Closure of Mucosal Defects Over Exposed Mandibular Plates Using Fibrin Glue

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Background: Mandibular plates may become exposed following radiation therapy, infection, and mucosal necrosis. This may lead to early removal of the mandibular plates with subsequent instability of bone fragments.

Objective: To compare fibrin glue, a bioadhesive, with traditional sutures in closing mucosa over exposed mandibular plates in a cat.

Design: Prospective matched-pairs analysis.

Subjects: Nine cats were used, and each cat served as its own control.

Intervention: Bilateral mandibular plates were fixed on the buccal side of the mandible of 9 cats. The surgical defects over the plates were left uncovered. After 4 days, the plates on the right side were covered with a mucosal graft fastened with fibrin glue, and on the left side the grafts were secured with sutures. After 10 days, the grafts were excised and a histological examination was performed.

Results: The mean operative time for coverage was 2 minutes 11 seconds for the fibrin glue and 12 minutes 48 seconds for the sutures ($P<.001$). Gross examination revealed granulation or ulceration in 3 of the fibrin and 9 of the suture specimens ($P<.005$). All specimens displayed mild-to-moderate acute and chronic inflammation. All sutured specimens showed focal foreign body-type giant cells surrounding fragments of bone and suture. Two mandibular plates were partially exposed on the fibrin glue side.

Conclusions: The use of fibrin glue to cover exposed mandibular plates is safe and well tolerated in cats. Glue application requires a shorter operative time and is associated with fewer occurrences of granulation and ulceration when compared with suture fixation. Further studies are indicated to titrate the concentration of fibrin glue and to prevent plate exposure.

Arch Facial Plast Surg. 1999;1:191-194

RESULTS

The operative time for the control (suture) group ranged from 9 minutes 51 seconds to 17 minutes 19 seconds. The mean operative time was 12 minutes 48 seconds ($\pm 1$ minute 37 seconds). In the experimental group, the operative time ranged from 1 minute 24 seconds to 4 minutes 3 seconds. The mean operative time for the fibrin glue was 2 minutes 11 seconds ($\pm 48$ seconds). The difference between the mean operative time of the experimental and the control group was statistically significant ($P<.001$) and Figure 1 displays these results. As the grafts were removed from the mandibular plates, it was noted that the grafts on the suture side were removed easily with the presence of a cleavage plane between the graft and the plate. On the experimental side, however, the grafts were firmly attached to the surrounding tissue as well as to the plate. No cleavage plane
MATERIALS AND METHODS

STUDY DESIGN

A prospective matched-pairs design of 9 cats was used for this study. Each cat served as its own control. Guidelines of the Advisory Committee for Animal Resources at our institution were strictly followed. The animals were not killed at the completion of this study.

MATERIAL

Fibrin glue is a bioadhesive composed of a mixture of bovine thrombin (Thrombin; Johnson & Johnson, Arlington, Tex) and bank cryoprecipitate. A vial of 20 000 U of thrombin was diluted in 20 mL of isotonic sodium chloride solution, giving a concentration of 1000 U/mL. One milliliter of thrombin was then mixed with 1 mL of cryoprecipitate, giving 2 mL of fibrin glue. The 2 components were mixed 10 seconds before application to the mandibular plates to avoid clogging of the syringe.

PROCEDURE

The surgical procedure was performed under general endotracheal anesthesia, using strict sterile conditions. On day 1, a mucosal defect was created on the buccal side of the mandible bilaterally. A 3-hole 1.5-mm titanium plate (Synthes Maxillofacial, Paoli, Pa) was fastened to the exposed mandible on both sides. The surgical defects over the plates were left uncovered. On day 4, 2 full-thickness mucosal grafts were harvested from the buccal mucosa of each cat. The donor sites were left to heal by secondary intention. On the control side, the mucosal graft was laid on the mandibular plate and sutured to the surrounding tissue using 5.0 polypropylene interrupted sutures. Nonabsorbable sutures were used instead of chronic catgut sutures to avoid rapid breakdown caused by motion of the animal’s tongue. On the experimental side, the mucosal graft was fixed to the surrounding tissue using fibrin glue in the following manner. Two milliliters of fibrin glue was initially laid directly on the mandibular plate. The mucosal graft was then placed on top of the gel coat formed by the fibrin glue. A second gel coat of fibrin glue (2 mL) was then placed over the mucosal graft. This “sandwich,” formed by the 2 layers of fibrin glue and the mucosal graft, was left to air dry for 10 minutes before the cat was awakened from general anesthesia. On day 10, the mucosal grafts on the control sides were removed from the plates by cutting the sutures. On the experimental sides, the mucosal grafts were peeled off the plates. During the entire study period, the cats were fed a soft diet.

HISTOPATHOLOGICAL ANALYSIS

The specimens were sent to the laboratory at the Tulane University Department of Pathology. They were stained with hematoxylin-eosin. Both gross and microscopic examination were performed on all specimens.

STATISTICAL ANALYSIS

All data were coded and recorded into the SPSS 6.1.1 statistical package for the Macintosh (SPSS Inc, Chicago, Ill). A paired sample t test was used to compare the mean operative times between groups. The chi-square test was used to evaluate statistical significance for categorical data. Due to the small sample size, nonparametric methods were used to confirm statistical significance on all tests.

Figure 1. Mean operative time for suture and fibrin glue sides.

was noted on the fibrin glue side (Figure 2), and it was necessary to use a scalpel to detach the grafts from the underlying tissue. Gross examination of the grafts revealed granulation tissue and/or ulceration in all the specimens on the suture side. On the experimental side, only 3 specimens had evidence of granulation and/or ulceration (Figure 3). The presence of granulation and/or ulceration was statistically different between groups (P<.005). On microscopic examination, all specimens from both sides were viable with normal vasculature identified. All had evidence of focal, mild-to-moderate acute and chronic inflammation. A focal foreign body–type giant cell infiltrate was seen surrounding the grafts on the suture side only. No such reaction was found on the experimental side. On day 10, 2 plates on the fibrin glue side were partially exposed.

Fibrin glue is a bioadhesive substance that mirrors the final common pathway of the normal coagulation cascade. When fibrinogen is mixed with thrombin, a loose monomeric fibrin develops. The presence of factor XII and calcium causes monomeric fibrin to form cross-links and become tight mesh, polymeric fibrin: the fibrin-glue clot. Aside from its adhesive property, fibrin glue has been found to enhance wound healing. In the first days of wound healing, inflammatory cells and fibroblasts infiltrate the fibrin clot. The inflammatory cells release proteolytic and fibrinolytic enzymes, which are responsible for lysis of the clot. The fibroblasts then deposit collagen that converts the clot into an organized scar.

The hemostatic effect of fibrin powder was first discovered in 1909 by Bergel. Young and Medawar were...
the first to test the property of this substance as a tissue sealant. They combined fibrinogen dissolved in plasma with chicken-embryo extract to develop a powerful clotting agent. The mixture was used to successfully approximate the stumps of a cut sciatic nerve in a rabbit and a dog. Since then fibrin glue has been used for various purposes in the fields of neurosurgery, otolaryngology, general surgery, plastic surgery, and maxillofacial surgery.

Depondt and colleagues used fibrin glue to assist with closure after parotidectomy. They reported fewer postoperative hematomas in the fibrin glue group when compared with a nonfibrin glue group (6% vs 18%; \( P > .05 \)). They also reported no flap necrosis in the fibrin glue group when compared with the suture group (0% vs 3%; \( P > .05 \)). Resorbable subcuticular sutures and subcutaneous skin sutures were used in their investigation, making a true glue-suture evaluation difficult. Similarly, Kulber and colleagues reported a decrease in the rate of flap necrosis after parotidectomy from 80% to 10% using fibrin glue as a sealant. Kang and coworkers measured the operative time using fibrin glue to stabilize a cartilage graft for laryngotracheal reconstruction. Fibrin glue stabilized the graft within 30 seconds as compared with an average of 10 minutes when using sutures. They also performed a complete histological evaluation of mucosal growth over the graft. Sixty-five percent of the 20 fibrin sealant specimens had complete coverage as compared with 15% of the 20 suture specimens (\( P < .05 \)). Saltz et al used fibrin glue to secure skin grafts on burn victims. They reported better functional and cosmetic results with decreased blood loss and enhanced graft survival in patients whose grafts were secured with fibrin glue.

In our investigation, fibrin glue successfully closed the mucosal defects over exposed mandibular plates in 7 of 9 cats. The use of fibrin glue was quick, well tolerated, and associated with less granulation and ulceration than the utilization of sutures. The exact concentration of fibrin glue (ratio of fibrinogen to thrombin) has yet to be determined. Two plates at the end of our investigation were partially exposed. We hypothe-
esize that this was due to an inadequate concentration of fibrin glue. To our knowledge, no studies using fibrin glue on titanium mandibular plates have been performed, and, consequently, the concentration we used was empiric and probably weak. The cost for fibrin glue is higher than the use of sutures, but the preparation time is less.

To our knowledge, the use of free mucosal graft to cover exposed plates has not been reported. Advantages of free mucosal grafts are several: easy to harvest and manipulate, little donor site morbidity, and readily available in the oral cavity.

CONCLUSIONS

Fibrin glue as a sealant to secure mucosal grafts on exposed mandibular plates is safe, well tolerated, and was associated with a shorter operative time in cats. Further studies are necessary to titrate the optimum concentration of fibrinogen. Considering that exposed mandibular plates are mostly a complication of radiation therapy, future studies using fibrin glue over irradiated tissue should be considered.

Accepted for publication May 28, 1999.

This research was made possible through a grant by Synthes Maxillofacial, Paoli, Pa.


The authors thank William H. Robichaux, MD, Department of Pathology, for his assistance with the pathology slides.

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Quotable

Don’t forget that Pare centuries ago wrote, “We dress them, God heals them.”

Richard Farrior

ARCH FACIAL PLAST SURG/VOL 1, JULY-SEP 1999

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