

Conservative mandibular resections for oral cavity malignancies: A review

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ABSTRACT

The mandible plays an important role in mastication, speech and facial cosmesis. Apart from direct involvement by oral malignancies, the mandible used to be excised in oral cancers due to its proximity to the tumour, for adequate resection margins and for fear of recurrence as cancer was thought to spread via the periosteal lymphatics. However, with better understanding of spread of oral cancers and also the various routes of mandibular involvement, more and more oral cancers are being resected with only a portion of the mandible that is juxtaposed to the tumour. This allows preservation of bony continuity of at least one cortex, which improves cosmetic outcome and provides better function. In this article, we have reviewed the recent literature on this topic and outline important clinical anatomy of the mandible, the pathological and clinical basis of selection of cases suitable for marginal mandibulectomy and the types of marginal mandibulectomies.

Keywords: Mandible, segmental mandibulectomy, marginal mandibulectomy, oral cancers, cosmetic outcome.

INTRODUCTION

The mandible is the key bone involved in mastication and speech, in addition to having an important role in facial cosmesis. Resection of the mandible is often done for cancers of the oral cavity as well as for benign lesions involving the mandible. This often leads to significant morbidity, both in respect of chewing and speech. As the pathology of oral cancer spread was better elucidated, the original mandibular resection i.e hemimandibulectomy or full thickness segmental mandibulectomy was modified to preserve part of the bone. This provided much better functional and cosmetic outcome. Here, we review the various types of conservative mandibular resections.

Anatomy: The mandible has an “U” shaped body with two quadrangular bony projections from its posterior part called ramus. The ramus has two superior processes, condyloid posteriorly forming the temporo-mandibular joint and coronoid anteriorly to which attach the muscles of mastication. The upper part of the body is alveolar, forming sockets for insertion of the teeth. The roots of the teeth are attached to sockets by periodontal membrane. The inner aspect of the body is marked by a mylohyoid line. Parallel to and above it runs the mandibular canal in the substance of the body, extending from the mandibular foramen at the inner aspect of ramus to the mental foramen on the outer surface of body below the premolar teeth. The inferior alveolar vessels and nerves run in this canal. The canal becomes relatively more cranial in the body with advancing age as the

alveolar process gets resorbed. The branches of the vessels and nerve reach the pulp of the teeth through the root canals which communicate with the alveolar canal.

The lower part of the body is strong having thick compact layer on the surface and spongy bone in between. The compact cortical bone near the alveolar margin is variable in thickness. On the labial surface, it is thinner anteriorly while on the lingual surface it is thinner posteriorly.¹

Some lymphatics vessels from oral cavity and tongue pass within the periosteum of mandible to submental and pre tracheal lymph nodes. Close apposition of the mandible to the tongue and alveolar tissue makes it prone to direct invasion by malignancies arising in these organs.

Spread of oral cancer: The mandible may be involved in oral malignancies in many ways. The reason why the mandible used to be removed with tumours of oral cavity was that it was believed that the periosteal lymphatics were one route of spread of the oral cancer and hence leaving the mandible behind would not allow en bloc resection of the tumour.² This method of spread was later disproved.

There are several possible routes of invasion of the mandible by oral cavity cancers. The most common route was thought to involve entry through small defects in the upper surface of the edentulous mandible (occlusal). This theory was based on McGregor’s work which was done on forty-six edentulous or partially dentate

mandibles.³ Later workers challenged this route of entry, especially in patients with dentate mandibles. They showed that in this group of patients, invasion of the periodontal membrane by the tumour at the gingival crest leads to mandibular involvement.⁴ Gingival cancers may also directly invade via the attached gingiva. Tumours may also enter the mandible via the mental or mandibular foramen. Finally, secondary tumour deposits in the neck nodes may erode into the lower border of the mandible.⁴

Types of marginal mandibulectomy: Once it was shown that periosteal lymphatic paths were not important in the spread of oral cancers, full thickness removal of the mandible where it was not involved, was not necessary. So the concept of marginal mandibulectomy, preserving bony continuity was developed. The various types of marginal mandibulectomy are

1. Classical (alveolar rim resection)
2. Reverse marginal (lower border)
3. Sagittal (lingual/ buccal plate)
4. Oblique

The initial operation done to preserve mandibular continuity after resection of the involved bone was the classical marginal mandibulectomy of the upper border including the alveolar canal. This rim resection of the upper border of mandible including the alveolar canal was proposed by McGregor and co workers as an alternative to full segmental resection.³ This provided adequate local control while maintaining the continuity of the mandibular arch. For lesions which were anatomically closer to the lower border of the mandible, such as submental nodes eroding into its periosteum, the same principle was used to resect the lower rim while preserving continuity in the upper border. This resection was termed the reverse marginal mandibulectomy.

Different criteria have been proposed by different authors for selecting marginal mandibulectomy. Randall recommended that it could be done when there was no radiological evidence of bone erosion and less than 50.0% of mandible's circumference was involved by tumour.⁵ Gilbert and co-workers analyzed the segmental mandibulectomy specimen in 104 patients of oral cancer and found 23 bones to be histologically involved (22.0%). They correlated histological invasion with site of tumour, stage of disease, tumour grade, clinical assessment of bone involvement and presence of nodal disease, preoperative x-rays and bone scans. They found that bony involvement was associated with alveolar lesions and those lesions which appeared clinically adherent to the mandible. Pre operative x-rays and radionuclide scans showing bony involvement was also strongly associated with histological invasion.⁶ Kudo *et*

al did a retrospective study of radiological pattern of bone resorption in their series of forty three patients.⁷ They reported that in those patients with pressure type of resorption and bone invasion limited to the alveolar region, marginal mandibulectomy is appropriate. For those patients with moth eaten pattern of resorption and invasion reaching the upper part of mandibular canal, the marginal resection should include the canal. Since this will lead to a small residual vertical height of the bone, additional strengthening by fixation of the bone by plate and screws is important to prevent fractures in future. In those patients who have radiological features of canal invasion, a full segmental mandibulectomy should be done. Van den Brekel *et al* evaluated the accuracy of different radiological tools in assessing the invasion of mandible by tumour.⁸ In their series of 29 patients of oral carcinomas where all the mandibles was examined histopathologically, MRI had the maximum sensitivity (94.0%) but the least specificity. Three of eleven normal mandibles were diagnosed as involved on MRI. MR also overestimated the extent of tumour invasion. Computerized tomography using 5 mm cuts and panoramic X-ray had relatively lower sensitivity (64 and 63% respectively) but higher specificity (80.0%). They concluded that as none of the radiological tests are accurate enough, the final decision regarding need for segmental resection vis a vis marginal mandibulectomy should be made by intra operative clinical assessment. However, evidence of tumour invasion on CT scan or pantomogram should be considered to be a strong predictor for actual involvement, as these have high specificity.

The other type of mandibular resection is sagittal resection of either the inner or the outer cortex of the mandible. These are done for tumours of the gingivo-buccal or gingivo labial (lateral) sulcus when the mandible is not involved but is in proximity to the tumour. So for adequacy of surgical margins, a part of the bone needs to be removed. Since the inner or outer cortex is in proximity, the cortex can be removed using a micro motor disk, maintaining bony continuity along the other cortex. Another variation of the sagittal / vertical mandibulectomy is the oblique marginal mandibulectomy done for floor of mouth tumours abutting the mandible. This technique has been used by Shaha in his series of sixty five patients of carcinoma floor of mouth, of which twenty two underwent marginal mandibulectomy.⁹ Most of these were oblique mandibulectomies including the upper rim and inner cortex of the mandible. The decision of extent of mandibulectomy was based on intra operative clinical examination. The mucosal defect was reconstituted by split thickness skin grafts, tongue flaps or myocutaneous

flaps. Good local control was achieved with excellent functional outcomes. In another series of 253 patients with floor of mouth cancer, 57 patients underwent marginal resection. Of these, 47 patients were available for follow up at 3 years. Primary site tumour recurrence occurred in 6 of these 47 patients, of which 3 involved the mandible.¹⁰ These results are comparable with those following segmental resections.

The safety of conservative mandibulectomy has been assessed in several trials retrospectively. In a study of 136 patients who underwent mandibular resection for oral malignancies (fifty four marginal resections and eighty two segmental resections), the incidence of local recurrence was not significantly different in the two groups. After a mean follow up of more than 90 months, the mean survival was also similar for the two groups (63.0 months for marginal mandibulectomy group and 53.1 month for segmental mandibulectomy group).¹¹ Another retrospective study of 106 patients of oral cancer who underwent either segmental or marginal mandibulectomy also showed that rim resections are as safe as segmental resections in terms of local recurrence or survival (about 60.0% 5 year survival for both groups).¹² On multivariate analysis by logistic regression model they found that advanced T stage, positive surgical margins and the need for resection of a larger part of the mandible (greater than 4 cm of bone versus less than 4 cm of bone) were the factors associated with increased chance of local recurrence, irrespective of the type of mandibulectomy. They also found that histological involvement of the mandible was also associated with higher local recurrence. Muscatello and co workers reported their retrospective series of 56 patients who underwent marginal mandibulectomy.¹³ They found actual bone invasion on histopathology in only one patient (1.8%). Local recurrence rate was 14.3% (eight patients). The five year overall and disease free survival rates were 60.7% and 77.3% respectively. Only one out of 56 patients developed fracture of the mandible on follow up. They concluded that marginal mandibulectomy was safe and effective in selected patients with oral cancers where the mandible in only in apposition or only the periosteum was adherent.

Complications: The specific non oncological complications associated with this operation are the chance of fracture of the remnant mandible and osteoradionecrosis of the mandible.

To prevent pathological fractures of the remnant bone segment, its arterial supply must be preserved. With advancing age, subperiosteal vessels arising from the lingual and facial artery take over from the inferior alveolar vessels to become the predominant supply to

the mandible.¹⁴ As the facial artery is often ligated during neck dissection for oral malignancies, there is greater risk of developing osteoradionecrosis when these patients also receive radiation. Song *et al* had reported a complication rate of 36.4% in those patients of marginal mandibulectomy who also received post operative radiation. Two of these patients and two patients who did not receive radiation also developed fracture of the mandible.¹⁵ Therefore workers have suggested that during the operation, excessive periosteal stripping should be avoided and if the patient is planned for post operative radiotherapy, the facial artery should be preserved, since this increases the vascularity of the bone and reduces chance of late osteoradionecrosis.¹⁶

CONCLUSIONS

The mandible need not be removed routinely during operations of oral cancers if it is not clinically or radiologically involved. For tumours close to the mandible, part of the bone may be excised for achieving adequate margins while maintaining bone continuity. This operation is called marginal mandibulectomy. There are several types of marginal mandibulectomy depending on which part of the cortex is being removed. Enough data with long term follow up has shown that marginal mandibulectomy is an oncologically safe operation with better cosmesis and retention of mandibular function. Complications like late pathological fracture can be avoided by adding support by plates and meticulous preservation of periosteal blood supply during resection.

REFERENCES

1. Williams PL, Warwick R, Dyson M, Bannister LH. *Gray's Anatomy* (37th Ed), Churchill Livingstone, Edinburgh, 1989, pp 367-70.
2. Ward GE, Robben JO. Composite operation for radical dissection and removal of cancer of the mouth. *Cancer* 1951; 4: 98-109.
3. McGregor AD, MacDonald DG. Routes of entry of squamous cell carcinoma to the mandible. *Head Neck Surg* 1988; 10: 29-31.
4. Brown JS, Lowe D, Kalavrezos N, D'Souza J, Magennis P, Woolgar J. Patterns of invasion and routes of tumour entry into the mandible by oral squamous cell carcinoma. *Head Neck* 2002; 24: 370-83.
5. Randall CJ, Eyre J, Davies D, Walsh-Waring GP. Marginal mandibulectomy for malignant disease: indications, rationale and results. *J Laryngol Otol* 1987; 101: 676-84.
6. Gilbert S, Tzadik A, Leonard G. Mandibular involvement by oral squamous cell carcinoma. *Laryngoscope* 1986; 96: 96-101.
7. Kudo K, Yagi M, Furihata K *et al*. Indication or limit of marginal mandibulectomy in surgery for carcinoma of the lower gum. Reconstructions and problems following marginal mandibulectomy. *Head Neck Cancer* 1997; 23: 625-30.
8. van den Brekel MWM, Runne RW, Smeele LE, Tiwari RM, Snow GB, Castelijns JA. Assessment of tumour invasion into the mandible: the value of different imaging techniques. *Eur Radiol* 1998; 8: 1552-7.

9. Shaha AR. Marginal mandibulectomy for carcinoma of the floor of the mouth. *J Surg Oncology* 1992; 49: 116-9.
10. Fleming WB. Marginal resection of the mandible in treatment of cancer of the floor of mouth. *Aust New Zealand J Surg* 2008, 57: 521-5.
11. Wolff D, Hassfeld S, Hofele C. Influence of marginal and segmental mandibular resection on the survival rate in patients with squamous cell carcinoma of the inferior parts of the oral cavity. *J Cranio-Maxillofacial Surg* 2004; 32: 318-23.
12. Munoz Guerra MF, Naval Gias L, Campo FR, Perez JS. Marginal and segmental mandibulectomy in patients with oral cancer: a statistical analysis of 106 cases. *J Oral Maxillofac Surg* 2003; 61: 1289-96.
13. Muscatello L, Lenzi R, Pellini R, Giudice M, Spriano G. Marginal mandibulectomy in oral cancer surgery: a 13-year experience. *Eur Arch Oto-Rhino-Laryngol* 2010; 267: 759-64.
14. Bradley JC. The clinical significance of age changes in the vascular supply to the mandible. *Int'l J Oral Surg* 1981; 10: 71-6.
15. Song CS, Gady H. Marginal mandibulectomy: Oncological and Nononcological Outcome. *Amer J Otolaryngol* 2003; 24: 61-3.
16. Komissar A, Barrow HN. Mandible preservation in cancer of the floor of the mouth: Anatomical and oncological consideration. *Arch Otolaryngol Head Neck Surg* 1994; 120: 1197-1200.

Report

Workshop on research methodology

Nepal Medical College Institutional Research/Review Committee (NMC-IRC) with the grant aid support of University Grants Commission (UGC) organized a three day workshop on research methodology on May 17 - 19, 2010. This was attended by twenty-eight junior faculties and PG students of the Kathmandu University undergoing training at NMC and few other MSc Microbiology thesis doing students.

The program consisted of brief inaugural session followed by presentation by the experts. Inaugural session was attended by NMC Chairman Dr. B Rijal, UGC Member-Secretary Prof. BK Shrestha, NMC MD Dr. SP Bhattarai, Principal and IRC Chairman Dr. SB Rizyal and IRC Members Prof. P Pradhan, Prof. RK Gupta, Prof. S Shakya and IRC Member-Secretary Prof. SK Rai. Presentation was done on (1) overview on health science research, (2) research proposal writing, (3) statistics in health research, (4) sampling in health research (5) dissemination of results, (6) ethics in health research, (6) budgeting in health research and (7) scientific paper writing. The experts who kindly contributed in the workshop were Dr. SP Bhattarai, Dr. SB Rizyal, Prof. RK Adhikari, Prof. RK Gupta, Mr. N Dawadi and Prof. SK Rai. At the end of third day, feedback from participants was taken and certificate of attendance was distributed to all participants.



Fig. 1. Inaugural session of the workshop (left) and participants of the workshop (right)



Fig. 2. Resource persons Prof. RK Adhikari (left) and Mr. N Dawadi (right)

Outcome of the Program

Training of this category of young people in the field of Health Science is expected to contribute in the Health Research a lot in days to come. Insights given by the UGC Member-Secretary Prof. Shrestha, NMC Chairman Dr. Rijal and other speakers during the inaugural session and by other resource persons during their deliberations, as expressed by the participants, were highly encouraging and inspiring to the young participants. Also, there was demand from the participants that such program should be organized on regular basis. Thus, this program was one of the most effective ways of doing dissemination of knowledge about the research and in turn, in improving the quality education in higher education in the field of Health Science in Nepal for which UGC is working hard. At the end of third day, certificate of attendance was given to all participants.