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Assessment of chewing and swallowing in post mandibular resection patients with no bony reconstruction – A cross sectional study

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ABSTRACT

Introduction: The intricate process of chewing and swallowing is compromised following mandibular resection. An evaluation of chewing and swallowing is crucial to comprehend the quality of life following surgery in cases when bone repair was not performed. The purpose of this study is to evaluate chewing and swallowing in mandibulectomy patients without bony reconstruction.

Material and method: This study involved ten patients, including four with H defects, three with L defects, and three with LC defects, after a one-year postop period. Using Robbin's penetration aspiration scale, video fluoroscopy was used to evaluate swallowing. Using a functional oral intake scale, chewing was assessed. Fischer's exact test was used for statistical analysis.

Results: Robbin's penetration aspiration scale score of 1 was noted in all 10 patients. According to FOIS, 50 % of patients with H defect scored 4, and 66.7 % of those with L defect scored 6. The results were not significant when the scores were correlated with the type of defect.

Conclusion: Mandibular surgical defects which were not reconstructed with bone were shown to affect the quality of life in our study. Chewing efficiency was poorest in patients with H defect. Swallowing efficiency was not affected adversely in this group of patients.

1. Introduction

Odontogenic tumours most often affect the mandible, particularly the posterior area of the mandible. Compared to the maxilla, the mandible is 2.8 times more involved. A multidisciplinary approach is necessary to achieve the best functional and aesthetic results after mandibular resection. There are various ways in which a patient's cosmetic, functional and psychological well-being might be negatively impacted by the surgical removal of benign or malignant tumours affecting the mandible. After mandibular resection, mandibular reconstruction remains a difficult task for surgeons.

The U-shaped mandible not only supports the tongue and muscles on the floor of the mouth but also arches the oral cavity to make mastication, speaking and swallowing easier. Restoring the exterior and internal soft tissue envelope, creating a stable arch and replacing the skeletal buttresses are all important goals of dental reconstruction. These objectives should be achieved to attain better aesthetic results and enhance quality of life.

Because mandibulectomy restricts the flexibility of the jaw and lips, chewing and swallowing are more difficult and slow down the oral stage of swallowing. Mandibulectomy can impair occlusion and also impact lateral and protrusive movement. The probability of dysphagia following mandibulectomy depends on several variables. These factors include the amount of the resection, the reconstruction technique that is utilized, the number of structures that are involved and the patient's ability and willingness to adjust to their new normal.

Nowadays, the free fibula flap is regarded as the best way to restore mandibular continuity. Patients with many medical conditions or those without the financial means to undergo microvascular repair may find satisfactory outcomes using pedicled flaps instead.[1] An important postoperative issue for mandibulectomy patients is dysphagia. Patients who have undergone mandibulectomy may benefit from an accurate diagnosis and time-bound goal-directed therapy for their chewing and swallowing issues.

There is currently not much information on how patients who have had mandibular resections swallow.[2] The entire swallowing process can be assessed when tools like video fluoroscopy are used. There is currently insufficient data in the medical literature to predict long-term

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postoperative swallowing performance.[3] The long-term survival rate and cure rate of patients with head and neck tumours who have had reconstruction with pedicled flaps are likely not the only indicators of therapy effectiveness.[4]

Patients who have mandibular resection without bone repair will have their chewing and swallowing abilities evaluated in this study.

2. Materials and methods

Ten patients who had undergone mandibulectomy without bony reconstruction participated in this study. The institutional ethics committee (IEC/Approval no.249) gave its stamp of approval to the research. Patients with congenital facial defects, patients not willing to take part in this study and patients with a history of allergy especially to iodine were excluded from the study.

Age, sex, diagnosis, and surgical treatment are some of the demographic variables shown in Table 1.

2.1. Mandibular defect

The Boyd mandibular defect[4] classification system divides bone defects into three groups which are as follows: Any lateral defect that extends to the condyle and does not substantially cross the midline is considered to be H. Defects that extend laterally of any length are denoted by L and defects that affect the entire central segment (containing the two canines and four incisors) are denoted by C.

2.2. Video fluoroscopic swallow study (VFSS)

The patients had undergone surgery a year before the video fluoroscopic examination. A single radiologist from the Department of Radiology at Kauvery Hospital in Salem conducted the videofluoroscopic assessment of swallowing. Participants in the VFSS were positioned in a supine posture and observed from both the front and the side throughout the procedure. The study's subjects all consumed liquid contrast material derived from non-ionic iodine. The patient was instructed to consume 10–15 mL bolus while being observed via fluoroscopy. This procedure was done using a GE machine - Innova 520 IGS.

To determine whether there was any clinically significant penetration or aspiration, the video fluoroscopy test results were evaluated using Robbin's penetration aspiration scale.[5] While aspiration was described as the passage of contrast via the glottis, penetration was defined as the persistence of contrast above the glottis with detectable residue. Robbin's penetration aspiration scale is shown in Table 2 and the video fluoroscopy images are shown in Fig. 1.

Table 1
Demographic details of patients.

PATIENT	AGE/ SEX	DIAGNOSIS	SURGICAL PROCEDURE
1	45/M	Ameloblastoma of right mandible	Segmental resection + PMMC flap reconstruction
2	36/F	Ameloblastoma of anterior mandible	Segmental resection + submental flap
3	22/M	Plexiform ameloblastoma right mandible	Segmental resection + primary closure
4	60/M	Well differentiated SCC of right buccal mucosa	Hemi mandibulectomy + PMMC flap reconstruction
5	48/F	OKC of right mandible	Hemi mandibulectomy + tongue flap
6	62/F	Unicystic ameloblastoma left mandible	Segmental resection + primary closure
7	65/M	Clear cell odontogenic tumor right mandible	Hemi mandibulectomy + primary closure
8	61/F	Ameloblastic carcinoma left mandible	Segmental resection + primary closure
9	43/F	Well differentiated SCC	Hemi mandibulectomy + PMMC flap reconstruction
10	37/M	Squamous cell carcinoma of right mandible	Segmental resection + nasolabial flap

2.3. Chewing assessment

To determine each patient's chewing capacity after surgery, the functional oral intake scale (FOIS) was used. Subjects were questioned regarding their meals and scoring was done accordingly. Table 3 depicts the functional oral intake scale.

2.4. Statistical analysis

For data analysis, we utilized SPSS version 24.0. The HCL Classified bony defects were compared using the Penetration Aspiration Scale and the Functional Oral Intake Scale. This was accomplished using Fisher's exact test. $P < 0.05$ was considered statistically significant.

3. Results

The patients were 47.9 years old on average. This study included 5 patients treated for benign tumours and 5 cases with malignancy. Malignant lesions included squamous cell carcinoma (n = 3), clear cell odontogenic carcinoma (n = 1) and ameloblastic carcinoma (n = 1), in contrast to benign lesions such as ameloblastoma (n = 4) and odontogenic cyst (n = 1). In this study, H defects accounted for 40 %, type LC defects for 30 % and type L defects for 30 %. Table 4 provides a summary of the patient's bony defects according to the HCL classification.

Reconstruction of the defects was done with PMMC flap (n = 3), primary closure (n = 4), tongue flap (n = 1), submental flap (n = 1) and nasolabial flap (n = 1). Titanium reconstruction plates were not used in any of the subjects. A videofluoroscopic swallowing study was done one year postoperatively in all ten patients. On VFSS, no penetration or aspiration was observed in 10 cases (100 %). Table 4 provides a synopsis of the swallowing score and functional oral intake scale score. In terms of the FOIS, fifty percent of patients who had H defect had a score of 4 and the remaining fifty percent had a score of five. 66.7 % of patients with L defect had scores of 6. Tables 5 and 6 demonstrate that there was no statistically significant impact of the kind of defect on swallowing or chewing.

4. Discussion

Surgery to the oropharyngeal and oral regions can result in a variety of physical, functional, and psychological problems, including severe swallowing and speech difficulties.[6,7] The old metrics of disease cure and long-term survival rate are insufficient to evaluate the efficacy of treatments for head and neck benign or malignant tumours. Disease-specific measures that take into account an individual's sense of well-being is also necessary as indicators of the outcome of surgery.[8]

Aspiration and dysphagia are experienced by 12–75 % of patients treated for head and neck tumours.[9] Both are acknowledged as possible disastrous repercussions. To evaluate swallowing dysfunction and aspiration, the gold standard is video fluoroscopy and fibreoptic endoscopic examination of swallowing.[10]

Table 2
Robbin's penetration aspiration scale.

Score	Description
1	Contrast does not enter the airway
2	Contrast enters the airway, remains above vocal folds, no residue
3	Contrast remains above vocal folds, visible residue remains
4	Contrast contacts vocal folds, no residue
5	Contrast contacts vocal folds, visible residue remains
6	Contrast passes glottis, no sub-glottic residue visible
7	Contrast passes glottis, visible sub-glottic residue despite patient's response
8	Contrast passes glottis, visible sub-glottic residue, absent patient response

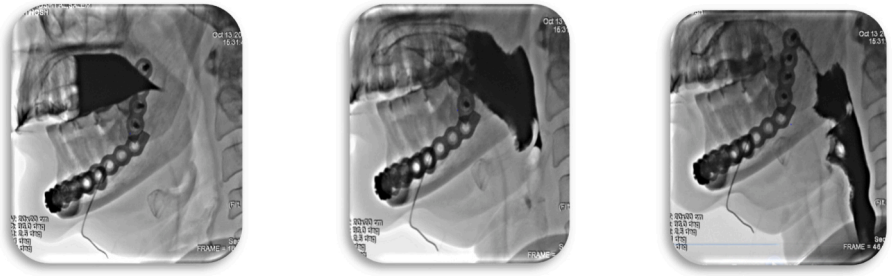

Fig. 1. Video fluoroscopy.

Table 3
Functional oral intake scale.

FOIS grade	Intake description
1	No oral intake
2	Tube dependent with minimal oral intake
3	Tube dependent with consistent oral intake
4	Total oral intake of single consistency
5	Total oral intake of multiple consistencies but requiring special preparation
6	Total oral intake with no special preparation but must avoid specific food or liquid items
7	Total oral diet with no restrictions

Table 4
Summary of defect type, swallowing score and FOIS score in the subjects.

PATIENT	DEFECT TYPE	ROBBINS SCORE	FOIS SCORE
1	LC	1	5
2	LC	1	5
3	LC	1	6
4	H	1	4
5	H	1	5
6	L	1	4
7	H	1	5
8	L	1	6
9	H	1	4
10	L	1	6

Table 5
Comparison of FOIS by HCL classification.

Functional oral intake scale		Classification			Total	P value
		LC	L	H		
4	n	0	1	2	3	.212
	%	.0 %	33.3 %	50.0 %	30.0 %	
5	n	2	0	2	4	
	%	66.7 %	.0 %	50.0 %	40.0 %	
6	n	1	2	0	3	
	%	33.3 %	66.7 %	.0 %	30.0 %	
Total	n	3	3	4	10	
	%	100.0 %	100.0 %	100.0 %	100.0 %	

Table 6
Comparison of Penetration aspiration score by HCL classification.

Penetration aspiration scale		Classification			Total	P value
		LC	L	H		
1	n	3	3	4	10	–

When it comes to the maxillofacial region, the most pressing issues before treatment are pain and functional impairments in chewing and swallowing. However, swallowing, chewing speaking and tongue movement are the most urgent post-operative problems. A patient's capacity to communicate, chew and swallow after mandibular resection is an important component of their health-related quality of life. With the help of training, patients may be able to recover from surgery more quickly and may enhance their post-operative quality of life.

The location and size of the lesion are two of the many factors that determine the final swallowing outcome. Soft tissue grafts used in mandibulectomy repair have a significant risk of adversely affecting speech, swallowing ability and quality of life.[11] Ohkoshi et al. conducted a prospective observational study and discovered that lateral or hemi-mandibulectomy did not substantially impede postoperative oral intake in contrast to the resection of other subsites in the oral cavity. Patients almost completely retain chewing and swallowing abilities after lateral or hemimandibulectomy with free flap reconstruction.[12] Ten patients who received free fibula flap repair after mandibular resection were the subjects of a case study published in 2005 by Seikaly et al. Before, during and after radiation therapy, all of these patients had undergone modified barium swallow tests.[13] They did not discover any statistically significant variations in dysphagia rates at any of the periods across their series of assessments. Additionally, none of their swallow trials revealed incidences of aspiration or laryngeal penetration.

It is crucial to think about using primary closure whenever feasible; the surgeon's choice to employ flap reconstruction is dependent on the type of defect to be treated and the extent of resection. Urken et al.[14] hypothesized in 1991 that patients who had free flaps used for primary oromandibular reconstruction returned to their pre-disease levels of function and aesthetics more closely than non-reconstructed patients. Studies comparing reconstructed and nonreconstructed patients in terms of objective speech and deglutition found no statistically significant changes. This is because these functions are mostly determined by the soft tissue components, namely the residual tongue's motion. Soft tissue repair decreases swallowing ability for 6 months and continues for 12 months, according to Borggreven et al.[15]

The postoperative speech and swallowing function of sixty patients with oral cancer reconstructed with either radial forearm free flap or submental island pedicled flap were compared by Paydarfar et al.[16] When comparing the two group's postoperative swallowing and speaking abilities, faster recovery periods and fewer consecutive hospital admissions were found in the submental island pedicled flap group, however, no statistically significant difference was found.

You Q. et al.[17] assessed the functional results and health-related quality of life in 117 patients who had primary surgery for oropharyngeal and oral squamous cell carcinomas. Patients were classified into three groups: primary closure, radial forearm free flap and submental island pedicled flap. The radial forearm free flap repair group had better results on measures of mastication, speaking and swallowing when compared to the primary closure group. After a year of recovery, patients in the submental island pedicled flap and radial forearm free flap

groups did not vary significantly in terms of quality of life.

Masticatory efficiency in oral cancer surgery patients was assessed by Namaki et al.[18] preoperatively and postoperatively. Patients undergoing marginal or segmental mandibulectomy had reduced masticatory performance postoperatively as compared to their preoperative levels.

Vicente et al.[19] looked at how different reconstruction methods affected swallowing abilities in oral cancer patients who had tumour removal and microvascular free flap repair and concluded that the method of reconstruction affects swallowing.

All the patients in this research had mandibulectomy followed by soft tissue repair. Procedures such as primary closure, pectoralis major myocutaneous flap (PMMC), tongue flap and submental flap were performed on these patients.

In this study, none of our patients had penetration or aspiration during swallowing. The patients were evaluated 1 year postoperatively during which swallowing was not affected. In the intergroup comparison, chewing efficiency was better in patients with L defect and was least in H defect.

There was no swallowing therapy for any of our patients between the surgery and the postoperative VFSS. VFSS offers the most accurate representation of the functional losses caused by surgery and it helps to identify patients having dysphagia. Additionally, with the aid of this knowledge, practitioners are better able to counsel patients and estimate the functional prognosis accurately.

Several limitations are associated with this research. This study has a limited sample size and also has an unequal distribution of variation in mandibular defects.

Despite these limitations, our study attempted to understand the swallowing and chewing efficiency of individuals undergoing mandibular resection with no bony reconstruction which is the surgical option in many institutions.

5. Conclusion

Mandibular surgical defects that were not reconstructed with bone were shown to affect the quality of life in our study. Chewing efficiency was poorest in patients with H defect. Swallowing efficiency was not affected adversely in this group of patients.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

1. Hassid VJ, Maqusi S, Culligan E, Cohen MN, Antony AK. Free microsurgical and pedicled flaps for oncological mandibular reconstruction: technical aspects and evaluation of patient comorbidities. *ISRN Surg.* 2012;2012, 792674.
2. O'Connell DA, Rieger J, Harris JR, et al. Swallowing function in patients with base of tongue cancers treated with primary surgery and reconstructed with a modified radial forearm free flap. *Arch Otolaryngol Head Neck Surg.* 2008 Aug;134(8):857–864.
3. Gonzalez SR, Hobbs B, Vural E, Moreno MA. Functional outcome predictors following mandibular reconstruction with osteocutaneous fibula free flaps: correlating early postoperative videofluoroscopic swallow studies with long-term clinical results. *Maxillofac Plast Reconstr Surg.* 2019 Aug 2;41(1):30.
4. Jewer DD, Boyd JB, Manktelow RT. Orofacial and mandibular reconstruction with the iliac crest free flap: a review of 60 cases and a new method of classification. *Plast Reconstr Surg.* 1989;84(3):391–403.
5. Robbins J, Coyle J, Rosenbek J, Roecker E, Wood J. Differentiation of normal and abnormal airway protection during swallowing using the penetration-aspiration scale. *Dysphagia.* 1999;14(4):228–232. Fall.
6. Pauloski BR, Logemann JA, Rademaker AW, et al. Speech and swallowing function after anterior tongue and floor of mouth resection with distal flap reconstruction. *J Speech Hear Res.* 1993 Apr;36(2):267–276.
7. Logemann JA, Pauloski BR, Rademaker AW, et al. Speech and swallow function after tonsil/base of tongue resection with primary closure. *J Speech Hear Res.* 1993 Oct;36(5):918–926.
8. Morton RP. Life-satisfaction in patients with head and neck cancer. *Clin Otolaryngol Allied Sci.* 1995 Dec;20(6):499–503.
9. Porto de Toledo I, Pantoja LLQ, Luchesi KF, Assad DX, De Luca Canto G, Guerra ENS. Deglutition disorders as a consequence of head and neck cancer therapies: a systematic review and meta-analysis. *Support Care Cancer.* 2019 Oct;27(10):3681–3700.
10. Clavé Pere, Arreola Viridiana, Romea Maise, Medina Lucía, Palomera Elisabet, Serra-Prat Mateu. Accuracy of the volume-viscosity swallow test for clinical screening of oropharyngeal dysphagia and aspiration. *Clin Nutr.* 2008;27(6):806–815.
11. Kanchan P Dholam, Sadashiva Karthik M, Sandeep Gurav J. Study of quality of life in patients with soft tissue reconstruction following mandibulectomy. *Maxillofac. Oral Surg.* 2019;18(2):266–272.
12. Ohkoshi A, Ogawa T, Nakanome A, et al. Predictors of chewing and swallowing disorders after surgery for locally advanced oral cancer with free flap reconstruction: a prospective, observational study. *Surg Oncol.* 2018 Sep;27(3):490–494.
13. Seikaly H, Maharaj M, Rieger J, Harris J. Functional outcomes after primary mandibular resection and reconstruction with the fibular free flap. *J Otolaryngol.* 2005;34(1):25–28.
14. Urken ML, Buchbinder D, Weinberg H, et al. Functional evaluation following microvascular oromandibular reconstruction of the oral cancer patient: a comparative study of reconstructed and nonreconstructed patients. *Laryngoscope.* 1991 Sep;101(9):935–950.
15. Borggreven PA, Verdonck-de Leeuw I, Rinkel RN, et al. Swallowing after major surgery of the oral cavity or oropharynx: a prospective and longitudinal assessment of patients treated by microvascular soft tissue reconstruction. *Head Neck.* 2007;29(7):638–647.
16. Paydarfar JA, Patel UA. Submental island pedicled flap vs radial forearm free flap for oral reconstruction: comparison of outcomes. *Arch Otolaryngol Head Neck Surg.* 2011;137:82–87.
17. You Q, Jing X, Fan S, Wang Y, Yang Z. Comparison of functional outcomes and health-related quality of life one year after treatment in patients with oral and oropharyngeal cancer treated with three different reconstruction methods. *Br J Oral Maxillofac Surg.* 2020 Sep;58(7):759–765.
18. Namaki S, Matsumoto M, Ohba H, Tanaka H, Koshikawa N, Shinohara M. Masticatory efficiency before and after surgery in oral cancer patients: comparative study of glossectomy, marginal mandibulectomy, and segmental mandibulectomy. *J Oral Sci.* 2004;46(2):113–117.
19. de Vicente JC, Rúa-Gonzálvez L, Barroso JM, et al. Functional results of swallowing and aspiration after oral cancer treatment and microvascular free flap reconstruction: a retrospective observational assessment. *J Cranio-Maxillo-Fac Surg.* 2021 Oct;49(10):959–970.