

Full Paper

Modified surgical method for mandibular gingival carcinoma in situ

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Abstract: Carcinoma of the mandibular gingiva is common and can more easily invade the mandibular bone compared with other head and neck cancers. Tumours that approach or involve the mandible usually require marginal resection or segmental resection of the mandible. Marginal mandibulectomy was not associated with worse prognosis than segmental mandibulectomy. However, these two conventional surgical methods lead to significant disability including loss of hard and soft tissues, impaired function of speech, swallowing and mastication. Rehabilitation can be difficult or impossible due to the distorted postsurgical anatomy. There are rare clinical studies on the surgical method for the mandibular gingival carcinoma in situ. In this study we introduce a modified surgical method, buccal partial mandibulectomy, focusing on how to keep the alveolar bone crest and lingual gingiva of the lesion in the largest extent for patients with mandibular gingival carcinoma in situ. Being more appropriate than traditional marginal or segmental mandibulectomy, the modified surgical method can not only ablate the whole tumour with negative margin in soft tissue, but also achieve higher quality of postoperative life without tumour recurrence during the longest follow-up time of more than 40 months. Buccal partial mandibulectomy can maintain the jaw continuity and make it possible to achieve an adequate prosthetic rehabilitation such as implant-fixed prosthesis.

Keywords: gingival carcinoma, carcinoma in situ, modified surgical method, buccal partial mandibulectomy, postoperative rehabilitation

INTRODUCTION

Except for non-melanoma skin cancer, oral cavity carcinoma is the most frequent head and neck cancer, with over 300,000 new cases reported annually globally [1]. The majority of instances of oral cavity carcinoma are caused by oral squamous cell carcinoma (OSCC) while the mandibular gingival mucosa is the second most common site of OSCC and is more common in elderly patients [2, 3]. Gingival cancer poses a diagnostic challenge for clinicians, who may not suspect a malignancy in light of other more commonly encountered pathologies such as peri-apical, periodontal disease, inflammatory reactive tumour-like lesions, lichen planus and non-specific granulation tissue [4]. Carcinoma of the mandibular gingiva (CaMG) can more easily invade the bone marrow compared with other head and neck cancers [5]. Furthermore, because the attached gingiva is relatively thin, gingival cancers show early invasion of the underlying bone. Some studies suggest that CaMG with bone invasion is more common than expected, with an incidence of 54-70% [2, 6, 7]. Therefore, how to treat the CaMG with bone invasion is of great importance.

The most important decision in terms of tumour ablation in oral cancer is the management of the mandible. Precise preoperative radiological assessment of mandibular bone invasion can allow bone-sparing and surgical de-escalation. Bone invasion by OSCC necessitates jaw resection, with preoperative imaging ideally able to guide the resection [8]. Major invasion is easy to detect; Computed tomography and magnetic resonance imaging are complementary in studying mandibular bone invasion while positron emission tomography-computed tomograph (PET-CT) is more specific in analysing mandibular invasion [9]. A horizontal marginal resection and a segmental resection of the mandible are two well established methods. The former is to remove the superior surface of the mandible with a safe margin when there is early invasion. The latter is usually used if mandibular invasion is more extensive or in some large soft tissue cancers where tumour abutment involves the whole depth of the mandible [10]. Of the prognostic factors studied in patients with OSCC, marginal mandibulectomy is not associated with worse prognosis than segmental mandibulectomy [11].

However, there has been little clinical study on the surgical method or the margins of resection for the presence of dysplasia and carcinoma in situ. Early and accurate diagnosis of gingival carcinoma in situ is of great importance in order to escape delaying treatment [12]. Both marginal and segmental mandibulectomy must remove at least 10 mm of bone measured from the crest of the ridge or the neck of the teeth, which would leave little height of the mandible and is not enough to retain mandibular continuity [10]. Postoperative reconstruction for the defect area is also complex. In this study we focus on how to perform the surgery to keep the alveolar bone crest and lingual gingiva of the lesion to the largest extent for patients with mandibular gingival carcinoma in situ.

PATIENTS AND METHODS

Patients

The modified surgery method has been applied in several cases of gingival carcinoma in situ in Shizuoka General Hospital. In three female patients over 60 years old, the tumours were located in the buccal side of left maxillary gingiva, which affected the buccal gingiva of the left maxillary. In others who were all between 60- to 70-year-old males, the tumours were all located in the buccal

side of mandibular gingiva, left or right. A biopsy was performed in all the cases and proved to be gingival carcinoma in situ.

Human experimentation in this study was ethically approved by the ethics committee of Shizuoka General Hospital (approval number: SGHIRB#2021084).

Classical Case Description

A 62-year-old man with an idiopathic granuloma-like tumour in the left mandibular gingiva for one month was referred for diagnosis and treatment. The 'granuloma' grew slowly without pain and uncomfotableness. Clinical examination revealed that the tumour was located in the buccal gingiva of the left mandibular canine tooth, not the margin of gingiva or the papilla. Similar hyperplastic lesions in the interdental, marginal, and attached gingiva of both the maxillary and mandibular arches were not seen. The gingival tumour was about 0.5 cm in diameter, pink, round and soft and had a clear boundary without infiltration or pedicel on palpation, which did not look like 'gingival fibroma' or 'polypus' (Figure 1).



Figure 1. Gingival tumour in left mandible (arrow)

The patient had followed regular oral hygiene and there was no clinically obvious mobility present in any of the teeth. The panoramic radiographic examination, ^{18}F -FDG PET-CT, revealed no obvious abnormalities (Figure 2). The patient was otherwise well and had no relevant medical or social history. He reported no history of previous infections, trauma or cancer.

Regular laboratory investigations such as complete blood count, urine analysis and other methods for detecting infection were performed to investigate the cause of this rare appearance of gingival enlargement. In addition, the presence of viruses, including HIV, human papilloma virus and other viral infections, was also tested. All results were negative.

Our first impression of the disease was 'gingival suspicious malignant tumour'. We therefore cut the tumour totally about 1.5 mm around it. One week later, the pathological diagnosis was 'oral intraepithelial neoplasia/ CIS of the gingiva.' In the tumour specimen, histopathologic examination showed epithelial thickening, parakeratosis; altered polarity of spinous cell; loss of fence-like array of the basement membrane; nuclear division and dyskeratosis—abnormal epithelial hyperkeratosis in the basal layer (Figures 3a-d). There still were malignant tumour cells remaining around the

tumour at the boundary. Based on history, clinical features, laboratory investigations and histopathologic examination, the case was provisionally diagnosed as idiopathic gingival carcinoma in situ, the etiologic factors of which were indefinite. A week later, the patient was admitted for further radical operation.

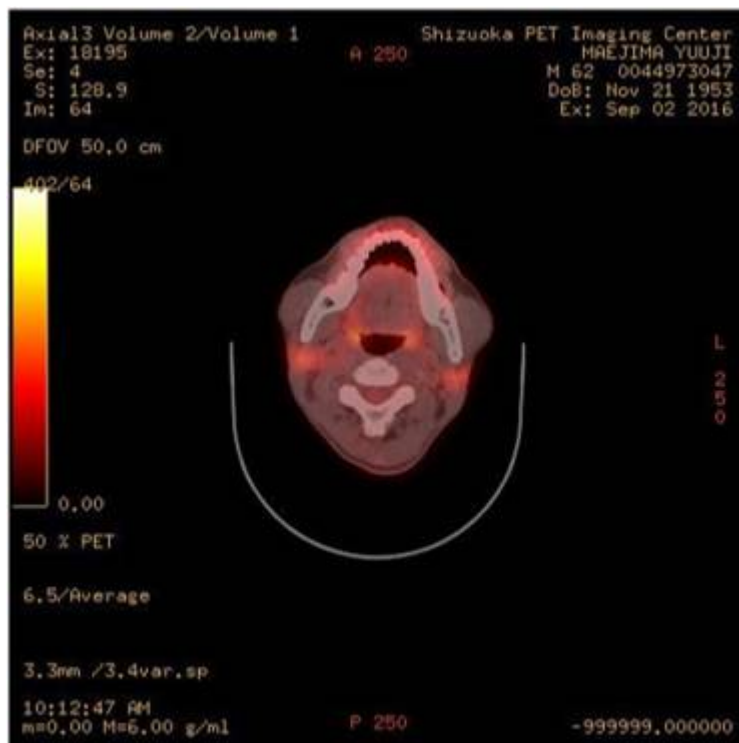


Figure 2. PET-CT showing no obvious abnormalities of tumour and lymph node

Surgical Procedure

The original tumour was located in the buccal gingiva of the canine. In order to protect nearby teeth, the incision line was designed as follows: bucco-mesial and bucco-distal lines were 1.0 cm away and apico-buccal line was 1.0 cm away from the scar caused by the first cut of the tumour. There was no incision line in the lingual gingiva. The crowns of the left mandibular canine and first premolar were cut off to expose the interdental papilla completely. Piezosurgery and the diamond bur were used to cut the bone and the tip of the roots of those teeth mentioned above. Then we shook and removed the buccal bone together with the buccal and interdental gingiva and parts of canine and first premolar, whose root tips were firstly spared but extracted carefully after a while (Figures 4a-h). The bone crest and lingual bone were preserved.

We cut four gingival pieces, each from the lingual, mesiobuccal, distobuccal and apicobuccal incision margin, for frozen biopsy, which showed no tumour cell. Then TERUDERMIS™ Artificial Dermis (Olympus Terumo Biomaterials Corporation, Japan) without outside silicone membrane was filled in the cavity and covered by a complete piece of TERUDERMIS™ Artificial Dermis with outside silicone membrane, which was sutured to the gingival mucosa. The removable denture repaired immediately (Figures 5a-d). All the tissues cut down accepted routine pathological examination.

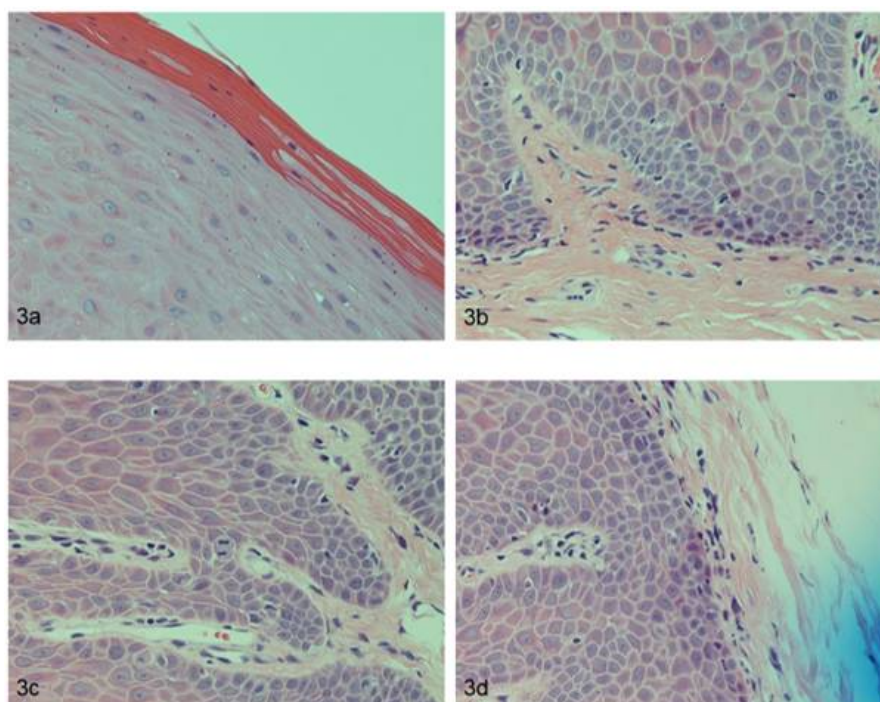


Figure 3. Microscopic findings: (a) epithelial thickening, parakeratosis; (b) altered polarity of spinous cell (hematoxylin-eosin, $\times 40$); (c) lost of fence-like array of basement membrane; (d) nuclear division and dyskeratosis – abnormal epithelial hyperkeratosis in basal layer (hematoxylin-eosin, $\times 40$)

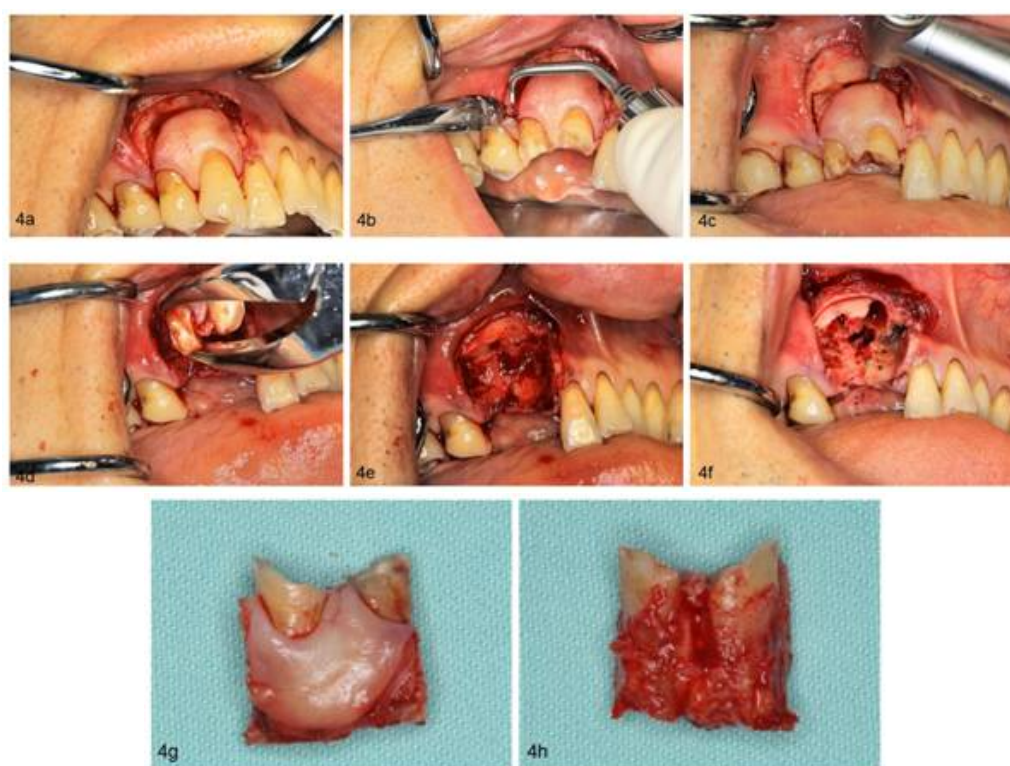


Figure 4. (a) Buccal gingival incision; (b) cutting the bone; (c) cutting the roots of left mandibular canine and first molar; (d) shaking and removing the buccal bone together with roots and buccal gingiva; (e) root tips left; (f) root tips extracted; (g) buccal view of tumour; (h) lingual view of tumour

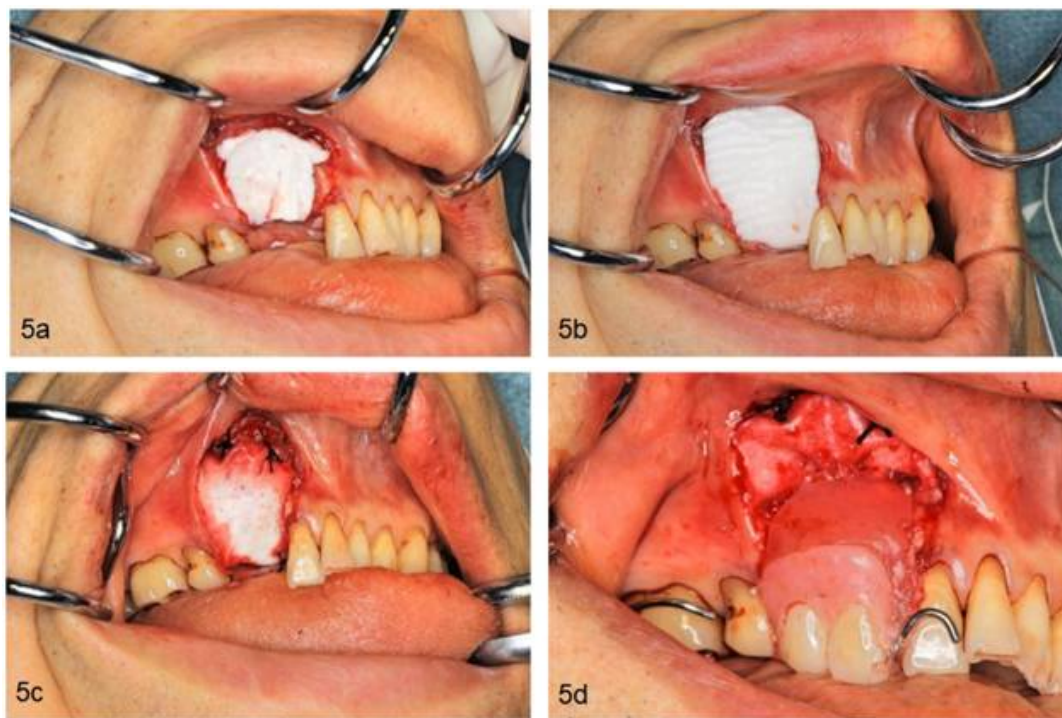


Figure 5. (a) Filling the bone defect with artificial dermis without silicone membrane; (b) covering a complete artificial dermis; (c) suturing silicone membrane with gingival mucosa; (d) removable denture repair

Postoperative analgesia and anti-inflammatory treatment were required. The first day after surgery, 500 mg hydrocortisone succinate diluted in 100 ml of 0.9% sodium chloride and 50 mg flurbiprofen axetil diluted in 100 ml of 0.9% sodium chloride were intravenously injected once. From the next day, the patient received only 100 mg cefazolin sodium diluted in 100 ml of 0.9% sodium chloride injected intravenously twice a day for five days.

RESULTS AND DISCUSSION

The final histopathological examination showed that all the specimens cut from the gingival incision margin were negative: no carcinoma cells were found in the tumour (including bone, root and gingival tissues) cut from the buccal side of the lesion.

One week after the surgery there were obvious granulation tissues fusing with TERUDERMIS™ collagen in the defect area and the silicone membrane separated itself (Figures 6a, 6b). No abscess, no bleeding and just a little pain were observed. We took away the sutures and adjusted the denture.

Three months after the operation, there were obvious recovery of the gingival tissues in the defect area that fused with TERUDERMIS™ collagen (Figures 7a, 7b). Besides, it was encouraging to find beautiful keratinised gingiva growing in the defect area with stable height from the lingual bone crest. No abscess, no bleeding and no pain were observed. Six months after surgery the gingival tissues in the defect area recovered better, and TERUDERMIS™ collagen could hardly be seen (Figures 8a, 8b). The keratinised gingiva and the height of lingual bone crest remained stable. Three years and 4 months after surgery the patient returned to the hospital for review. There was no recurrence of gum tumour. The width of the alveolar bone had narrowed slightly over time, but the

colour, shape and texture of the gums were exactly the same as those of normal gingival mucosa (Figure 9).



Figure 6. (a) Oral view of postoperative recovery with artificial membrane; (b) granulation tissues growing well



Figure 7. Postoperative recovery showing the fusing with TERUDERMISTM collagen: (a) buccal view; (b) occlusion view



Figure 8. Postoperative recovery after 6 months: (a) buccal view; (b) occlusion view



Figure 9. Smooth and healthy gum without recurrence of gum tumour

Carcinoma of the mandibular gingiva differs from other oral cancers because it can easily invade the bone marrow due to the thin gingiva [13, 14]. Surgical treatment is an ideal approach to eradicate the disease. Current surgical approaches, marginal mandibulectomy and segmental mandibulectomy, have several limitations (Table 1). In this study we have introduced buccal partial mandibulectomy, a modified surgical method for mandibular gingival carcinoma in situ, which can achieve a negative margin in soft tissue and preserve the alveolar bone crest and lingual gingiva of the lesion to the largest extent. The results of a three-year follow-up has demonstrated that there is no recurrence of gum tumour with improved life quality.

Table 1. Comparison between buccal partial mandibulectomy and conventional mandibulectomy [13, 14]

	Buccal partial mandibulectomy	Marginal mandibulectomy	Segmental mandibulectomy
Indication	Disease approaching buccal gingiva of the left maxillar	Disease approaching but not directly invading the mandibular cortex	T4 stage; mandibular bone invasion; tumours referred previously
Removed tissue	Crowns of the left mandibular canine and first premolar	Part of jawbone	Large portion of jawbone and rebuilding jaw
3-year local recurrence	0%	29.1%	18.4%
3-year survival rate	100%	75.2%	69.2%

Mandibulectomy such as marginal and segmental mandibulectomy should be conducted for OSCC close to or invading the lower mandible [15]. The primary site, size, proximity to bone, and depth of infiltration are factors which influence a particular surgical approach [16]. The pattern of bone destruction, as well as the extent of the bone invasion, is one of the determinant factors of the choice between marginal or segmental resection of patients with CaMG [15]. Researchers choosing segmental or hemimandibulectomy method to achieve radical treatment believe that the tumour invades the lower mandible through diffusion in the lingual periosteum lymphatic channels

previously, especially when the bone is extensively involved [16], while other researchers subsequently propose that invasion of the lower mandible by OSCC is a gradual process from the outside to the inside [8]. Nakayama [17] and Brown et al. [18] found that the mandible was involved by the tumour only if there was a direct extension through the periosteum rather than through the periosteal lymphatics. With advances in the increasingly enhanced functional and esthetic outcomes in patients, more and more surgeons favour the preservation of cortical continuity using marginal resection in appropriate cases with suspected tumour invasion or tumour invasion in an erosive pattern [19]. Even for those patients with stage T4, studies have not supported using recommended segmental mandibulectomy [20, 21].

In both marginal and segmental resection of the mandible a large part of the mandibular bone and nearby soft tissues must be removed for patients with OSCC. Patients with poor prognosis usually undergo more involved treatment. Resection of malignancies and jaw removal can affect mastication, swallowing, speech and respiration [22]; neck dissection, flap transplantation, radiotherapy and chemotherapy can all alter the quality of life. The mechanism of spread of oral cancers to the mandible has been well studied [23]. In patients with early invasion of the alveolar process, marginal mandibulectomy is feasible since the cortical part of the mandible inferior to the roots of the teeth remains uninvolved and can be safely spared [24]. As for the mandibular gingival carcinoma in situ, which must be shallower than mandibular superficial erosion [16], the trauma brought by traditional surgical methods mentioned above seems too heavy to accept. Based on the understanding of the patterns of invasion of the mandible [23, 25], it has become possible to design and carry out our modified surgical method, buccal partial mandibulectomy, for mandibular gingival carcinoma in situ. For those patients with lesions approaching gingiva of the left maxillar, our method can definitely achieve a negative margin in the soft tissue normally associated with a reduced rate of control and a worse survival [18]. Besides, the buccal partial mandibulectomy can certainly maintain the jaw continuity.

Patients who accepted our modified surgical method could also accommodate a removable partial denture with better retention or fixed implant restoration in the future because the height of the lingual mandibular bone is almost preserved and kept stable. Guided bone regeneration is relatively easier to carry out to increase the width of alveolar bone rather than to increase its height. In our study the function, comfort, esthetics and eventually the quality of postoperative life can be improved in patients using our modified buccal partial mandibulectomy method. In situ and superficially invasive lesions present a lower risk of regional lymph node metastases and they are highly curable [24]. Patients were free of tumour recurrence during the follow-up time of more than 40 months.

CONCLUSIONS

Early detection and prompt treatment are key for the management of mandibular gingival carcinoma in situ.. In a very early stage of disease where bone invasion is not suspected on clinical grounds, our surgical method, the modified buccal partial mandibulectomy, is more appropriate than traditional marginal or segmental mandibulectomy for the mandibular gingival carcinoma in situ because the modified method can not only ablate the whole tumour with negative margin in the soft tissue, but also achieve a higher quality of postoperative life without tumour recurrence.

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