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RESEARCH ARTICLE

Modified visor approach applied to total or subtotal glossectomy and reconstruction: avoidance of lip splitting and mandibulotomy and cutting off mental nerve

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Abstract A lower lip-splitting incision has traditionally been performed with different types of mandibulotomy approaches for obtaining wide access to total or subtotal glossectomy. However, lip splitting can be associated with unfavorable aesthetic and function results. We describe our new modification of a traditional visor approach without lip splitting, mandibulotomy, and reserve mental nerve to avoid these morbidities and to compare aesthetic, functional, and patient subjective outcomes between the two access procedures.

Of the patients undergoing total or subtotal glossectomy and reconstruction with flaps, 99 were grouped according to a surgical access procedure performed (lip split and mandibulotomy [LSM] or modified visor approach [MVA]). Data on surgical morbidity and outcomes were compared. All the tumors were safely removed by means of our modified visor approach through the combined intraoral and transcervical routes with adequate resection margins. There were no troublesome difficulties in reconstruction of the surgical defects with various flaps. Recurrence rates, swallowing, chewing, and speech were similar for both groups. Rates of postoperative fistulae were 9.3 % (LSM) vs 0 % (MVA). There were significant differences between the two groups in the temporomandibular joint (TMJ) signs (p=0.000) and for appearance domains (p=0.01). Avoiding lip splitting and mandibulotomy reduces patient morbidity and hospital stay and gets excellent aesthetic consequences; reserve mental nerve can avoid lower lip numbness after surgery. In our experience, the lower lip-splitting and mandibulotomy procedure for surgical exposure is unnecessary for both oncologic resection and reconstruction of tongue cancers.

Keywords Lip split · Mandibulotomy · Tongue cancer · Modified visor approach

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Introduction

Roux [1] in 1836 was the first to describe the approach of dividing the lower lip and mandible for gaining surgical access to the oropharynx. The lower lip-splitting approach with mandibulotomy has been popularized and has been most widely used for many years to facilitate the access to tumors in the oral cavity and oropharyngeal tumors [2, 3]. The necessity to perform lip splitting for tumor extirpation remains controversial. Proponents of the lip splitting report improved access and three-dimensional assessment than with other techniques where the lip remains intact and facilitate the flap setting. Critics of the lip-splitting technique cite a higher rate of functional deficit, postoperative morbidity (lip vermillion notching, stenosis of labial sulcus, fistula formation), and unsightly scarring, even in the most experienced hands [4, 5]. Some author suggested that lip splitting in transmandibular resection for oral and oropharyngeal tumors is not necessary [6].

In advanced tongue cancer, it is difficult to control the local tumor and regional lymph node metastasis with pure chemotherapy and radiotherapy treatments. The surgery to take the full tongue or subtotal tongue with extended resection, injury, postoperative swallowing, and language features are obvious

obstacles that are difficult to accept by the patients and their families, sometimes making the surgeon give up surgery. With the continuous progress of plastic surgery and the accumulated experience of the doctor, the whole tongue excision repair reconstructed patients' postoperative function which improved significantly and prolonged the survival time and quality of life of patients. Recent years, in order to reduce the surgical injury and improve the quality of life, we have taken to modified visor approach which retains the integrity of the lower lip chin and mandible continuous in total or subtotal glossectomy and flaps reconstruction.

Patients and methods

Due to the retrospective nature of this study, it was granted an exemption in writing by the China Medical University of Ethical Review Board. From October 2005 to July 2012, a total of 99 cases of tongue cancer and tongue and floor of the mouth cancer took total or subtotal tongue glossectomy. Fifty-four patients used the modified visor approach: This retains the integrity of the lower lip and mandible continuous and reserve mental nerve. The remaining 45 cases were applied with a lip-split mandibulotomy. We excluded patients having distant metastatic disease. We also excluded patients who had invasion in the mandible. All patients were presented at a multidisciplinary tumor board comprising head and neck oncologic and reconstructive surgeons, radiation oncologists, and medical oncologists.

We compiled and reviewed data for preoperative variables (T stage, tumor primary site, sex, age), intraoperative variables (tumor resection, estimated blood loss, intravenous fluid administration), reconstruction flaps characteristics (flap dimensions and flap success), postoperative variables (presence of fistulae, oral incompetence, mandibular malunion, temporomandibular joint (TMJ) function, and total hospital days), final pathologic features (aggressive features and margins), and follow-up information (recurrence and survival situation).

The University of Washington Quality of Life scale (UW-QOL) is a self-administered scale that provides a broad measure of QOL for patients with head and neck cancer with good acceptability, practicality, validity, reliability, and responsiveness [7]. The questionnaire is composed of 15 domains: 12 are disease-specific items (pain, appearance, activity, recreation, swallowing, chewing, speech, shoulder, taste, saliva, mood, and anxiety), and 3 are global questions. Only appearance, speech, chewing, and swallowing were measured. Each item is scaled from 0 (for poor health) to 100 (good health).

Speech, TMJ functions, and lip competence were scored using a simple numerical system (Table 1). This method was described by Devine [8].

Table 1 Clinical function measures

Assessment by clinician		Score
Speech	Normal intelligible speech	1
	Understand most words	2
	Only few words understood	3
	Incomprehensible	4
	(Range 1–4, lower score indicating better function)	
Tongue mobility	Normal	1
	To lips	2
	To alveolus	3
	To palate	4
	Immobile	5
	(Range 1–5, lower score indicating better function)	
Lip competence	At rest	1
	On effort	2
	Incompetent	3
	(Range 1–3, lower score indicating better function)	
TMJ signs	Tenderness on palpation of TMJ	Yes=2
		No=1
	Muscle of mastication tenderness	Yes=2
		No=1
	Restricted opening	Yes=2
		No=1
	(Range 3–6, lower score indicating better function)	

Surgical technique

Modified visor approach The visor flap has been described as a surgical approach in one form or another for decades. It is a versatile flap for oral cavity access and can extend from mastoid to mastoid or mastoid to mental foramen of the opposite side, depending on the extent and location of tumor. The flap is raised in a subplatysmal plane to the level of the inferior border of the mandible. Care is taken not to injure the marginal mandibular branch of the facial nerve. Larger lesions of the anterior oral cavity involving the anterior floor of the mouth and lower gum can be resected adequately through a wide exposure gained via a visor flap approach. This approach avoids the need for lip-splitting incision and mandibulotomy but has the disadvantage of causing numbness of the skin of the total lower lip and chin because of the need to sacrifice both mental nerves [9]. We have improved the visor flap.

Modified visor flap approach The tongue and floor of the mouth is exposed via a single curve skin incision extending from the mastoid process on one side to that on the other. The flap is raised in a subplatysmal plane to the level of the inferior border of the mandible. Care is taken not to injure the marginal mandibular branch of the facial nerve. This requires a mucosal incision in the gingivobuccal and gingivolabial sulci, with

division of all the soft tissues lateral to the mandible. Moreover, compared with the traditional visor approach, we reserve mental nerve so avoiding causation of lower lip numbness after surgery. While this can be somewhat limiting, the level of raising the chin and cheek skin flaps, however, when specimen of the tongue and floor of the mouth down to neck exposure place can provide excellent visualization of the total or subtotal glossectomy and flaps reconstruction. The resected tongue tumor specimens from the floor of the mouth and neck dissection specimens used resection pull-through with en bloc ("en-block"). Flap insetting starts from the posterior end of the defect, either at the base of the tongue or above the epiglottis. This part of the flap insetting is completed through the neck exposure, before vascular anastomoses are performed. When flap insetting reaches the mandible, one can either proceed with vascular anastomosis or continue the insetting intraorally depending on the surgeon's preference and the ischemia time. Intraorally, one lateral edge of the flap is sutured to the gingiva and the other to the cutting edge of the remaining tongue (Fig. 1).

Results

MVA group Of all the 54 patients, 39 patients were male, 15 patients were female, and the male-to-female ratio was 2.44:1, with an average 55.1 years of age (45–70 years old). The demographic description of the patients is shown in Table 2. The average follow-up was 35.40 months (range 16.5–51.8 months). Apart from 2 cases of glossectomy patients after 12 months of distant recurrence and death, the remaining 52 cases still survived. Of the patients, 45 (83.33 %) did not have recurrence. Four patients (7.41 %), 3 patients (5.56 %), and 2 patients (3.70 %) had local, regional, and distant recurrences alone, respectively.

LSM group Mean follow-up was 32.2 months (range 16.3–50.5 months). There were 36 males and 9 females, the male-to-female ratio was 4:1, with an average age of 53.5 years (range 38–70; Table 2). Apart from 3 case patients with distant recurrence and death, the remaining 42 cases still survived. Of the patients, 36 (80.0 %) did not have recurrence. Three patients (6.67 %), 2 patients (4.44 %), and 4 patients (8.89 %) had local, regional, and distant recurrences alone, respectively. For local recurrences, there is no significant difference between the two groups (4/54 vs 3/45).

The clinical examination showed little functional deficit of speech, tongue movement, lip competence, TMJ signs (Table 3). TMJ signs were worse in the LSM group and have statistical significance ($p=0.000$).

The comparison of subjective outcome using the UW-QOL is shown in Table 4. The patients scored similarly for

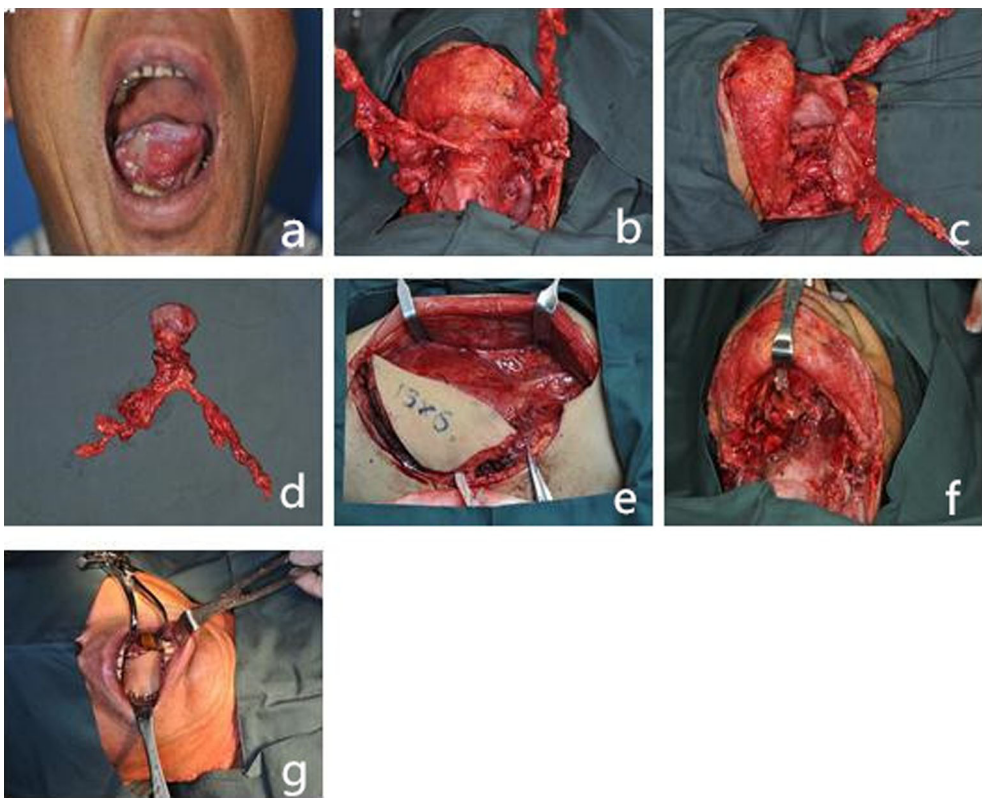

Fig. 1 **a** Squamous carcinoma of the tongue and floor of the mouth. **b** Bilateral neck dissections are completed. The flap is raised in a subplatysmal plane to the level of the inferior border of the mandible, reserve mental nerve. **c** Resected the tongue tumor specimens with the floor of the mouth and bilateral neck dissection specimens resection pull-through en bloc ("en-block"). **d** Surgical specimen of tongue and floor of the mouth with bilateral neck dissections. **e** Preparation of free anterolateral thigh perforator flaps. **f** Showing adequate three-dimensional resection. **g** Free anterolateral thigh perforator flaps suture finished

Table 2 Patients profile

Variables	No. of patients (%)	
	MVA (n=54)	LSM (n=45)
Age		
<50 years	14 (25.93)	10 (22.22)
≥50 years	40 (74.07)	35 (77.78)
Gender		
Male	39 (72.22)	36 (80.00)
Female	15 (27.78)	9 (20.00)
Primary tumor sites		
Tongue	42 (77.78)	31 (68.89)
Floor of mouth	12 (22.22)	14 (31,11)
T classification		
T1–T2	19 (35.19)	15 (33.33)
T3–T4	35 (64.81)	30 (66.67)
Pathology		
SCC	50 (92.59)	43 (95.56)
ACC	4 (7.41)	2 (4.44)
Reconstruction		
ALTFF	27 (50.00)	14 (331.11)
RFFF	16 (29.63)	13 (28.89)
PMMC	11 (20.37)	7 (15.56)
MSAP	0	2 (4.44)
Intraoperative resection margin		
Negative	50 (92.59)	42 (93.33)
Positive	4 (7.41)	3 (6.67)
Neck dissection		
SND	42 (77.78)	36 (80.0)
RND	12 (22.22)	9 (20)

ALTFF free anterolateral thigh perforator flaps, *RFFF* radial forearm free flaps, *PMMC* pectoralis major myocutaneous flap, *MSAP* medial sural artery perforator flap, *SCC* squamous cell carcinoma, *ACC* adenoid cystic carcinoma

swallowing, chewing, and speech. However, there were significant differences between the MLA groups and LSM groups for the appearance (60.63±9.42 vs 54.42±12.0, p= 0.01).

Of the flaps, 98.99 % (98/99) survived, and two pectoralis major myocutaneous flap of postoperative infection with upper cervical pharyngeal fistula healed after 2 months. In free flaps, one flap was completely lost; in two radial forearm free flaps, delayed wound healing in the distal parts of the flaps healed by secondary intention. Yet, three free anterolateral thigh perforator flaps were successfully revised after removing compression from the perforator. The rest of flaps were without any complications. All the patients with tracheotomy, 3 months after surgery, have varying degrees of difficulty in swallowing, into the flow of food choking, but normal swallowing returned after 3 months in most patients. The shortest case of the postoperative month (full tongue cut) will be able to swallow normally.

Discussion

Orally, especially on the expansion of oropharyngeal cancer resection, traditional universally accepted technique is to cut the lower lip and mandibulotomy, open the lip and cheek composite flap, or even lip splitting, or removal by approaching the side of the mandible. This technique has the advantage of creating minimal damage to the innervation and blood supply of the lip, and it avoids injury to branches of the mental nerve and facial nerve [10]. However, this technique will increase the operation time in cutting the flap and closing the wound, and the lower lip and chin, leaving a scar, affecting the appearance. Furthermore, these incisions are associated with occasional lip deformities, because this disrupts the muscle fibers of the orbicularis oris muscle [11]. Other complications may include notching of the lower lip, labial sulcus stenosis, fistula, loss of chin pad contour, decreased lip sensation, and decreased lip mobility [12]. Especially in cases of mandibulotomy, also needing to be reset, the metal plate fixation with postoperative radiotherapy may cause radioactive osteomyelitis increasing risk of a patient's pain.

In our study, the LSM group has a higher rate of fistula formation than that of the MFA group (5/45 vs 0/54). Of the

Table 3 Clinical examination

	MVA			LSM			p value
	Mean	SD	Range	Mean	SD	Range	
Speech	1.35	0.59	1–3	1.53	0.69	1–3	0.170
Tongue mobility	1.50	0.95	1–5	1.60	0.86	1–4	0.359
Lip competency	1.00	0.00	1–1	1.04	0.21	1–2	0.119
TMJ signs	3.00	0.00	3–3	3.89	0.68	3–5	0.000

Lower score indicates better function

Table 4 Subjective outcome

Domains	MVA				LSM				*p* value
	Mean	SD	Median	Range	Mean	SD	Median	Range	
Appearance UW-QOL	60.63	9.42	62.00	30–84	54.42	12.00	56.00	20–80	0.001
Swallowing UW-QOL	72.28	5.89	73.00	60–85	70.93	6.40	71.00	58–85	0.235
Chewing UW-QOL	66.89	7.91	67.00	50–78	65.53	7.83	66.00	50–78	0.955
Speech UW-QOL	69.37	9.07	70.00	40–80	70.76	9.47	72.00	40–80	0.121

patients in the LSM group who developed a fistula, four patients had a history of postoperative external beam radiation as part of their treatment regimen. Mandibular skin fistula occurred in a patient after radiotherapy; at the same time, the patient exhibited symptoms of temporomandibular disorders (Fig. 2).

In the present study, assessments of speech, swallowing, appearance, and chewing using the University of Washington questionnaire were used. We were not able to see any significant differences between the MFA group and LSM groups regarding swallowing, chewing, and speech. This shows that oral cancer surgery does seem to have an overall effect on oral function. However, there was a significant change in the appearance components. This result shows that more of the lower lip scars cause high levels of patient anxiety self-abased and decreased quality of life.

In our study, functional assessment after oral access procedures is in accordance with the method of Devine [8]. There were no significant clinical functional differences between the two groups, such as speech, tongue mobility, and lip competence. In regard to the average score of TMJ signs, there was a significant difference in the presence of TMJ signs between the two access methods (MVA 3.00±0, LSM 3.89±0.68, p= 0.000). The lip-split mandibulotomy access technique is the out-swinging of the mandible, and it would seem that this causes significant long-term TMJ problems. However, in the two groups, 3 months after surgery, in patients with TMJ discomfort, they had some improvement.

In order to avoid these shortcomings, some take visor approach extended resection of oral cavity cancer. Seventy patients undergoing resection of advanced (T4) anterior oral cavity squamous cell carcinoma requiring fibula reconstruction were grouped according to surgical access procedure performed (lip splitting or visor flap). Data on surgical morbidity, margin status, and outcomes were compared. The lip-split approach has a higher rate of postoperative fistula formation than the visor flap approach; fistula formation may be associated with previous irradiation [3]. In 2011, Myers et al. report the outcomes of patients with locally advanced (T3–T4) oral cancers undergoing surgical resection and free tissue reconstruction without the lower lip-splitting procedure. They found that the lower lip-splitting procedure for surgical exposure is unnecessary for both oncologic resection and reconstruction for locally advanced oral cancers. Clear margins, relatively facile flap inset with high success rates, and acceptable complication rates can be safely achieved in this patient population [5]. Tahera's study also has a similar result [13]. However, Peter's studies had the opposite result. They thought lip-splitting mandibulotomy approach provides satisfactory scarring and low self-perception of disfigurement for patients. Moreover, the lip split does not impact lower lip sensation, movement, or oral continence [14].

Our cases neither cut the lower lip nor resect the mandible. The bilateral neck dissection chunk of specimens with the tongue and floor of the mouth resection specimens is pull-through resection. This method not only revealed the double neck dissection wild but also fully revealed bilateral mandibular and oral front of the operative field, oropharynx (base of tongue). The operative field of the hyoid motivated a road directly up to the base of the tongue of the vallecula. Operative field clearly favored the repair and reconstruction of the defect, provided sufficient space for the flap insetting, shortened

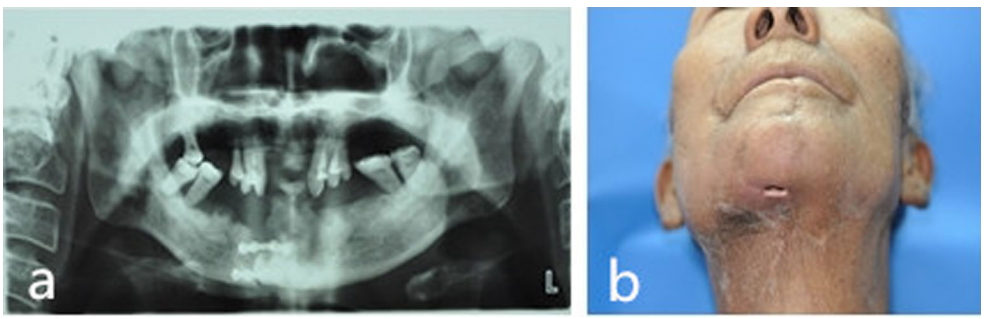

Fig. 2 **a** A patient used lip splitting and mandibulotomy. Postoperative radiotherapy leads to poor healing of bone fragments. **b** A patient used lip splitting and mandibulotomy. Postoperative radiotherapy leads to poor healing of bone fragments, resulting in lower jaw skin fistula

operative time significantly, reduced bleeding, and reduced postoperative complications, with good shape. Moreover, reserving the mental nerve can avoid lower lip numbness after surgery.

Following the complete oncologic resection of oral cancers, reconstruction is indeed a critical component of comprehensive cancer treatment. Flap transfers are widely accepted as the reconstruction method of choice for large defects because they provide a wide variety of well-vascularized skin, mucosa, and bone. Hanasono et al. [15] reviewed their impact of reconstructive techniques in treating advanced head and neck cancers. They compared 349 patients undergoing free tissue transfers for advanced oral cancers to a historical control group of 135 patients who were treated with pedicled flaps. They found that overall recurrence rates were maintained at 38 % longitudinally, and survival between two study periods also remained similar. In our study, all flaps survived, one flap was completely lost, and only 3 cases postoperatively had small problems after processing all healed.

In theory, mandible discontinuity could allow for increased access and tumor visualization. The data from our study do not support performing mandibulectomy when resecting and reconstructing patients with total or subtotal glossectomy. Our modification of the visor flaps without lip-splitting technique and reserve mental nerve affords a less but still adequately wide exposure for the total or subtotal glossectomy. In this series, our experience was limited to tongue floor of the mouth cancers. We have obtained enough exposure to work and to achieve adequate resection in clearing margins. Resection with clean margins is the main goal in surgical treatment for malignant tumors of the head and neck. In our study, all cases can get broad resection and en-block with the cervical nodes.

The modified visor approach is suggested to be an acceptable and optional approach for total or subtotal glossectomy because of wide exposure, satisfied function, inconspicuous scar, and preservation of the facial nerve. The indications for this approach are primary malignant lesions arising from the tongue and tongue floor of the mouth. However, if the lesion involves the maxilla, maxillary gingiva, and hard/soft palate, this approach could not provide adequate three-dimensional resection place.

Conclusion

Choice of technique is ultimately that of the operating surgeon. The purpose of our study was to promote the use of the modified visor approach in total or subtotal glossectomy as a safe and effective treatment with both a low complication rate and cosmetic results that are superior to the lip-splitting techniques.

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