

• Clinical Research •

# Application of various flaps to intraoral reconstruction of buccal defects after resection of buccal mucosa carcinoma

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**[Abstract]** **Background and Objective:** Reconstructing buccal defects with proper flaps can expand the indications of surgery, improve quality of life and prolong survival. This study was to investigate the indications for such application, the selection of different kinds of flaps and the skills of the reconstructive operation. **Methods:** From September 2005 to August 2007, 26 patients underwent reconstructive operation after resection of buccal mucosa carcinoma: eight had simple buccal mucosa resection, 11 had resection of the bucca cavioris and facial skin, seven had resection of the bucca cavioris, facial skin and angulus oris; besides, seven patients underwent parotid duct resection. As for the reconstructive operation, pectoralis major myocutaneous flap was used in five patients, free radial forearm flap in 11 patients, free anterolateral thigh flap in six patients, and sternodeiceomastoid myocutaneous flap in four patients. Eight patients received postoperative radiotherapy at 66–70 Gy. **Results:** No perioperative death occurred. Necrosis happened in one patient who used free radial forearm flap; partial necrosis in one patient who used pectoralis major myocutaneous flap. The survival rate of the flaps was 96.2%. Hydrops of the operative wound happened in one patient with salivary fistula. During the follow-up of 1–3 years, seven patients had recurrence (four had recurrence in primary lesion and three in cervical lymph nodes), two died of recurrence in primary lesion. **Conclusion:** The free anterolateral thigh flap and free radial forearm flap are suitable for reconstruction of large buccal defects, and are first-choices for defects larger than 4 cm; the pectoralis major myocutaneous flap can be applied as the second-choice flap; the sternodeiceomastoid myocutaneous flap can be used for defects smaller than 4 cm.

**Key words:** buccal mucosa neoplasm/surgical operation, flaps, buccal defect, reconstruction

Buccal mucosa carcinoma is one common malignant tumor among all oral neoplasms. Advanced buccal mucosa carcinoma poses significant threat on the patients life and severely affects their quality of life. Currently, treatment strategy of buccal mucosa carcinoma is mainly surgery-based comprehensive therapy. Extensive and complete resection of buccal mucosa tumor is the most effective way to improve local control rate of buccal mucosa carcinoma.<sup>1</sup> However, due to the distinctiveness of buccal anatomy, malignant tumor originated from buccal mucosa can infiltrate into the loose layer under buccal muscle and thereafter spread around along this layer; in advanced stage, it can affect facial skin and also spread

outward affecting angulus oris and lips, as well as spreading upward and downward and affecting maxilla, mandible and even both hard and soft palates and floor of mouth. Massive buccal mucosa carcinoma tends to affect outlet of parotid duct as well. Therefore, the only way to ensure the thoroughness of the surgery is to fully and completely remove the tumor tissue while preserving adequate normal margin. Nevertheless, a fair number of patients end up with large defect after extensive surgical resection, which leads to severe dysfunction and worsened quality of life for the patients. Hence, how to reconstruct such defects and expand the indications for surgeries have become the key issues in improving survival and quality of life in patients with buccal mucosa carcinoma. Since September 2005, Cancer Center of Sun Yat-sen University has used a good number of flaps in reconstructing different buccal defects and has yielded fine efficacy. The study was summarized hereunder:

## Materials and Methods

**General data.** Among 26 patients, 10 were male and 16 were female; the age ranged from 41 to 73 years, with a median age of 57 years. Radiotherapy was given to six patients, and six patients developed recurrence; of these patients, 20 patients were treatment-naïve, among which two patients were classified as T1N0M0; four patients as T2N0M0; one patient as T2N1M0; three patients as T3N0M0; two patients as T3N1M0; one as T3N2M0; five as T4N1M0 and two as T4N2M0. Post-surgical recurrence included recurrence in primary lesion; two of the recurrent patients showed metastasis in ipsilateral lymph nodes.

**Surgical treatments.** All the patients in our study underwent surgical treatments and all buccal defects underwent one-stage flap reconstruction. Among them, 21 patients received cervical lymph node dissection, of which seven underwent radical dissection and 15 underwent supraomohyoid lymph node dissection.

**Preparation of flaps.** In our study, except for the preparation of sternocleidomastoid

myocutaneous flap, other flaps were prepared by two groups of surgeons; one group was responsible for resection of primary lesion and the other was responsible for preparation of flaps.

Before surgery, extent of the defect was estimated and size of the flap was designed according to the characteristics of each flap. In our study, size of the skin flaps provided by myocutaneous flaps ranged from 4 cm × 5 cm to 12 cm × 16 cm. Pectoralis major myocutaneous flap and sternocleidomastoid myocutaneous flap were vascular pedicle flaps, therefore length of the vascular pedicles had to be designed before surgery as well, to ensure that the flap could reach the farthest end of the constructed defect. Radial forearm flap and anterolateral thigh flap were free flaps, so the length of the vascular pedicles was decided by the distance from the defect site to the to-be-anastomosed artery and vein of recipient site (as measured during surgery); generally a spare vascular pedicle of 1-2 cm would be obtained from donor area.

### Reconstruction of defect sites.

Reconstruction of simple buccal mucosa defect: for buccal mucosa defects of less than 4-5 cm in diameter, sternocleidomastoid myocutaneous flap, forearm flap or anterolateral thigh flap were used for the reconstruction. The vascular pedicle went through the lateral surface of mandible and then connected to the buccal defect site.

Reconstruction of through-and-through defect of buccal mucosa and facial skin: when huge buccal mucosa tumor or facial skin involvement necessitated through-and-through resection of buccal mucosa and facial skin, pectoralis major myocutaneous flap, forearm flap or anterolateral thigh flap were used in the construction. During reconstruction, the flap was divided into two portions according to the sizes of buccal mucosa and facial defects. The dividing incision should not go deeper than subcutaneous layer (Figs. 1-3).

Reconstruction of defect of buccal mucosa, angulus oris, lip and facial skin: when tumor infiltrated the angulus oris or lips, which necessitated resection of angulus oris or partial resection of lips, forearm flap and anterolateral thigh flap were used for the reconstruction of



Figure 1 Perforated defect through the buccal mucosa and facial skin



Figure 2 Dividing the pectoralis major myocutaneous flap into two



Figure 3 Appearance after reconstructive operation using pectoralis major myocutaneous flap

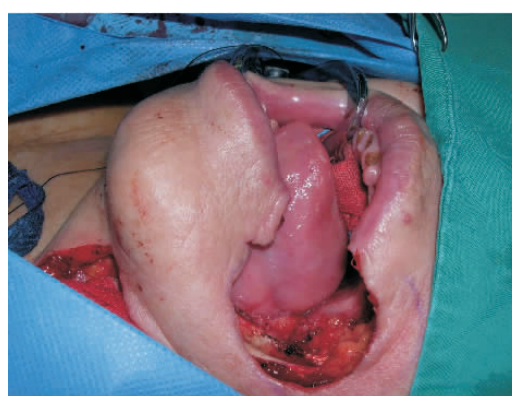


Figure 4 Defect of the buccal mucosa, angulus oris, lips and facial skin

such defects. During reconstruction, procedures were dependent on the size of the defects of angulus oris and lips. If defect of angulus oris was small, the defect could be simply closed by paired suture, then buccal and skin defects were repaired by flaps (see figure 4, 5 and 6). When defects of angulus oris and lips were bigger and simple paired suture would result in significantly smaller gape, it was not necessary to divide the flap. Instead, angulus oris could be recreated by suturing the invagination of the flap from internal to external side.

Treatment after parotid duct resection: when tumor involvement in outlet of parotid duct or inadequate safety margin made parotid duct resection necessary, a soft tube of 1 mm in diameter was used. One end of the tube was inserted into residual parotid duct and the other end was situated inside oral cavity and was fixed along the margin of the sutured wound. At around four weeks later, the soft tube was

removed when the fistula was basically established.

## Results

All 26 patients received one-stage reconstruction surgery with flaps for buccal defect. Among them, eight patients received simple buccal mucosa resection; 18 patients with massive buccal defect included 11 patients receiving through-and-through resection of buccal and facial skin and seven patients receiving buccal mucosa, skin and angulus oris resection; another seven patients were given parotid duct resection. Reconstruction with free forearm radial flap was used in 11 patients; anterolateral thigh flap in six patients; pectoralis major myocutaneous flap in five patients and sternocleidomastoid myocutaneous flap in four patients. Post-surgical radiotherapy was used in eight patients at the dose of 66-70Gy.



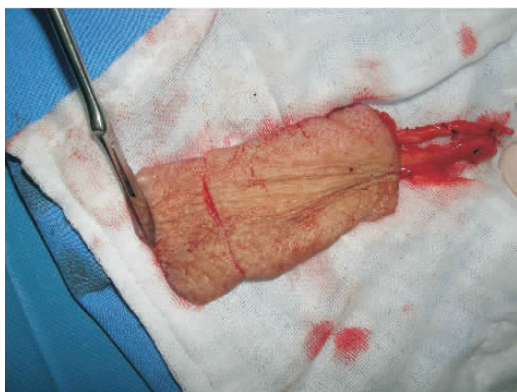


Figure 5 The free radial forearm flap



Figure 6 Appearance after reconstructive operation using free radial forearm flap

Post-surgical pathology revealed 21 squamous cell carcinomas, three mucoepidermoid carcinomas and two adenoid cystic carcinomas.

During perioperative period and radiotherapy, no surgery-related death was recorded. Flap necrosis occurred in one patient using forearm flap reconstruction; partial flap necrosis developed in one patient using pectoralis major myocutaneous flap; another patient experienced wound hydrops related to salivary fistula, which was improved by frequent changing of dressing during hospitalization.

All these patients were followed for one to three years. During follow-up, three patients died, of which two patients developed local recurrence in primary lesion and one developed recurrence in cervical lymph nodes. During follow-up, a total of seven patients experienced recurrence, among which four were recurrence in primary lesion and three were recurrence in cervical lymph nodes. Of the four patients with recurrence in primary lesion, three patients had undergone simple buccal mucosa resection. The shortest time to recurrence was five months. Among the patients with recurrence, one patient refused further treatment due to personal issue; another six patients received re-operation or radiotherapy.

## Discussion

Buccal mucosa carcinoma is one common malignant tumor in oral cavity that accounts for 20.85-26.83% of all oral carcinomas.<sup>1-3</sup> Jian Sun et al.<sup>4</sup> reported that buccal mucosa carcinoma had become the second most common oral carcinoma

preceded only by tongue cancer. Treatment for buccal mucosa carcinoma is mainly surgery, but the treatment outcome is not quite satisfactory, with a five-year survival of 38.0-53.41%.<sup>5, 6</sup> The major cause for treatment failure is local recurrence, which could occur in as high as 31.8% of all patients.<sup>6</sup> Since the anatomic structure is distinct by containing a loose layer of connective tissue under buccal muscles, cancer cells tend to spread around along this layer. Therefore, the key to improve local control rate needs extensive resection of buccal tissue, or even through-and-through resection of buccal tissue and skin. Badakh et al.<sup>7</sup> reported that positive surgical margin in buccal mucosa carcinoma operations was a crucial factor that influenced prognosis; Guang-Jin Xu et al.<sup>8</sup> demonstrated that adequate extent and depth of resection is the key in preventing post-surgical recurrence of buccal mucosa carcinoma. Thereby, to ensure adequate resection extent in buccal mucosa carcinoma, and to render better appearance and function, more and more doctors are using vascular pedicle or free flaps to reconstruct buccal defects. In our study, four patients developed local recurrence, and only one patient receiving through-and-through resection showed local recurrence, which demonstrated that its ability of achieving local control had yielded satisfactory efficacy.

Selection of flaps: for the repair of large buccal defects, the selection of flaps is crucial. In clinical setting, there are a varieties of flaps for repair buccal defects, including adjacent tissue flaps, such as buccal mucosa flap, tongue flap and

platysma flap, vascular pedicle flaps such as sternocleidomastoid flap and pectoralis major myocutaneous flap, as well as free flaps, such as forearm flap, anterolateral thigh flap and rectus abdominis myocutaneous flap. Different flaps have different advantages and disadvantages. In our study, 17 (65.4%) patients used free flaps for buccal reconstruction. The most frequently used flap was free forearm flap, which was used in 42.3% (11/26) patients for through-and-through reconstruction, buccal tissue, skin and angulus oris reconstruction and simple buccal mucosa reconstruction, respectively. Since forearm flap is thin and is capable of providing large area of skin. For large scale buccal defect, especially through-and-through buccal defect, forearm flap can be prepared into double-island flap or be invaginated for reconstruction of through-and-through defects. In our study, six out of 11 patients with through-and-through defect used forearm flaps, and achieved relatively desirable appearance and functions (gape and mastication) after the surgery. Forearm flap has large defined blood vessels and long vascular pedicle, which makes it eligible for reconstruction of complicated defects; it is also easy to isolate and handle, with a high successful rate in transplantation. In our study, only one out of 11 patients using forearm flaps developed vascular crisis, with a successful rate of 10/11. Therefore, forearm flap is an optimal flap for buccal defects. Rhemrev et al.<sup>9</sup> used forearm flaps to repair buccal defects and yielded a successful rate of 99.3%; Chi Mao et al.<sup>10</sup> reported that successful rate of reconstruction with forearm flap could be 100%. However, the harvesting of forearm flap affects the appearance of patients arms, which is unacceptable for some patients. To tackle with the adverse influence of flap harvesting on donor sites, some experts have suggested the use of free anterolateral thigh flap for buccal reconstruction and have achieved nice efficacy.<sup>11, 12</sup> During recent years, we have used anterolateral thigh flaps for buccal reconstruction, too. Since the skin area provided by anterolateral thigh flap can be as much as 12 cm × 18 cm, it is fairly competent for reconstruction of large buccal defect. Anterolateral thigh flap is also characterized by

concealed donor site, lengthy vascular pedicle, large blood vessels and high successful rate in surgery. In our study, six patients using anterolateral thigh flap have achieved successful transplantation. In addition, injury is minor and well acceptable for the patients. Therefore, at present time anterolateral thigh flap has become one of the most commonly used free flaps for the reconstruction of buccal defects. In our study, only one patient using free flap for reconstruction experienced flap vascular crisis and subsequent flap necrosis; successful rate of the surgery was 16/17. Hence, transplantation reconstruction with free flaps has become a mature treatment strategy.

For simple buccal resection, especially defect of less than 4 cm, Licameli et al.<sup>13</sup> used buccal mucosa flap for reconstruction. But excessive harvesting of buccal mucosa tends to result in complications, such as trismus and injury on parotid duct. In our study, vascular pedicle sternocleidomastoid myocutaneous flap harvest from adjacent tissue was used for the reconstruction, and produced good efficacy as well. Since preparation of sternocleidomastoid myocutaneous flap is simple and induces minimal injury, and the successful rate of the surgery is high as well, thus the use of such flap is well acceptable for the patients. But it has the shortcoming of providing limited area and diameter of reconstructions. Therefore, it is suitable for buccal defect of less than 4 cm. For non-through-and-through defect larger than 4 cm, free forearm flap (3/8) and anterolateral thigh flap (1/8) are optimal choices and can achieve better functions after the reconstruction. Pectoralis major myocutaneous flap is also frequently used in the reconstruction of buccal defects. In our study, five out of 26 patients used pectoralis major myocutaneous flap. Since pectoralis major myocutaneous flap provides large area of skin and vast amount of tissue and produces high successful rate in the surgery, it is commonly used for the reconstruction of large defects of buccal mucosa, skin and angulus oris. In our study, it was used for the reconstruction of two through-and-through defects and three large defects of buccal mucosa,

skin and angulus oris. Pectoralis major myocutaneous flap is a well developed flap. Since it is a vascular pedicle flap, complete flap necrosis is generally rare. In our study, only one patient developed partial necrosis; because the flap was large and donor site extended below ensisternum level, distal end of the flap developed necrosis after surgery. Hai yan Xu et al.<sup>15</sup> also reported one similar case (1/19) of partial necrosis when using pectoralis major myocutaneous flap in reconstruction of buccal defects. However, sometimes pectoralis major myocutaneous flap is too corpulent to allow precise moulding in the reconstruction. Furthermore, preparation of pectoralis major myocutaneous flap induces substantial injury and renders thoracic deformity for the patients. Thereby, we select pectoralis major myocutaneous flap only when: (1) large amount of tissue is resected which results in through-and-through buccal defect; (2) vasculature of the recipient site is poor due to arteriosclerosis or radical cervical lymph node dissection which requires resection of internal and external jugular veins; (3) the patient is too old to endure lengthy surgery.

Reconstruction of large buccal defects: in our study, 69.2% (18/26) of patients underwent through-and-through buccal resection and total resection of buccal tissue, skin and angulus oris. Among these patients undergoing extensive resection, only one patient developed local recurrence during follow-up, with a recurrence rate of 5.6% (1/18). It is reasonable to believe that extensive buccal resection is the key in improving local control of buccal mucosa carcinoma. Nevertheless, through-and-through resection induces major damage and results in significant facial deformity and dysfunction in the patients, thus it is necessary to perform proper reconstruction of large buccal defects so as to restore favorable appearance and oral functions for the patients. In our study, we used large-scale flaps (five pectoralis major myocutaneous flaps, eight forearm flaps and five anterolateral thigh flaps) to repair large buccal defects. The largest flap was a pectoralis major myocutaneous flap of as much as 12 cm × 16 cm. For the reconstruction in patients with preserved angulus

oris, large flaps were divided into two portions as described in previous methods section and were properly allocated for the reconstruction of buccal tissue and facial skin depending on the area of the defects. For patients with total resection of buccal tissue, skin and angulus oris, the flap was invaginated that one part of the flap was used for reconstruction of buccal tissue and the other for reconstruction of facial skin, and the invagination was used to recreate angulus oris. When dividing large flaps into two portions, the following issues should be noted: first, the flap should be properly insetted to cover internal and external surfaces of oral cavity; dividing incision on the skin should not be deeper than subcutaneous layer; try not to resect subcutaneous vascular network; second, for free flap, vascular pedicle should be situated at the lowest layer of the flap, so as to avoid the influence of gravity on the stability of the anastomosis.

Treatment on parotid duct: when parotid duct involvement by the tumor or inadequate safety margin necessitates resection of parotid duct, the treatment of parotid duct is a fairly tricky issue. Some scientists suggest, when safety margin is not adequate but parotid duct is preserved anyway, supplementary radiotherapy should be given after surgery; others also performed radiotherapy on parotid gland after parotid duct resection to reduce occurrence of parotid gland fistula. Based on the experience of our study, extensive resection of buccal tissue is the key to improve local control rate; therefore, we should not hesitate to perform parotid duct resection when necessary. During the surgery, a soft silicon tube of 1 mm in diameter could be inserted into residual parotid duct and situated inside the oral cavity. After being retained for more than four weeks when fistula was developed in the wound, the silicon tube could be removed. In our study, silicon tube retention was used in seven patients who had undergone parotid duct resection. At day 2 after the surgery, the tube in one patient went off spontaneously, which resulted in hydrops of parotid gland. Subsequently, radiotherapy was used to control the hydrops. Another six patients achieved satisfactory efficacy. Since silicon tube is easy to

use and is readily available as well as highly effective, besides it helps avoid the post-surgical use of radiotherapy for parotid gland fistula, such method is worthy of widespread use.

The use of flaps in the reconstruction of buccal defects has expanded the indications of buccal mucosa carcinoma surgeries and thereby has increased local control rate of the disease, which makes it an effective way to treat buccal mucosa carcinoma. Free flaps, including anterolateral thigh flap and forearm flap, can be flexibly used and produces nice reconstruction; the technique is well developed and results in high successful rate. For buccal defects of larger than 4 cm, free flaps should be first choice for the reconstruction. Pectoralis major myocutaneous flap can be an alternative flap for reconstruction of large buccal defects. Its application is well developed, widely used and also produces high successful rate. For buccal defects of smaller than 4 cm, sternocleidomastoid myocutaneous flap, which induces minimal injury and is easy to use, should be selected.

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