The use of autologous fibrin glue for closing sinus membrane perforations during sinus lifts

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Sinus lift procedures depend greatly on fragile structures and anatomical variations. These procedures may cause sinus membrane perforations, which can lead to graft infection and early failure. The aim of this study was to assess the efficacy of autologous fibrin glue in the management of large perforations of the maxillary sinus membrane occurring during sinus lifts. After elevating the sinus membrane in the bilateral maxillary sinuses of 6 adult female mongrel dogs, a laceration (about 2.0 cm in length) was made in the membrane and either repaired with autologous fibrin glue or covered with a bioabsorbable collagen membrane as a control. Wounded areas were biopsied 2 weeks after the operation. Wounds repaired with autologous fibrin glue showed newly formed continuous epithelium across the previous perforation site. However, extensive fibrosis, inflammatory infiltration, and absent epithelium were observed in wounds treated with the collagen membrane control. Our results support the clinical use of autologous fibrin glue for repairing sinus membrane perforations. **(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;101:150-4)**

The sinus lift procedure is an internal augmentation of the maxillary sinus, and it is intended to increase the vertical bony dimension in the lateral maxilla in order to facilitate the use of dental implants. The classical sinus lift operation consists of the preparation of a superiorally hinged door in the lateral maxillary sinus wall.[1,2] This door is luxated inward and upward together with the sinus membrane to a horizontal position, thus forming the new sinus base. The space underneath this lifted door and sinus mucosa is then filled with graft material.

The surgical procedure of trap door preparing and luxation, together with the preparation of the sinus mucosal, may cause mucosa perforations. As has been reported extensively in the literature,[3-6] large perforations represent an absolute contraindication to the continuation of surgery, especially if the graft material is in granules and/or chips. Such perforations may cause loss of the graft into the sinus, graft infection, and early failure of the sinus lift.[7,8] Various techniques, including the use of collagen membranes[5,7,9,10] and fibrin sealants,[11] have been proposed for managing these perforations; however, these have been reported as clinical observations without a well-defined set of success parameters or a control group.

The idea of using autologous fibrin glue for closing wounds seems attractive because it contains large numbers of platelets that release significant quantities of growth factors known to promote wound healing.[12] In addition, fibrin glue is easily applied, involves less tissue-handling and consequent trauma, and facilitates the coaptation of wounds. For these reasons, we considered autologous fibrin glue for use in sinus mucosa repair. The aim of this study was to assess the efficacy of autologous fibrin glue in the management of large perforations of the maxillary sinus membrane occurring during sinus lifts, and to compare results to using collagen membranes.

MATERIALS AND METHODS

Preparation of autologous fibrin glue

Six adult female mongrel dogs, each weighing more than 15 kg (15 to 20 kg total body weight), were used in this experiment. All surgical procedures were performed under systemic anesthesia (ketamine, 5 mg/kg, and xylazine, 2 mg/kg IM). In order to prepare the autologous fibrin glue, 20 mL of autologous blood was withdrawn prior to surgery and treated using a previously described technique.[12] Briefly, the blood was centrifuged for 15 minutes at 327*g* to separate the

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platelet rich plasma (PRP) from the blood. Platelet counts were then conducted for each dog yielding a mean PRP platelet count of 1 520 000 (with a range of 1 120 000 to 2 300 000). The fibrinogen solution was subsequently prepared using the PRP. To 7.5 mL of PRP, 240 μL of transexamic acid and 900 μL of ethanol were added, and incubated in an ice water bath for 20 to 30 minutes. The precipitated fibrinogen was separated by centrifugation at 3000*g* for 8 minutes at 0 to 4°C. After discarding the supernatant, the fibrinogen precipitate was redissolved at 37°C and then diluted to 50% with 0.9% NaCl. A thrombin solution was then prepared using the remaining PRP. Briefly, to 2.5 mL of the remaining PRP, 22.5 mL of citric acid were added, and the mixture was then centrifuged at 3000*g* for 5 minutes at 4°C. After discarding the supernatant, the precipitate was dissolved in 150 μL $CaCl_2$ (0.1 M) and the pH adjusted to 7 by adding 100 μL of $NaHCO_3$. After clot formation, the thrombin solution was collected and diluted to 10% with 0.05 M $CaCl_2$. The fibrin glue was formed by mixing the fibrinogen and thrombin solutions in a 3:1 (vol/vol) ratio. Thorn et al.[12] reported that autologous fibrin glue prepared using this technique contains high platelet and fibrinogen concentrations.

Maxillary sinus membrane perforation and repair

A flap was reflected on the buccal cortical plate, extending from the first maxillary premolar to the second maxillary molar, over both maxillary sinuses. The lateral bony wall was then removed using a round bur, and the sinus lining was carefully elevated from the floor, lateral, and the medial walls of the antrum. Care was taken during this procedure not to perforate the antral membrane. After elevating the sinus membrane in both maxillary sinuses, a laceration (about 2.0 cm in length) was made in the membrane (Fig. 1). The laceration was repaired with autologous fibrin glue on one side in each animal. When applying the fibrin glue, the edges of the membrane were manually approximated using forceps, and drops of the glue were then applied over the apposed membrane edges using a 30-gauge needle. The membrane was then held for 60 seconds to allow complete gelation at body temperature. On the other side, an identical laceration was covered with a bioabsorbable collagen membrane (CollaTape, Integra LifeSciences Corporation, Plainsboro, NJ) to form a new ceiling; this served as the study control. Subsequently, space obtained by elevating the sinus membrane on both sides was filled with deproteinized cancellous bovine bone granules (Bio-Oss, Geistlich Sons Ltd, Wolhusen, Switzerland). The fenestration of the buccal plate was subsequently closed by placing an expanded polytetrafluoroethylene (e-PTFE) membrane (GORE-TEX, W.L. Gore & Assoc, Flagstaff, Ariz) to exclude interference with soft tissue. Finally, the periosteum and mucosa flap were replaced and sutured. Wounded areas were biopsied 2 weeks after the operation for microscopic evaluation of the antral membrane. Specimens were embedded in paraffin wax, sectioned, and then stained with hematoxylin and eosin.

RESULTS

Prompt sinus membrane sealing was obtained when perforation sites were closed with autologous fibrin glue (Fig. 1). Immediately after closing the perforations, sinus air pressure began moving the maxillary sinus membrane. However, air leaks were not sealed when a collagen membrane was placed over the opening of the sinus membrane.

At the time that the specimens were harvested, no signs of infection were observed in any maxillary sinus cavity in either the autologous fibrin glue or collagen membrane sides. The graft materials placed in the space underneath the lifted sinus mucosa were contained outside the sinus lumen in all samples. On gross examination, the antral membrane appeared to have been repaired by a newly formed membrane on the autologous fibrin glue side, whereas the antral membrane appeared to have scar tissue in the wounds treated with collagen membrane.

Histological examination showed newly formed continuous epithelium across the previous perforation site on the autologous fibrin glue side. Below the epithelial layer, close to the previous perforation site, a lack of serous glands was noted because the glands had been replaced by connective tissue (Fig. 2). Autologous fibrin glue was not found around the bonded region, nor were any discernible inflammatory reactions of cytotoxic tissues observed. However, on control sides, wounds showed extensive fibrosis and complete loss of the surface epithelium. In addition, an intense inflammatory infiltrate of lymphocytes was noted. Collagen membrane fibers were incorporated into the regenerated fibrous connective tissue (Fig. 2). The histological changes noted in each treatment group were identified consistently in each animal within the respective groups.

DISCUSSION

The basic technique of suturing tissues is difficult for sinus membrane perforations because of limited access to and friability of the membrane, which may lead to large perforations during suturing. For this reason, various techniques have been examined for the purpose of developing a suture-less technique to close sinus membrane perforations.[7,9,11] At present, resorbable collagen membranes are commonly used to cover such perforations.[5,7,9,10] However, little is known about their efficacy in the management of sinus membrane