

# Applications of Tissue Adhesives in Anterior Segment Surgery

The future of ophthalmic sealants looks bright.

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Achieving the highest degree of wound integrity is an important goal in any cataract, corneal, or refractive surgery procedure. Delays or disruptions in an incision's closure increase the risk for complications, including infection, inflammation, hypotony, epithelial ingrowth, and astigmatism. The disadvantages of sutures, the conventional method for repairing corneal and conjunctival wounds, include tissue trauma, irregular healing, astigmatism, providing a nidus for infection, scarring, and the need for their removal. Interest is growing in the off-label use of cyanoacrylate and fibrin-based adhesives to close incisions as a safe and effective alternative to sutures. Adhesives offer the added advantages of decreased operative time, easy application, increased comfort for patients, biodegradability, and a potentially better seal. This article reviews the uses of presently available cyanoacrylate and fibrin-based adhesives and discusses the potential role of some newer materials.

## CYANOACRYLATE GLUE

A standard in corneal wound repair, cyanoacrylate glue is used most often to address corneal perforations, although it has also been studied for sealing clear corneal incisions after routine cataract surgery.<sup>1</sup> The glue typically consists of octyl-, isobutyl- or n-butyl-cyanoacrylate derivatives. Because cheaper preparations such as Isodent are no longer manufactured, surgeons now must use alternative preparations such as Dermabond (Ethicon, Inc., Somerville, NJ), which is widely available in ERs and acute care facilities for closing wounds of the skin.

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Cyanoacrylate glue is drawn up in a pipette or syringe, and a small amount of the adhesive is applied to the area of perforation after the surface is dried. Polymerization occurs very quickly and typically leaves a brittle, opaque mound of glue that often requires a bandage contact lens to improve patients' comfort during lid closure. Alternatively, surgeons can use a specially designed applicator to wipe another formulation of cyanoacrylate glue (Liquid Band-Aid; Ethicon, Inc.) directly onto a cataract incision to improve its closure.<sup>1</sup> Tissue heals beneath the layer of glue, which is eventually extruded.

Although effective in some respects, cyanoacrylate glue has its limitations. Its effectiveness decreases on moist surfaces, and the application process is cumbersome. In addition, the adhesive has unfavorable mechanical properties (stiff, brittle consistency) and is potentially toxic to the surrounding ocular structures.

## FIBRIN GLUE

Fibrin glue has many potential uses in ophthalmic surgery, including—but not limited to—pterygium

excision with conjunctival autograft/amniotic membrane graft, lamellar keratoplasty, and the treatment of epithelial ingrowth after LASIK.<sup>2-4</sup> Products such as Tisseel (Baxter, Inc., Deerfield, IL) and Eviceal (Ethicon, Inc.) consist of two components: fibrinogen and thrombin. Upon contact, the thrombin converts fibrinogen to fibrin by an enzymatic reaction, and a fibrin clot starts to form within 60 seconds.

In pterygium excision, the surgeon can use fibrin glue to secure a conjunctival autograft or amniotic membrane graft to the bare scleral bed without the need for sutures. Key to success is ensuring that the scleral bed is dry before placing the fibrin component. The thrombin portion is applied to the stromal side of the conjunctival/amniotic membrane graft, which is then placed onto the bare scleral bed so that the two components can combine to form a solid coagulum in 5 to 8 minutes. Not using sutures to secure the graft markedly decreases operative time and enhances patients' comfort and satisfaction.

Lamellar keratoplasty is a partial corneal transplant technique that offers many advantages over traditional full-thickness penetrating keratoplasty, including a lower incidence of endothelial graft rejection. Lamellar keratoplasty also avoids iris prolapse, synechiae formation, endophthalmitis, and suprachoroidal hemorrhage. Surgeons can use fibrin glue instead of sutures to secure the anterior donor graft to the recipient bed. First, the ophthalmologist dries the stromal bed and covers it with the fibrin component. Next, he or she dries the stromal surface of the donor cap and covers it with the thrombin component. Then, the surgeon places the donor cap on the recipient bed with enough pressure to squeeze out any excess adhesive, and the two components then combine to form a clot as described earlier. Again, the major advantages of fibrin glue over sutures include patients' greater comfort and decreased procedural time. Studies have shown that using fibrin glue with this surgical procedure has resulted in good graft adherence and healing, retention of corneal clarity, and refractive outcomes dependent on underlying astigmatism and visual potential.<sup>4,5</sup>

Epithelial ingrowth is a potentially devastating complication following LASIK surgery. Fibrin glue can help to prevent its recurrence. The surgeon lifts the flap's edge and uses a spatula to scrape the stromal bed and the underside of the flap to remove all epithelial cells. A key step is to manually debride the epithelium off the peripheral cornea outside the flap's edge, frequently the source of recurrent epithelial ingrowth. After irrigating the interface with balanced salt solution, the surgeon replaces and repositions the flap and allows it to dry for

2 to 3 minutes. The two components of the fibrin adhesive can then be applied together (using the supplied dual-barrelled syringe) or separately, as described earlier, along the flap's edge.<sup>6</sup>

The cost of fibrin glue is greater than of standard sutures. Adhesives decrease operative time, however, by avoiding suturing and produce similar outcomes. The required volume of each component of the glue is typically very small compared with the volume given in the original packaging. Using the glue for multiple procedures reduces its cost. Surgeons who routinely employ fibrin glue in anterior segment surgery may divide the primary vial into individual sterile vials to use for each case.

## THE HORIZON

The next challenge is to develop a product specifically for ophthalmic surgery. Dendritic polymers and other hydrogels hold promise,<sup>7-10</sup> and OcuSeal (BD, Franklin Lakes, NJ) and iZip (iTherapeutix, Inc., Waltham, MA) have been developed specifically for ophthalmic application. The results of their clinical trials are pending. In the meantime, ophthalmologists can use currently available adhesives in an effort to improve surgical outcomes. ■

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