with superior fluidics. Table 2 shows comparison of 20, 23 and 25G vitrectomy systems. Despite gauge conversion, 20G parsplana vitrectomy maintains a niche of its own. Sutureless 20G vitrectomy techniques that have been described, can enable retinal surgeons to graduate into this surgery without a steep learning curve. Also, as routine instruments can be used, additional investments are not required and this makes it economical. Advantages of using biologic adhesives to seal sclerotomies are that it imitates the final stage of the normal physiological coagulation process and mimics physiological wound healing process. This technique coupled with the transition back towards 20G vitrectomy seems very promising. A randomized control trial could bring out the comparison better and enable wider acceptance.

REFERENCES


