Journal of Glaucoma
5:367–370, Lippincott–Raven Publishers, Philadelphia

Fibrin Glue: An Alternative Method of Wound Closure in Glaucoma Surgery

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Summary:

Purpose and Methods: A commercially available tissue glue has been used to effect conjunctival wound closure after trabeculectomy. In four cases it was used in conjunction with sutures and in two cases alone to achieve watertight closure of the conjunctiva. A small transient leak was noted postoperatively in one case, and no case of flat anterior chamber occurred.

Results and Conclusion: Intraocular pressure was controlled in all cases 3 months postoperatively. Tissue glue can be an effective method of achieving conjunctival wound closure in glaucoma surgery.

Key Words: Tissue glue—Watertight wound closure in glaucoma—Aprotinin—Thrombin—Fibrinogen.

Some of the most serious complications of trabeculectomy can be directly attributed to poor conjunctival wound closure with leakage of aqueous fluid. Shallow or flat anterior chamber with formation of peripheral anterior synechiae, choroidal detachments, and occasionally corneal-lens touch can damage vision and impair the long-term aim of good intraocular pressure control (1). Secure conjunctival closure would largely eliminate these complications but is sometimes not achieved by using sutures such as absorbable vicryl or nonabsorbable nylon. A commercially available tissue glue (Tisseel) has been used in six cases of trabeculectomy to give a smooth and continuous conjunctival wound seal.

This tissue glue is a mixture of freeze-dried fibrinogen and aprotinin, which is easy to apply and sets in a clear firm but slightly pliable manner.

METHODS

Six cases of trabeculectomy were included in this study. Standard trabeculectomy was performed in all cases for inadequate intraocular pressure control in high-pressure glaucoma. In two cases, the trabeculectomies were repeat procedures, where the first drainage operation had failed. Four cases had limbal-based conjunctival wounds, and the others had fornix-based flaps. After the scleral flap was closed with 10/0 nylon sutures, a layer of Healon was placed over the posterior aspect of the scleral flap to prevent the tissue glue from sealing the flap down (Fig. 1).

The tissue glue was then applied in two steps along the length of the conjunctival wound. First the fibrinogen solution was applied and then the thrombin solution (Fig. 2). Then two forceps were used to place and firmly hold down the conjunctiva in the desired position for at least 2 min until the glue had set (Fig. 3). If sutures were also used to close the wound, these were inserted first (in all cases 8/0 vicryl) and the tissue glue then applied to the wound. Subconjunctival injections of gentamicin and betamethasone were then given in all cases.

TISSUE GLUE

Tissue glue (Tisseel) comes in kit form, which is reconstituted when required for use (2). It consists of a

Received January 15, 1996; accepted May 1, 1996
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FIG. 1. Fornix-based conjunctival flap with scleral flap sutured.

biological two-component sealant. Lyophilised fibrinogen is reconstituted in aprotinin solution to give the first component. Lyophilised thrombin is reconstituted in calcium chloride solution to give the second component. Both vials are warmed before reconstitution to 37°C using a water bath and are kept at that temperature until used. The two components are either premixed in a double chamber syringe or applied one after the other directly to the tissues (see Methods).

There are two strengths of thrombin available in the Tisseel kit. If Thrombin 500 Solution is used, the glue sets in seconds of addition of the thrombin. If Thrombin 4 Solution is used, the glue sets ~60 s after addition. In all these cases, the Thrombin 4 Solution was used to allow time for approximation of the conjunctival edges.

Tisseel sets to form a clear elastic rubber-like mass that firmly adheres to tissues. The glue attains 70% of its ultimate strength after 10 min and 100% strength after 2 h. The process simulates features of the physiological coagulation process.

As wound healing proceeds, the solidified fibrin glue is completely absorbed. Fibrinolysis is delayed by Aprotinin. The standard recommended dose of Aprotinin is 300 KU/ml, and this was used in all our cases. If more rapid reabsorption had been desired, the Aprotinin solution could have been diluted at the time of reconstituting the glue.

All plasma units used for manufacture are ALT tested and are nonreactive in tests for hepatitis B surface antigen (HBs Ag) as well as for HIV 1, HIV 2, and HCV antibodies. To further reduce the risk of viral transmission, steam treatment under product-specific conditions is carried out.

RESULTS

A total of six trabeculectomies were included in the series. Six consecutive cases were performed. Two cases had fornix-based flaps, and four had limbal-based conjunctival flaps. The four limbal-based flaps and glue plus

FIG. 2. Application of tissue glue to allow closure of conjunctival wound. Tissue glue is kept away from posterior edge of scleral flap.

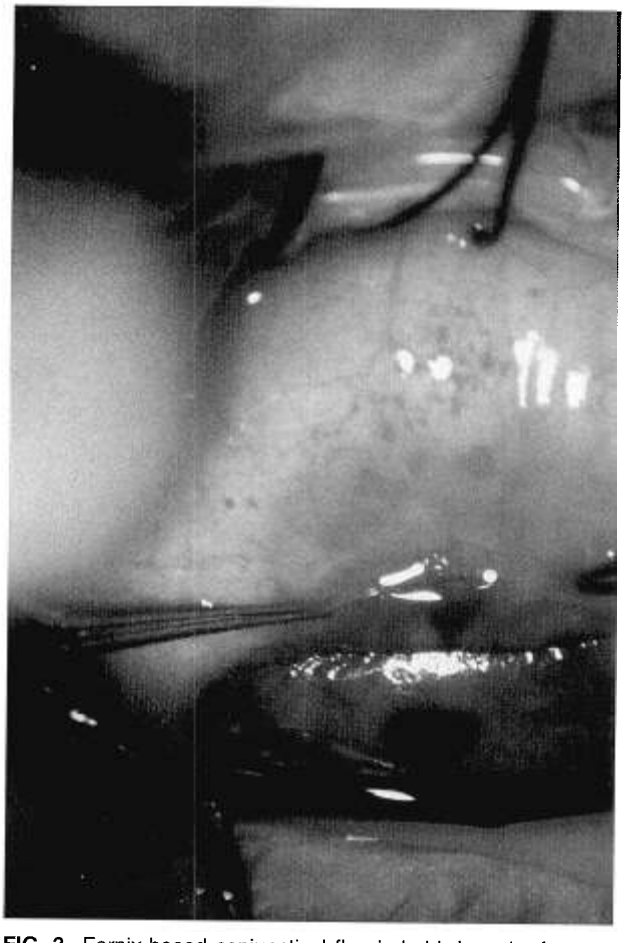

FIG. 3. Fornix-based conjunctival flap is held down by forceps until tissue glue has set. In this case, no sutures were used to close conjunctiva.

interrupted sutures used to close the wounds. In the two fornix-based flaps, glue alone was used to close the wounds.

All wounds were water tight on the first postoperative day with good depth anterior chambers in intraocular pressures of 6–22 mm Hg. In one case where tissue glue alone was used, the patient was found to have a slow intermittent leak from under the conjunctiva at the first postoperative visit (5 days postoperatively). The patient recounted rubbing his eye and noticing watering afterwards. Despite this small leak, the anterior chamber retained good depth, the intraocular pressure was 20 mm Hg, and there was no gross dihescence of the conjunctival wound on slit-lamp examination. This Seidel positive wound sealed over by the 12th postoperative day without any additional measures.

The wounds all healed without further leakage, and with a mean follow-up of 4 months (range, 2–7 months) the conjunctival wounds are intact. The tissue glue is almost undetectable on slit-lamp examination as it is clear or slightly white in color. It is therefore not possible to be exact as to when fibrinolysis is complete. Unlike cyanocacrylate, Tisseel glue is smooth and no discomfort was felt by any of the patients. The two cases that had no sutures to the conjunctiva were remarkable for the uninflammed appearance of the blebs.

DISCUSSION

Tisseel glue has been used in several other human sites where secure wound healing is required. In both neurosurgical and cardiological procedures, it has been used effectively where sutures are inappropriate (3,4). This glue has also been used with success in corneal surgery, where it has been used to seal epikeratophakia and to close breaks in anterior and posterior lens capsule perforations (5,6). Thus, it is not unreasonable to suppose that it would effect conjunctival closure.

Sutures have distinct disadvantages in closure of the conjunctival trabeculectomy flap. Vicryl sutures may loosen after a few days unless many throws are used in tying the knots; this in turn may precipitate a late onset leak. Nylon sutures last longer but may cut through the conjunctiva on occasion. Both types of suture material are "foreign bodies" and excite an inflammatory reaction. Tissue glue is attractive theoretically as it mimics physiological sealing processes. Furthermore, it allows a smooth seal along the entire length of the wound edges. This would be an advantage with fornix-based flaps, where so often a leak appears to come from under an apparently adequately sutured flap.

This report has shown that Tisseel glue can work to close conjunctival flaps both in conjunction with sutures and alone. Also, by using a viscoelastic layer to protect the opening of the scleral flap, it is possible to avoid the risk of Tisseel glue closing the internal fistula.

An equally important issue is whether Tisseel glue is safe. The fibrinogen component is prepared from pooled plasma products. Although the manufacturer states that all units are ALT tested and steam treated, the use of pooled plasma products is not approved by the Health and Safety Authority. Therefore, Tisseel glue can only be used on a named patient basis (2). Although all batches have tested negative for HIV 1 and 2, HCV, and HBs Ag, there will always be a limit to the detection powers of such assays (7). One alternative is to consider preparing autologous fibrinogen, which would avoid the risk of transmission of infection (8).

Finally, the limits of tensile strength of Tisseel glue in this particular situation have not been determined. We cannot say whether Tisseel glue is stronger or indeed

longer lasting than nylon sutures. It is highly likely that Tisseel glue provides support for a longer time to the conjunctival wound than absorbable sutures. Further clinical studies and laboratory-based models would be necessary to answer these questions. However, Tisseel glue does offer theoretical and practical attractions in the effective closure of the conjunctiva in glaucoma surgery.

Acknowledgment: We have no proprietary interest in the product Tisseel.

REFERENCES

1. Watson PG, Jakeman C, Ozturk M, Barnett MF, Barnett F, Khaw KT. The complications of trabeculectomy: a 20-year follow-up. *Eye* 1990;4:425–38.
2. *Tisseel Kit: two-component fibrin sealant heat treated.* Wien, Austria: Immuno AG, 1993.
3. Palazzi S. The use of fibrin sealant in nerve adhesion (peripheral nerve and plexus bracialis). In: Schlag G, Redl H, eds. *Fibrin sealant in operative medicine: ophthalmology neurosurgery, vol. 2.* Berlin: Springer Verlag, 1986:168–71.
4. Mozillo N, Quarto G, Ottaviano A, Formato A, Molino C. Uso della colla di fibrina in 8 casi di T.E.A. con o senza patches. *Min Chir* 1986;41:571–3.
5. Rostron CK, Brittain GPH, Morton DB, Rees JE. Experimental epikeratophakia with biological adhesive. *Arch Ophthalmol* 1988; 106:1103–6.
6. Buschmann W. Fibrin sealant in the treatment of perforating injuries of the anterior and posterior lens capsule. In: Schlag G, Redl H, eds. *Fibrin sealant in operative medicine: ophthalmology neurosurgery, vol. 2.* Berlin: Springer Verlag, 1986.
7. Hildebrant CM, Gomperts ED, Kasper KC, et al. Evaluation of two viral inactivation methods for the preparation of safer factor VIII and factor IX concentrates. *Transfusion* 1985;25:510–5.
8. Gestring GF, Lerner R. Autologus fibrinogen for tissue adhesion, hemostasis and embolization. *Vasc Surg* 1983;17:294–304.