

Application of Acellular Dermal Matrix in Reconstruction of Oral Mucosal Defects in 36 Cases

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Purpose: Artificial grafts have been investigated for use in the repair of oral mucosal defects. The aim of this retrospective study was to present the outcomes of the use of acellular dermal matrix (ADM) grafts to repair oral mucosal defects.

Materials and Methods: Data from 36 patients with oral mucosal defects reconstructed with ADM grafts from 2003 through 2009 were reviewed. All patients were followed-up for at least 6 months to observe the graft repair, wound-healing time, contracture, color, infection, pain, immunologic reaction, texture of the graft, and clinical course. Graft success was defined as the ADM graft being replaced by new mucosa-like tissue and the oral mucosal defect being covered with the new mucosa-like tissue. Any evidence of incomplete graft re-epithelialization or graft sloughing was considered a graft failure (complete or incomplete).

Results: Of the 36 cases, 34 grafts (94.4%) were successfully replaced with new mucosa-like tissues and only 2 grafts (5.6%) failed. No complaints such as pain, immunologic reaction, or infection were observed during the follow-up. Mild graft contraction occurred in 7 patients with lip or buccal defects, especially at approximately 3 to 5 weeks after the reconstructive surgery.

Conclusions: The ADM grafts for oral mucosal defects were safe and effective. The present data support the clinical application of ADM grafts in reconstructing oral mucosal defects caused by various oral diseases.

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Tumors, trauma, oral mucosal diseases, preprosthetic surgery, and other conditions frequently result in oral mucosal defects, which may have a significant impact on deglutition, speech, and swallowing. The maintenance of the oral cavity lining, tongue mobility, and sensation are crucial to the preservation of these functions.¹

Reconstructive options for mucosal defects of the oral cavity historically have included primary closure,

mucosal grafts, split-thickness skin grafts (STSGs), and free microvascular transfer of tissues.¹

Primary closure is a good choice for small defects in a loose area of the oral cavity. However, large oral mucosal defects are difficult to repair by primary closure because the procedure may lead to limited mobility or create anatomic deformity. For limited defects, mucosal grafts or STSGs are common choices. However, these 2 methods have their disad-

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vantages. Mucosal grafts are limited by the donor supply, dysfunction, unaesthetic appearance, pain, and infection at the donor and receptor sites. The STSG procedure has gained popularity owing to the ease of harvest from a distant site (usually the thigh), the large quantities of skin available for grafting, and the improved graft take resulting from the thin nature of the graft.¹ However, there is often significant contracture of the graft, which may result in decreased tongue mobility and function. Moreover, complications, including morbidity and poor esthetics at the donor site, often occur.¹ The free microvascular skin flap, with its rich vascularity permitting a high degree of versatility and reliability in design, is a useful reconstruction method for postoperative defects. Unfortunately, this method often results in complications at the donor site, including poor esthetics, morbidity, and decreased strength and sensation.²

In the previous decade, the acellular dermal matrix (ADM) has been found to have wide applications in many areas of reconstructive surgery. Investigators have suggested that the ADM might be an acceptable alternative to the criterion standard STSG for the reconstruction of mucosal defects of the small oral cavity caused by oral cancer resection surgery.³ The present retrospective study presents a review of 36 patients with oral mucosal defects who were treated with ADM grafts. With this procedure, a satisfying therapeutic effect was achieved.

Materials and Methods

GENERAL DATA

The authors reviewed the data for 36 patients treated from 2003 through 2009 for oral mucosal defects resulting from various causes. The inclusion criteria were 1) an oral mucosal defect size of at least 1 cm² in the palate or gingiva, at least 1.5 cm² in the buccal mucosa or the dorsum of the tongue or lip, or at least 2 cm² in the margin of tongue or vestibular groove; 2) no inflammation, erosion, or infiltration; and 3) at least 18 years old. The exclusion criteria were 1) preoperative radiotherapy or chemotherapy; 2) an oral mucosal defect size smaller than 1 cm² in the palate or gingiva, smaller than 1.5 cm² in the buccal mucosa or the dorsum of the tongue or lip, or smaller than 2 cm² in the margin of the tongue or vestibular groove; 3) inflammation, erosion, or infiltration; and 4) younger than 18 years old. All oral mucosal defects were repaired with ADM grafts at the Department of Oral and Maxillofacial Surgery, Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine. The study was approved by the institutional review board of Shanghai Ninth People's Hospital (201142), and written informed consent was obtained from all patients.

ACELLULAR DERMAL MATRIX

The human ADM (AlloDerm) was obtained from Beijing Qinyuan Weiye Biologic Tissue Engineering Science and Technology Ltd Co (Beijing, China; authorized number, 04-3460736). The size of the ADM patches ranged from 1 × 1 to 4 × 5 cm.

SURGERY

All patients underwent routine diagnostic evaluation before proceeding to surgical resection of the oral lesions. The surgeries were performed under local anesthesia in the operating room. The oral lesions were removed according to the operative routine. All patients required reconstruction of significant full-thickness intraoral mucosal defects. The resulting defect was evaluated by the treating surgeon (Y.W.), and the patients who met the criteria underwent the grafting procedure with the aim of maintaining optimal postoperative oral cavity function. After rehydration for at least 30 minutes, an appropriately sized and shaped piece of ADM graft was placed directly on the basement membrane surface (the coarse side) to contact the wound and was secured with peripheral sutures. The sutures were left untrimmed to allow a bolster to be secured. A medical iodoform gauze bolster was then made to cover the graft and was secured with the peripheral sutures to securely fix the graft to the underlying tissues. This bolster was left in place for a mean of 3 to 7 days, and the sutures were removed on the seventh postoperative day. Antibiotics and antiseptic mouthwash were used to prevent infection.

POSTOPERATIVE FOLLOW-UP

The patients were required to visit the outpatient clinic on the seventh postoperative day. Further clinic visits were performed after 1, 3, and 6 months to observe the results of the graft repair. Graft success was defined as the ADM graft being replaced with new mucosa-like tissue and the oral mucosal defect being covered with new mucosa-like tissue. Any evidence of incomplete graft re-epithelialization or graft sloughing was considered graft failure (complete or incomplete). Two patients, 1 with squamous cell carcinoma and 1 with mucoepidermoid carcinoma, were followed every 3 months beyond the 6-month follow-up visit. Wound-healing time, contracture, color, infection, pain, immunologic reaction, texture of graft, and clinical course were recorded. The immunologic reaction included acute erythematous bulla formation, redness, and itching of the skin; swelling of the oral mucosa; damage to the host tissue; and destruction of the artificial graft.² Patients' complaints with regard to discomfort at the graft bed

Table 1. CLINICAL DATA AND OUTCOMES OF 36 PATIENTS

Patient No.	Age (yr)	Gender	Diagnosis	Graft Location	Graft Size (cm ²)	Graft Success	Contraction
1	45	F	Papilloma	Palate	1.5 × 1	Yes	No
2	25	M	Trauma	Gingiva	1 × 1	Yes	No
3	57	F	Fibroma	Palate	1 × 1	Yes	No
4	37	F	Maxillary sinus fistula	Palate	1 × 1	Yes	No
5	66	M	Papilloma	Palate	1.5 × 1	No	Graft failure
6	54	M	Papilloma	Palate	1 × 1	Yes	No
7	43	F	Fibroma	Palate	1 × 1	Yes	No
8	27	M	Trauma	Lower lip	1.5 × 2.5	Yes	Mild
9	49	M	Papilloma	Palate	1.5 × 1	No	Graft failure
10	46	M	Fibroma	Palate	1.5 × 1	Yes	No
11	50	F	Papilloma	Palate	1 × 1	Yes	No
12	55	M	Papilloma	Palate	1 × 1	Yes	No
13	55	F	Epulis	Gingiva	2 × 2	Yes	No
14	62	M	Papilloma	Palate	1.5 × 1	Yes	No
15	62	F	Papilloma	Palate	1 × 1	Yes	No
16	82	F	Shallow vestibular groove	Vestibular groove	2 × 3.5	Yes	No
17	47	M	Maxillary sinus fistula	Palate	1 × 1	Yes	No
18	78	M	Hyperplasia after ill-fitting denture	Lip and gingiva	4 × 5	Yes	Mild
19	50	M	Papilloma	Palate	1.5 × 1	Yes	No
20	45	F	Papilloma	Palate	1 × 1	Yes	No
21	46	F	Chronic mucositis	Buccal	1.5 × 2	Yes	Mild
22	66	M	High attachment of frenum	Buccal	2 × 2.5	Yes	Mild
23	57	M	Epulis	Gingiva	1.5 × 2.5	Yes	No
24	57	F	High attachment of frenum	Buccal	1.5 × 2.5	Yes	Mild
25	21	M	Shallow vestibular groove	Vestibular groove	2 × 3	Yes	No
26	50	F	Fibroma	Palate	1 × 1	Yes	No
27	23	F	Trauma	Gingiva	3 × 4	Yes	No
28	28	M	Trauma	Gingiva	2 × 3	Yes	No
29	54	M	SCC	Buccal	1.5 × 2	Yes	Mild
30	22	F	Trauma	Lower lip	1.5 × 2.5	Yes	Mild
31	27	F	Maxillary sinus fistula	Palate	1 × 1	Yes	No
32	62	F	Papilloma	Palate	1 × 1	Yes	No
33	54	M	Papilloma	Palate	1.5 × 1	Yes	No
34	50	M	Papilloma	Palate	1.5 × 1.5	Yes	No
35	52	F	Mucoepidermoid carcinoma	Palate	1.5 × 2.5	Yes	No
36	58	M	Papilloma	Palate	1.5 × 2.5	Yes	No

Abbreviations: F, female; M, male; SCC, squamous cell carcinoma.

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were considered evidence of pain.⁴ In addition, deglutition and sleeping quality were recorded for 5 trauma cases. All patients were assessed by the same observer (Y.W.).

Results

The patients' data and outcomes are presented in Table 1. There were 19 male and 17 female patients whose ages ranged from 21 to 82 years (mean age, 48.9 yr). Of the 36 cases reviewed in this report, 34 grafts (94.4%) were successfully replaced with new mucosa-like tissues (Figs 1 to 5) and only 2 grafts (5.6%) failed. After 6 months of follow-up, a natural-appearing mucosal surface of the ADM graft area was observed in every patient.

The clinical courses of the 34 successful cases were as follows. Twelve grafts (35.3%) were found to have a porcelain-whitish color and were attached to the wounds when the bolsters were removed. The attached grafts were soft in texture and infiltrated with red specks. The red infiltration became extensive from the 14th postoperative day, and total integration with the peripheral oral mucosa was observed subsequently. The other 22 grafts (64.7%) were found to be pink and integrated with the peripheral oral mucosa on the day when the bolsters were removed.

The 2 failed grafts were found to be pale at the first follow-up. On the 14th postoperative day, the grafts were found not to be closely attached to the palate. However, the wounds in the hard palate had healed



FIGURE 1. Upper lip and anterior upper gingival hyperplasia derived from ill-fitting denture (frontal view).

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completely at the next clinic visit, that is, 1 month after surgery.

Mild graft contraction occurred in 7 patients with lip or buccal defects, most notably at 3 to 5 weeks after reconstructive surgery. No more contraction was found until the third postoperative month. It is interesting that no graft contraction was found in the compact oral mucosa. A linear scar around the graft was found in only 3 patients. No recurrence was observed in 2 patients with oral squamous cell carcinoma and mucoepidermoid carcinoma, respectively, during the follow-up. Of all patients, including the 2 with failed grafts, no complaints such as pain, immunologic reaction, or infection were reported during the follow-up.

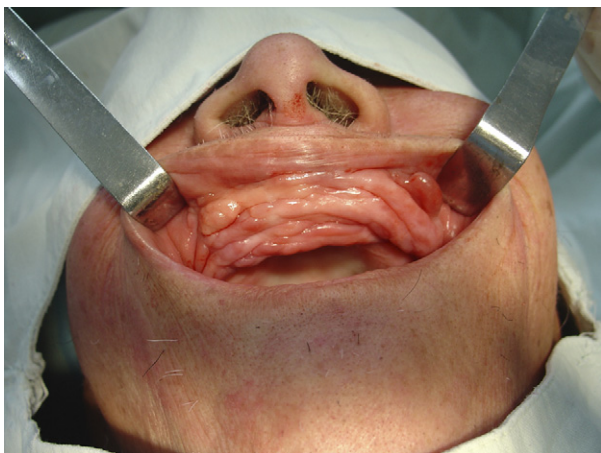


FIGURE 2. Upper lip and anterior upper gingival hyperplasia derived from ill-fitting denture (intraoral view).

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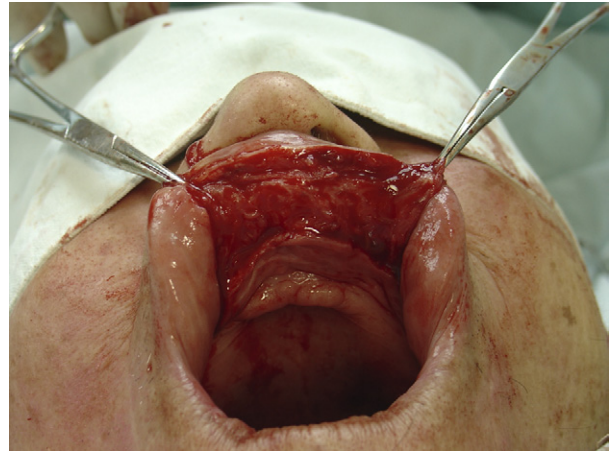


FIGURE 3. Excision of the lesion.

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For the 5 patients with defects resulting from trauma, pain was greatly relieved on the second postoperative day, and better deglutition and sleeping quality were achieved.

Discussion

Oral mucosal defects resulting from tumors, trauma, oral mucosal diseases, and preprosthetic surgery frequently represent major reconstructive challenges to oral and maxillofacial surgeons. Here, the authors present a review of 36 patients with oral mucosal defects repaired with ADM grafts. With this procedure, a satisfying therapeutic effect was achieved. The composition of the patients included in this study differed from those described by Rhee et al⁴

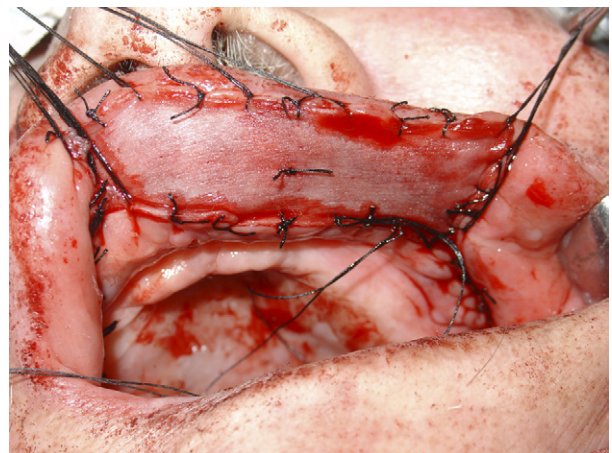


FIGURE 4. Reconstruction of mucosal defect with the acellular dermal matrix graft.

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FIGURE 5. Three weeks after surgery.

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and Girod et al¹ who focused mainly on oral mucosal defects resulting from oral cancer.

The ADM is derived from donated human skin tissue. It has a meshed structure composed of an extracellular matrix. This structure creates a suitable scaffold for epithelial cell and fibroblast infiltration and neovascularization. The retained basement membrane complex of the ADM provides for a basement membrane side and dermis side. The dermis side is beneficial for quick vascularization, whereas the basement membrane side provides a natural surface for ADM epithelialization. In the previous decade, the ADM has found wide application in many areas of reconstructive surgery, such as complex anorectal fistula repair,⁵ diabetic foot ulcers and wound treatment,^{6,7} ventral hernia repair,⁸ breast reconstruction,⁹ burn treatment,¹⁰⁻¹² and coverage of the radial forearm free flap donor site.¹³ The ADM has shown its effectiveness in preventing Frey syndrome after parotidectomy¹⁴⁻¹⁶ and in periodontal practice, including alveolar ridge augmentation,¹⁷ gingival augmentation,¹⁸ root coverage,¹⁹⁻²⁵ and alveolar ridge collapse prevention.²⁶ To date, the ADM graft has been used mainly in the reconstruction of oral mucosal defects after surgery for oral cancer.^{1,4} In the present study, most defects resulted from benign tumor resection surgery or trauma.

Previous investigators have suggested that ADM may be an acceptable alternative to the criterion standard STSG for the reconstruction of small oral cavity mucosal defects.³ Girod et al¹ compared the efficacy of the ADM with the STSG in oral cavity reconstruction for oral cancer. ADM grafting for reconstructing the oral cavity offers several advantages over STSGs, including the lack of donor site morbidity, lower cost, a natural-appearing mucosal surface, and comparable—and possibly superior—functional status. Fur-

thermore, the ADM grafts exhibited decreased inflammation, fibrosis, and keratinization compared with STSG samples in histopathologic examination.

After elimination of keratin-containing epidermis and cell elements in the dermis by freeze drying, the ADM has an acellular collagenous structure that elicits a minimal immune response.²⁷ Moreover, the 3-strand spiral structure of the collagen molecule is very stable and is associated with minimum metabolic activation.²⁷ As expected, no immunologic reactions were observed in this study.

In the present report, the ADM grafts were used to repair buccal, palate, gingival, lip, vestibular groove, and maxillary sinus mucosal defects in 36 patients. Of the 36 cases in this study, 34 grafts (94.4%) were successfully replaced with new mucosa-like tissues and only 2 grafts (5.6%) on the hard palate were sloughed. The failures may have been caused by the bolster not being tightly secured to the palate. However, the meshed ADM graft covers the exposed bone by providing a barrier, thus limiting granulation healing and decreasing discomfort. In the other denuded bone cases, graft success was achieved because enough pressure was set over the bolster to eliminate the dead cavity between the thin graft and the denuded bone. In the report by Rhee et al,⁴ 1 graft in the retromolar triangle and palate failed because of postoperative hemorrhage.

Primary closure after resection of the denture hyperplasia without reconstruction of the lip would result in complete vermilion lip introversion, which would impair the appearance and function of the upper lip and cause difficulty for the prosthodontists. In the present cohort, lip deformity was avoided by applying the ADM graft in lip reconstruction as an alternative to primary closure.

The authors succeeded in applying an ADM graft to cover the defect of the oral maxillary sinus fistula after tooth extraction in 3 patients. Compared with the traditional sliding buccal mucosal flap reconstruction, the authors' procedure displayed several potential benefits, including operation simplification, shorter surgical time, absence of a donor site wound, and an elimination of tensional sensation resulting from a shallow vestibular groove.

Graft contraction of various degrees was observed, most notably in 7 patients with lip or buccal defects. However, no obvious graft contraction was observed in the defects of the compact oral mucosa. To the authors' minds, the grafts in the lip or buccal areas contracted more than those in other areas because of the loose texture of the lip and buccal mucosa.

In conclusion, the ADM grafts for oral mucosal defects were safe and effective. The present data support the clinical application of ADM grafts in re-

constructing oral mucosal defects caused by various oral diseases.

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