Use of Adhesives in Glaucoma Surgery

Fibrin glue and sealants are time-saving alternatives to sutures in some procedures.

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Traditional glaucoma surgery can often be complex both in surgical technique and postoperative course. Careful dissection of multiple tissue types such as the conjunctiva, sclera, and Descemet membrane is often required. There is also a need to create aqueous from the eye versus a watertight environment, which is desired for most other ocular procedures.

Suturing can be time consuming and unpredictable in a procedure’s outcome both intraoperatively and during the postoperative follow-up period. Sutures may lead to discomfort for the patient, result in local tissue melts, be a pathway for infection, and be expensive. Suturing can also be difficult and can make certain tenuous situations worse, as in the case of creating conjunctival tears and buttonholes in eyes with thin or attenuated conjunctiva.

Adhesives, in comparison, can enhance some aspects of traditional glaucoma surgery and lead to shorter operating times with the potential for reduced costs and improved comfort for the patient. Although not applicable to all procedures, there are stages in many surgeries that are amenable to using glues and adhesives as suture alternatives. Sealants fuse holes and stop flow for extended periods of time, preventing or repairing wound leaks. It is important to note, however, that none of these surgical tools is approved for use in ophthalmic surgery.

ADHESIVES IN GLAUCOMA SURGERY

The most commonly used adhesive in ophthalmic surgery is fibrin glue, the first report of which was autologous fibrin glue several decades ago.1 Ophthalmic applications include conjunctival closure after retinal surgery, strabismus, oculoplastics procedures, epikeratophakia, pterygium surgery, autologous grafts, amniotic membrane grafts, and corneal applications to prevent epithelial ingrowth. For glaucoma surgery, fibrin glue has been used to repair bleb leaks, secure patch grafts, and close the conjunctiva after glaucoma drainage device procedures. The role of fibrin glue in these procedures varies depending on the circumstance. It can be used alone or to enhance procedures in conjunction with traditional suturing techniques. Fibrin glue can temporally seal holes, secure tissue or devices into place, or most commonly, help tissues to adhere to one another.

APPLICATIONS FOR FIBRIN GLUE

There are two commercially available fibrin glues for use in the United States (Tisseel [Baxter Biosurgery] and Evicel [Johnson & Johnson]). These materials were originally developed as adjuncts to traditional surgical techniques for abdominal surgery and are indicated as an adjunct for hemostasis as well. These fibrin glues are available in a premixed form as well as the traditional two-component system and come in 2-, 4-, and 10-mL syringes that can be delivered to the surgical site through a common syringe and needle system, as individual components, or as a spray.

Drainage Device Surgery

I most commonly use fibrin glue when implanting glaucoma drainage devices, including the Ahmed Glaucoma Valve (New World Medical, Inc.), the Baerveldt glaucoma implant (Abbot Medical Optics Inc.), and the Molteno Implant (Molteno Ophthalmic Limited). The fibrin glue is useful for securing the device’s plate into place, which will remain for several days if it is undisturbed.

In glaucoma drainage device procedures, fibrin glue is even more helpful for securing patch grafts over tubes. I have used all of the available fibrin glues with a number of tissues including sclera, pericardium, cornea, fascia, and KeraSys (IOP Ophthalmics) for this application. Due to the glues’ ability to secure the patch graft material into place, I have not had to use sutures at this stage of the procedure for many years.
Fibrin glues are optimally suited for use on the eye in conjunctival closure. In glaucoma drainage device surgery, the glue effectively creates a secure and anatomically optimal closure of the conjunctiva. The fibrin glue is typically placed over the patch graft material and sclera, and the conjunctiva is placed over the area and pressed into position as the final step in the case.

**Revision Procedures and Other Uses**

Fibrin glue can be a great help in revising prior glaucoma procedures in which exposure, leaks, or other anatomical issues have developed. For example, I have placed amniotic membrane grafts to cover areas of exposure after proper coverage or tube repositioning is performed. The glue can also be helpful in placing patch grafts over areas of scleral thinning in which there is a risk of suturing thin or ischemic scleral flaps. Another use of fibrin glue is in positioning the conjunctiva before suturing by keeping it in the desired anatomical position and minimizing pulling or tearing in situations where it may be compromised or of poor quality. Applying fibrin glue over sutures can help with a temporary decrease of flow and can improve patients' comfort in the immediate postoperative period.

Other glaucoma procedures amenable to sealant use are those involving the conjunctiva and sclera. I use fibrin glue in canaloplasty procedures to minimize the use of sutures and to aid in positioning the conjunctiva. Once cannulation and suture placement in Schlemm canal are complete, I use fibrin glue to close the overlying scleral flap and limit flow. The conjunctiva can also be secured into place with the fibrin glue, and sutures are sometimes used to secure the conjunctiva or the sclera if necessary.

In cases in which I have performed a vitrectomy through the pars plana to clean up vitreous, treat malignant glaucoma, or facilitate an endoscopic cyclophotocoagulation-plus procedure, I use fibrin glue to close the conjunctival incision. If only a 25-gauge vitrector has been used, I apply fibrin glue over the sclerostomy without suturing; if the sclerostomy was enlarged for endoscopic cyclophotocoagulation, however, then I will apply the glue after I suture the sclerostomy.

I have also used fibrin glue in conjunction with the placement of an Ex-Press Glaucoma Filtration Device (Alcon Laboratories, Inc.). This surgical situation is different from the others I have described because of the potential and desire for higher flow rates of aqueous from the eye. Depending on the case, if appropriate, I use fibrin glue to achieve closure or flow stoppage until natural healing takes place. If flow cannot be tolerated for several days, then fibrin glue can be used to close and position the conjunctiva in place after the scleral flap is made watertight with the intent to open the flap with suture lysis after several days when the conjunctiva has begun to heal. If flow needs to be halted for a day or so, then the conjunctiva can be closed in a watertight fashion, and the fibrin glue can be used to seal the scleral flap with or without sutures and allow the healing process to begin.

**SEALANTS**

The use of biologic sealants is risky. Because most forms are made from human plasma, there is a danger of infectious disease such as Creutzfeldt-Jakob disease. Fibrin glues also contain aprotinin, from which allergic reactions can develop.

In cases in which there are leaks through scleral or other tissue, I have used materials that act more like true sealants. DuraSeal (Confluent Surgical) is used for sealing cerebrospinal leaks and can be helpful for sealing leaks on the eye. Another sealant, ReSure Adherent Ocular Bandage (Ocular Therapeutix, Inc.), which is being investigated by the FDA as an adjunct to cataract surgery, is a polyethylene glycol-based hydrogel that is applied as a liquid and then gels to form a barrier on the ocular surface. It needs to be applied to a dry surface, but the gel will penetrate tissue to fill gaps and defects. I have used these materials to close leaks when other measures have failed.

It is important to understand the physical properties of fibrin glue and other sealants in order for them to perform optimally. Fibrin glue only remains in place for a couple of days underneath the conjunctiva and only for a day on the ocular surface. For most routine procedures with an uncompromised conjunctiva, this amount of time is more than adequate to keep tissue in place. Also, fibrin glue does not have much tensile strength, meaning it will not tolerate forceful movement or tension and can easily be displaced.

**PEARLS FOR SUCCESS**

For ophthalmic surgeons who are new to using fibrin glue, there are several points to consider in the setting of glaucoma surgery. I recommend using it first in glaucoma drainage device surgery to secure patch graft material over the tubes, which is low risk. I would also recommend applying the fibrin glue as two separate components—the thrombin and the plasminogen. If they are applied through a common syringe or needle, there can be polymerization in the tube, and only one component may come out, the result of which may be a lack of effective tissue adhesion. The surgeon can apply the components with a cannula that often
comes with the fibrin glue, a needle if smaller volumes are desired, or without any extension of the syringe, if larger volumes are desired. As a general rule, however, less is better.

I typically apply the thrombin (Figure 1) to the eye’s surface and then the fibrinogen, which is much more viscous. I lift the patch graft with a forceps after confirming the final desired position. I use just enough of each component to create a thin layer over the desired tissue. The tissue should be prepositioned and pushed onto the glue, which begins to set (15-20 seconds to set) after the two components come into contact with each other (Figure 2). Diluting the components can extend the working time, but the result can be unpredictable and is not usually necessary with a little practice.

The patch graft can be tested gently. If placement is not optimal, the surgeon can pull the glue off and reapply it without difficulty. It is important to apply downward pressure to ensure that there is tissue-tissue’s contact. I use forceps, the back of a Weck-Cel sponge (Beaver-Visitec International), or even the syringe tip to improve contact. Once the tissue is in a good position, care should be taken not to move it, or the bond will be broken and the glue dislodged. The surgeon can trim off any excess glue with scissors; the adhesive should not be pulled, or it will dislodge. Also, when the lid speculum is removed, care should be taken to ensure that there is no excess glue sticking to it, or this, too could dislodge the fibrin glue.

**COST AND BENEFIT**

The material costs of sealants and adhesives tend to be higher than for sutures. Sutures generally cost approximately $20 per pack, whereas fibrin glue costs a little more than $100 for a smaller syringe kit. The most compelling argument for the use of sealants and adhesives is the savings in OR time. In a review of cases at my practice, operating times have been reduced by 5 to 15 minutes for glaucoma drainage device procedures. Operating time in a hospital setting can be as high as $50 per minute. We have successfully instituted these agents’ use in all types of OR situations, including standalone and hospital-based ambulatory surgery centers and university, community, and Veterans hospitals. In each setting, the savings in time justified the increased material costs.

**CONCLUSION**

Glues and sealants are very effective tools that can be used as adjuncts or replacements in glaucoma surgery. Their use can facilitate surgery, reduce operating times, and improve healing and comfort for the patient after surgery. By helping to minimize some of the more tedious steps and complications of glaucoma surgery, our current procedures can be made both more surgeon and patient friendly.

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