Original Research Article

Comparative study of marginal mandibulectomy vs segmental or hemi-mandibulectomy in oral cavity cancers

Shekhargouda[1,*]**, Digvijay B Patil**[1]

[1]*Dept. of Surgical Oncology, Krishna Institute of Medical Sciences "Deemed To Be University, Karad, Maharashtra, India*

A B S T R A C T

Introduction: Surgery is the most well-established mode of initial definitive treatment for the majority of oral cancers. The most important decision in terms of tumor ablation in oral cancers when the jaws are potentially involved is the management of the mandible.

Materials and Methods: The present study was conducted at a tertiary healthcare institute among 61 patients who underwent bony resection for Squamous Cell Carcinoma (SCC) close to the mandible, adherent or directly invading this bone, from January 2021 to December 2021. Records of the patients were reviewed. The patients whose surgical resection involved a marginal or segmental mandibulectomy and with a minimum follow-up of 24 months were included in the analysis. Adequate clinical information was available in 61 patients.

Conclusions: Size of mandibular resection greater than 4 cm and tumor infiltration beyond the resection margins are correlated with poor survival rates, but no differences between marginal or segmental mandibulectomies could be shown, as was the case in other reports. When gross bone involvement has occurred, segmental resection is the method of choice. Careful case selection will allow a favorable oncologic outcome with preservation of mandibular contour.

1. Introduction

For the most majority of oral malignancies, surgery is the most well-established means of first definitive therapy. The management of the mandible is the most important decision in terms of tumor ablation in oral cancers when the jaws are potentially involved.

The treatment aims in the therapy of oral cavity cancer include tumor elimination and achieving an acceptable aesthetic appearance. There is substantial discussion over the best surgical approach for treating squamous cell carcinoma (SCC) of the oral cavity. Although it is widely acknowledged that individuals with mandibular invasion should be treated surgically, the level of mandibular resection necessary remains debatable. We now understand that SCC invades the mandible by direct extension rather of metastasis.[1,2]

Oral SCC next to or infiltrating the mandible has traditionally been treated by segmental excision. However, the severe functional and cosmetic consequences of radical surgery have prompted surgeons to seek for novel conservative mandibular excision approaches. The notion of mandibular preservation is strongly related to the advancement of a better knowledge of the techniques of local and regional spread of oral cavity cancers.

Mandibular continuity preservation allows for a less difficult surgical procedure and a favourable long-term functional outcome.[3] The main challenge is whether these excellent functional and aesthetic outcomes can be obtained without compromising disease management.

* *Corresponding author.*
E-mail address: goudashekhar@gmail.com (Shekhargouda).

The goal of this research was to compare the results of two distinct mandibular resection procedures, segmental and marginal mandibulectomy, in terms of local control and survival.

2. Materials and Methods

The current study was conducted from January 2021 to December 2021, among 61 patients who received skeletal resection for intraoral SCC adjacent to the mandible, adhering to, or directly entering this bone at a tertiary healthcare centre. The patients' records were examined. The study comprised individuals whose surgical resection included a marginal or segmental mandibulectomy and who had a minimum follow-up of 24 months. In 61 patients, sufficient clinical information was available.

Age, gender, initial tumor location and size, surgical method used, presence of mandibular invasion, surgical margin status, lymph node metastases, adjuvant radiation, local tumor recurrence, and survival free of illness were among the data retrieved.

Clinical examination, panoramic radiography, and/or computed tomography scans were used to determine mandibular invasion prior to surgery. En bloc excision of a variable length of mandible was referred to as segmental mandibulectomy. In 56 instances, a segmental resection comprising the whole height of the mandibular body was done. These instances were classified as part of a segmental group (SG). Several reconstructive procedures, including regional and free flaps, were performed in these patients who had substantial resections. As previously stated, mandibular abnormalities were often restored using a free fibular flap in recent years.[4]

Subtotal mandibulectomies were referred to as marginal mandibulectomy. Marginal resections were often conducted in an oblique approach. To mark the boundaries of the excision, the bone was sliced with a well-cooled drill, and the holes were then connected with a cutting drill. The marginal group included all instances with preservation of mandibular continuity (MG). This category consisted of 50 instances. The operating surgeon chose whether to utilise marginal or segmental resection at the time of surgery, hence the two groups were not randomised.

The size of mandibulectomy was evaluated, and three groups were considered (2, 2 to 4, or >4 cm) to clarify the efficiency of bone resection for illness management. The TNM classification, as defined by the American Joint Committee on Cancer, was used to stage all cases. At the first visit, 49 patients had clinically positive lymph nodes (SG, 27 instances; MG, 22 cases), but no distant metastases was found. In 103 instances, neck dissection was done for therapeutic or elective reasons (SG, 55 cases; MG, 48 cases). The floor of the mouth, gingiva, and retromolar trigone were the three most prevalent sites for intraoral SCC. Table 3 indicates tumor size (pT) in connection to segmental or marginal mandibulectomy, while Table 4 reveals nodal stage (pN). Pathologic (post-treatment) tumor and node staging are denoted by the terms pT and pN, respectively. Patients receiving marginal mandibulectomy had smaller tumors on average than those undergoing segmental mandibulectomy.

During the procedure, margins of at least 1 cm beyond all clinically visible tumors were acquired in most cases. The appropriateness of mucosal margins has been validated by intraoperative frozen section in the previous 5 years, but no effort has been made to check the suitability of bone resection margins intraoperatively. Following decalcification of the removed bone, microscopic examination revealed mandibular involvement.

Postoperative radiation was frequently administered if the initial tumor was greater than 4 cm, if several nodes in the neck harboured metastatic disease, or if the pathologic surgical margins were thought to be compromised. 56 individuals were treated with postoperative adjuvant radiation treatment based on these grounds (MG, 24 cases; SG, 32 cases).

Postoperatively, patients were examined every 3 months for the first 24 months, then every 6 months for the next 5 years, and finally yearly. The patient's illness state was verified two and five years after therapy began.

To investigate the relationship between categorical data and the frequency of local recurrence, categorical data were analysed using the Pearson $y2$ test with Yates' correction when appropriate. The following characteristics were investigated: tumor site, pathologic tumor stage, surgical margin status, pathologic cervical node involvement, kind of mandibulectomy, degree of bone resection, and bone involvement. A logistic regression for multivariate analysis was used to investigate the link between mandibular bone involvement and several pertinent parameters (kind of mandibulectomy, pathologic cervical node involvement, degree of bone resection, and pathologic tumor stage).

For statistical purposes, cervical node involvement was defined as positive or negative, and tumor stage was classified as follows: early stages, pT1 and pT2 stages; late stages, pT3 and pT4 stages.

3. Results

The present study consisted of 50 men and 11 women who ranged in age from 35 to 80 years (mean age, 54.6 years). Gingiva was the commonest location (63.93%), followed by retromolar trigone (18.03), tongue among 8.2%, buccal mucosa was affected among 5.56% subjects and oropharynx among 3.208% study subjects.

The tumor size, pathologic tumor stage (majority presented with pT4 grade) and pathologic cervical node staging (majority presented with pN0 grade) is mentioned in above table. SG group resulted in a local recurrence rate of 33.33% (12 of 36 cases), whereas MG group had a 28%

Table 1: Demographic and clinical presentation

Demographic and clinical presentation		Number	Percentage
Genderwise distribution	Males	50	81.96
	Females	11	18.03
Mean age		54.6 years	
Site of tumors	Gingiva	39	63.93
	Retromolar trigone	11	18.03
	Tongue	5	8.20
	Buccal mucosa	4	6.56
	Oropharynx	2	3.28

Table 2: Tumor grading

Tumor grading		Segmental	Marginal
Size of tumor	<2 cm	1	10
	2 to 4 cm	12	13
	>4 cm	23	2
Pathologic tumor stage	pT1	0	1
	pT2	9	7
	pT3	6	5
	pT4	21	13
Pathologic cervical node stage	pN0	17	14
	pN1	11	6
	pN2	7	5
	pN3	1	0

(7 of 25 cases) local recurrence rate. The recurrence rate was not directly related to the size of the primary tumor, because T1 stage was associated with an higher local recurrence rate. In the MG, 4 cases were salvaged across this secondary surgical treatment.

Table 3: Local recurrence rate (Tumor Stage)

Local recurrence rate (Tumor Stage)	Segmental		Marginal	
	N	%	N	%
pT1	0	0.00	0	0.00
pT2	1	11.11	2	28.57
pT3	3	50.00	1	20.00
pT4	8	38.10	4	30.77

The cases treated with a greater than 4 cm bone resection showed a lower survival rate than those treated with less than 4 cm mandibulectomy. Also, no significant association was observed between postoperative adjuvant radiotherapy and survival.

Table 4: Results of follow-up

Results of follow-up	Segmental		Marginal	
	N	%	N	%
No evidence of disease	11	30.56	13	52.00
Death from cancer	16	44.44	7	28.00
Death from other causes	9	25.00	5	20.00
Total	36	171.43	25	100.00

4. Discussion

The notion of mandibular preservation is strongly related to a better understanding of the manner in which oral cavity neoplasms propagate. Polya and von Navrati[5] discovered in 1902 that lymphatics from the tongue and mouth floor travelled through the mandibular periosteum on their route to the cervical nodes. Slaughter et al[6] recommended aggressive excision of the mandible for the treatment of tumors with bone involvement based on this anatomic analysis, thinking that it was involved by either direct ex- tension or periosteal involvement via lymphatic drainage of the tumor. As a result, segmental resection was deemed sufficient surgical treatment for oral SCC close to or penetrating the mandible. In an initial effort to preserve mandibular continuity, Ward and Robben9 proposed the "pull-through" operation for tumors placed more than 1 cm from the lingual side of the mandible in 1951.

Greer et al,[7] on the other hand, described the marginal mandibulectomy procedure in a study of 21 patients in 1953, removing just a portion of the mandibular thickness for the treatment of intraoral malignancy. The basis for this approach was described by Marchetta et al.[1,2] who demonstrated that tumors only involved the mandible if there was direct extension through the periosteum rather than periosteal lymphatics. These researchers conducted a thorough examination of surgical pathologic materials and discovered no indication of mandibular invasion by lymphatic dissemination. The current tendency clearly supports maintaining cortical continuity with marginal excision in appropriate situations.

Due to the loss of mandibular continuity, segmental resections cause severe functional and cosmetic issues. The preservation of arch continuity is critical for functional morbidity following mandibular resection. In the case of segmental resections, this may be accomplished primarily by microvascular transfer of vascularized bone grafts.[4]

Barttelbort et al.[8] proposed a unified theory of mandibular tumor invasion. The malignancy first infiltrates the mandible in the area superior to the mylohyoid muscle along a wide front, immediately affecting the inferior alveolar canal. However, the tumor can only invade the inferior lingual plate and the inferior cortical edge as a relatively late phenomenon. As a result, marginal mandibulectomy offers the ability to remove the at-risk tissues over an appropriate length without adversely disrupting mandibular shape.

Brown et al[9] discovered that bigger and deeper tumors are more likely to infiltrate the mandible and have a more aggressive pattern of bone invasion. A segmental resection would be a safer oncologic alternative in such circumstances. If panoramic roentgenography reveals an erosive bone defect that does not extend beyond the inferior alveolar canal, an invasive bone defect that is restricted to a superficial region of the alveolar bone,

or no bone involvement at all, marginal resection of the mandible may be considered. If conservative mandibular resection achieves cure rates equivalent to segmental mandibulectomy, the less invasive approach is preferred. Conservative mandibulectomy may be an option for individuals with T4 lesions who do not have signs of medullary invasion.

According to earlier authors,[10] there is probably no justification to execute a segmental resec- tion when preoperative investigations show no evidence of bone invasion. However, we feel that the ultimate choice about the mandibulectomy procedure should be based on clinical judgement in the operating theatre, analysing the tumor's closeness to the mandible and its adhesion to the mandible, as previously indicated.[11]

A positive resection margin was seen in 16 of 61 of our patients (26.23 percent). Six individuals died as a result of locoregional uncontrolled illness in these situations with a positive margin. According to Ravasz et al,[12] the prevalence of positive resection margins ranges from 3% to 60% in various studies, although these authors found no significant variations in locoregional failure in connection to the status of the surgical margin.

However, investigations such as those of Spiro et al[13] discovered a very significant link between positive margins and poor survival in the case of oral tongue cancers. According to our procedure, a positive resection margin was an indication for post-operative irradiation, and a positive resection margin had a substantial detrimental impact on survival (P =.0001). It is also worth mentioning that in a multivariate model, positive surgical margin (P =.01) and node involvement (P =.001) are associated with a poor survival rate in the MG. The important factors are nodal stage and tumor invasion of the surgical margins.

Slaughter et al[6] discovered bone involvement in 29 percent of his cancer patients. Bahadur[14] observed tumor erosion into the jaw in 25% of his patients. In the current research, 35% of the cases had verified evidence of bone involvement, while studies on mandible gingival cancers include the bone in a significant proportion of patients (>75%).[15] Our findings support the notion that non-gingival bone-invading tumors are often big. In an Ash et al. investigation, tumor size was shown to be a more relevant prognostic predictor than mandibular invasion.[16] Some research have looked at the prognostic value of mandibular invasion. These trials yielded contradictory findings, with claims of a negative affect on prognosis[17,18] or no influence on outcome.[19]

According to Wong et al.,[20] the difference in survival in the event of bone invasion is attributable to the histologic type of mandibular invasion or to the increased number of positive surgical margins detected in the infiltrative lesions. Our research also demonstrated the significance of obtaining a histologically negative margin. The absence of statistical

connection between local recurrence and bone invasion in this dataset backs with previous results.[19] Only two studies reported on local recurrence and survival following segmental and marginal operations.[19] Overall survival was determined by tumor stage, nodal stage, and bone invasion in these studies.

In 1987, Barttelbort et al[8] published the results of a 38-patient research comparing rim mandibulectomy to segmental method, which revealed comparable local control rates (75 percent versus 64 percent). In our MG, 10 cases (20%) had a local recurrence, whereas 19 (33.9%) had a recurrence in the SG. Furthermore, failures after marginal resection were usually retrieved. In the current research, analysis of these two modalities revealed that rates of "no indication of illness" after 2 years following surgery for the SG and MG were almost identical, 56 percent and 61 percent, respectively. Our findings led us to believe that in carefully chosen situations, SCCs may be effectively managed by marginal resections.

In this series, the role of postoperative adjuvant radiation treatment is unknown. The impact of postoperative radiation on survival cannot be regarded in isolation in this dataset. As a result, it is impossible to compare and draw clear conclusions. Oral SCC has a good prognosis, with a 5-year survival rate of less than 50%.

26 Patients with oral cancer and mandibular bone involvement had the lowest survival rate of all oral cavity tumors. The current research found that after the first surgical therapy, the MG had a local control rate of 80%. Totsuka et al18 found that following a 2-year follow-up, the survival rate for mandibular gingival cancer after marginal (86 percent) and segmental (86 percent) techniques was almost identical (82 percent). In a trial of 222 patients, Werning et al[24] found a local control rate of 87.4 percent, while Ord et al[25] reported a local control rate of 92.3 percent. Wald and Calcaterra[29] reported the outcome of mandibular gingival cancer therapy in 1983, and the failure rates for marginal and segmental groups were comparable. The later stages necessitated a major surgery with segmental mandibulectomy; yet, despite this therapy, the locoregional recurrence rate was significant.

In other studies, marginal resection was linked with comparable[8,15] or slightly inferior[19] survival rates when compared to segmental resection. Our study's findings are consistent with those of others.[10] found that the kind of mandibular resection (marginal versus segmental) had no effect on survival rates, however this was not the case with regard to the amount of the mandibulectomy. Our findings support the efficacy of both modalities of mandibular resection, highlighting surgical margin status and bone penetration as the most significant predictors of survival. Although we were unable to demonstrate a clear association between margin involvement and local recurrence, the negative effect of involved surgical margin

on survival in our research is consistent with prior reports.

5. Conclusions

The size of mandibular resection higher than 4 cm and tumor infiltration beyond the resection margins are associated with poor survival rates, but no differences between marginal and segmental mandibulectomies could be shown, as in previous studies. When there is a lot of bone involved, segmental resection is the way to go. With careful patient selection, a positive oncologic result with preservation of mandibular shape is possible.

6. Conflict of Interest

The authors declare no relevant conflicts of interest.

7. Source of Funding

None.

References

1. Marchetta FC, Sako K, Badillo J. Periosteal lymphatics of the mandible and intraoral carcinomas. *Am J Surg*. 1964;108:505–7. doi:10.1016/0002-9610(64)90144-8.
2. Marchetta FC, Sako K, Murphy JB. The periosteum of the mandible and intraoral carcinoma. *Am J Surg*. 1971;122(6):711–3. doi:10.1016/0002-9610(71)90432-6.
3. Randall CJ, Eyre J, Davies D. Marginal mandibulectomy for malignant disease: Indications, rationale and results. *J Laryngol Otol*. 1987;101(7):676–84.
4. oz MFM, Naval L, ıguez FJR. Vascularized free fibular flap for mandibular reconstruction: A report of 26 cases. *J Oral Maxillofac Surg*. 2001;59(2):140–4. doi:10.1053/joms.2001.20482.
5. Polya AE. Untersuchungen ueber die lymph- bahnen der Wangenschleimhaut. *Dtsch Z Chir*. 1902;66:122–75. doi:10.1007/BF02790876.
6. Slaughter ED, Roeser EH, Smejkal WF. Excision of the mandible for neoplastic disease. *Surgery*. 1949;26(3):507–22.
7. Greer DB, Smith RR, Klopp CT. A surgical method of treatment of carcinoma of the floor of the mouth. *Surgery*. 1953;34(2):279–87.
8. Barttelbort SW, Bahn SL, Ariyan S. Rim mandibulectomy for cancer of the oral cavity. *Am J Surg*. 1987;154(4):423–8. doi:10.1016/0002-9610(89)90017-2.
9. Brown JS, Lowe D, Kalavrezos N. Patterns of invasion and routes of tumor entry into the mandible by oral squamous cell carcinoma. *Head Neck*. 2002;24(4):370–84. doi:10.1002/hed.10062.
10. De Vicente JC, ıguez OR, Llorente S. Oral squamous cell carcinoma of the mandibular region: A survival study. *Head Neck*. 2001;23(7):536–43. doi:10.1002/hed.1075.
11. Leipzig B. Assessment of mandibular invasion by carcinoma. *Cancer*. 1985;56(5):1201–5. doi:10.1002/1097-0142(19850901)56:5<1201::aid-cncr2820560540>3.0.co;2-r..
12. Ravasz LA, Slootweg PJ, Hordijk GJ. The status of the resection margin as a prognostic factor in the treatment of head and neck carcinoma. *J Craniomaxillofac Surg*. 1991;19(7):314–8. doi:10.1016/s1010-5182(05)80339-7.
13. Spiro RH, Guillamondegui O, Paulino AF. Pattern of invasion and margin assessment in patients with oral tongue cancer. *Head Neck*. 1999;21(5):408–13. doi:10.1002/(sici)1097-0347(199908)21:5<408::aid-hed5>3.0.co;2-e.
14. Bahadur S. Mandibular involvement in oral cancer. *J Laryngol Otol*. 1990;104(12):968–71. doi:10.1017/s0022215100114501.
15. Totsuka Y, Usui Y, Tei K. Results of surgical treatment for squamous carcinoma of the lower alveolus: Segmental vs mar- ginal resection. *Head Neck*. 1991;13(2):114–20. doi:10.1002/hed.2880130206.
16. Ash CS, Nason RW, Abdoh AA. Prognostic implications of mandibular invasion in oral cancer. *Head Neck*. 2000;22(8):794–8. doi:10.1002/1097-0347(200012)22:8<794::aid-hed8>3.0.co;2-w.
17. Soo KC, Spiro RH, King W. Squamous carcinoma of the gums. *Am J Surg*. 1988;156(4):281–5. doi:10.1016/s0002-9610(88)80292-7.
18. Overholt SM, Eicher SA, Wolf P, Weber RS. Prognostic factors affect- ing outcome in lower gingival carcinoma. *Laryngoscope*. 1996;106(11):1335–9. doi:10.1097/00005537-199611000-00006.
19. Dubner SM, Heller KS. Local control of squamous cell carci- noma following marginal and segmental mandibulectomy. *Head Neck*. 1993;15(1):29–32. doi:10.1002/hed.2880150107.
20. Wong RJ, Keel SB, Glynn RJ, Varvares MA. Histological pattern of mandibular invasion by oral squamous cell carcinoma. *Laryngoscope*. 2000;110(1):65–72. doi:10.1097/00005537-200001000-00013.

Author biography

Shekhargouda, Senior Resident ⓘ https://orcid.org/0000-0002-1838-7747

Digvijay B Patil, Assistant Professor