J. Maxillofac. Oral Surg. (July–Sept 2019) 18(3):360–365
https://doi.org/10.1007/s12663-018-1164-6

REVIEW ARTICLE

Mandibulotomy Approach for Resection of Maxillary Tumours: A Clinical Review

Venkatesh Anehosur[1] · Mohit Bindal[1] · Niranjan Kumar[2] · Chaitra Shetty[1]

Received: 25 May 2018 / Accepted: 3 October 2018 / Published online: 9 October 2018

Abstract
Purpose The objective of this study was to assess the accessibility in the resection of maxillary tumours, resection margin status, and morbidity following maxillectomy through lip split with paramedian mandibulotomy approach.
Materials and Methods A retrospective review of 20 consecutive patients who underwent maxillectomy with resection of primary tumours through lip split mandibulotomy approach with supraomohyoid neck dissection for maxillary tumours between 2008 and 2016. Patients details including the tumours site, extension and neck node involvement. were recorded. Resection technique, status of surgical resected margins was also discussed. Disease status was obtained from patients follow up records. Morbidity was assessed at mandibulotomy site in terms of infection, osteotomy healing, neural disturbance and mouth opening. The institutional research committee approval was taken for this study.
Results All patients underwent adequate en bloc resection of the tumours, except in two patients in whom superior margins was positive. Osteotomy site healed well in our all patients except in one patient in whom there was infection at the osteotomy site during post radiation therapy. Minimal neural morbidity was encountered in four patients (three patients had lingual nerve hypothesia and two patients had inferior alveolar nerve hypothesia) which recovered in all four patients, over the 6th month post-operative period. Post-operative interincisal distance was satisfactory with a mean of 30.5 mm.
Conclusion Mandibulotomy with lip split is considered to be an ideal approach to access tumours of maxilla and its adjacent structures, SOHND with level III clearance. This approach provide excellent accessibility for en bloc resection of operable maxillary tumours with good outcome of resultant scar and minimal morbidity.

Keywords Infratemporal fossa · Mandibulotomy · Supraomohyoid neck dissection · Maxillary tumours · Mandible swing

✉ Venkatesh Anehosur
venkyrao12@yahoo.co.in

Mohit Bindal
mbindal008@gmail.com

Niranjan Kumar
drniranjankumar@sdmmedical.org

Chaitra Shetty
chaitrashetty2015@gmail.com

[1] SDM Craniofacial Surgery and Research Centre, SDM College of Dental Science and Hospital, Dharwad, Karnataka, India

[2] SDM College of Medical Science and Hospital, Dharwad, Karnataka, India

Introduction

Malignancy of maxilla and its anatomically approximated structures like maxillary sinus, nasal cavity and orbital floor pose numerous challenges to the surgeons, for surgical clearance of tumour-free margins due to difficulty in accessibility. Various challenges that were encountered by surgeons were firstly they often present in advanced stages, complex anatomy and the close proximity of the critical structures like extension of tumour into orbit superiorly, medially the nasal cavity and superolaterally the infratemporal fossa, which compromise effective surgical

excision in toto unlike in mandible and necessitates effective radiation deliverance [1–3]. Malignancy of maxilla and its adjacent structures usually requires partial or total maxillectomy depending on the extent of the tumour, which is mostly accessed through Weber–Ferguson incision with sublabial degloving incision, which is been the gold standard approach in surgical management of maxillary sinus tumours [4]. The drawback of this approach is difficult to achieve en bloc resection of the tumour from infratemporal fossa along with maxilla [5–7]. In 1836, Roux described an approach by dividing the lower lip and mandible for gaining surgical access to the oropharynx [8]. The mandibulotomy approach with lower lip splitting has been repopularized and most widely used for more than 20 years to facilitate the access to the tumours in the posterior aspect of the oral cavity, oropharynx and parapharyngeal space [9, 10]. With the mandibulotomy approach, there is improvement in the accessibility and exposure to the structures which are in close vicinity which also helps in preserving the important anatomic structures.

The objective of this study was to assess the accessibility in the resection of maxillary tumours, resection margin status and morbidity following maxillectomy through lip split with paramedian mandibulotomy. Advantages of this approach are highlighted in this study, and also complications at the osteotomy site are assessed in terms of healing, neural morbidity and infection.

Materials and Methods

A retrospective study was carried out on 20 patients out of 28, operated for malignancy involving maxilla and its associated structures, accessed by lip split and mandibulotomy approach in the department of oral and maxillofacial surgery, SDM Craniofacial & Research Centre, Dharwad from 2008 to 2016. Eight patients were excluded due to lack of records and follow-up issues.

Patients demographics details were recorded in terms of age, gender, site of lesion and type of lesion. Preoperative imaging like conventional radiographs, CT scans, MRI and HRUSG was used to assess the site, extent of tumours and neck node assessment. Resection technique along with type of neck dissection was also discussed, and status of surgical resected margins was determined through histopathology report. Disease status was obtained from patients follow-up visit records. Morbidity was assessed prospectively in terms of patient's complaints, complications at mandibulotomy site in terms of infection, osteotomy healing, neural disturbance (mental, lingual and inferior alveolar nerve) and mouth opening. The institutional research committee approval was taken for the retrospective review of patients data sets, with the requirements to obtain informed consent weighed by the committee.

Technique

A submandibular incision is placed in skin crease around the chin and on the lower lip in a step ladder pattern (Fig. 1). Subplatysmal flap is elevated, and supraomohyoid neck dissection is performed with clearance up to level III. Then incision is extended intraorally along the labial mucosa to the mandibular mucoperiosteum, the interdental incision is placed between canine and first premolar, which is away from the osteotomy site. The lingual mucoperiosteum is reflected after placing a crevicular incision up to last standing molar in the oral cavity and extended buccally. Osteotomy is planned anterior to mental foramen between the canine and first premolar in a step fashion using straight fissure bur and followed by the saw (Fig. 2). Osteotomy is then completed using an osteotome.

Pre-plating of the osteotomized segments is done to achieve accurate anatomic reduction and to prevent asymmetry.

Mandibulotomy segment is separated from the lingual mucoperiosteum during elevation. The lingual nerve is identified and preserved. Medial pterygoid muscle fibres are stripped from the medial aspect of mandible, and inferior alveolar neurovascular bundle is identified and preserved. Stripping of temporalis muscle fibres is done from coronoid process along with release of stylomandibular ligament from mandibular ramal region to achieve lateral mandibular swing for adequate exposure.

A maxillary degloving incision is placed for the lesion requiring maxillectomy (partial, total). Lateral nasal wall, frontal process of the maxilla, zygoma and orbital rim were

Fig. 1 Lip split and submandibular incision marking

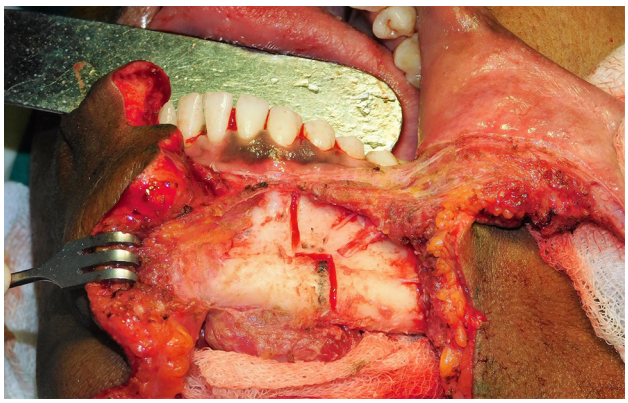

Fig. 2 Mandible osteotomy site marking with preservation mental nerve

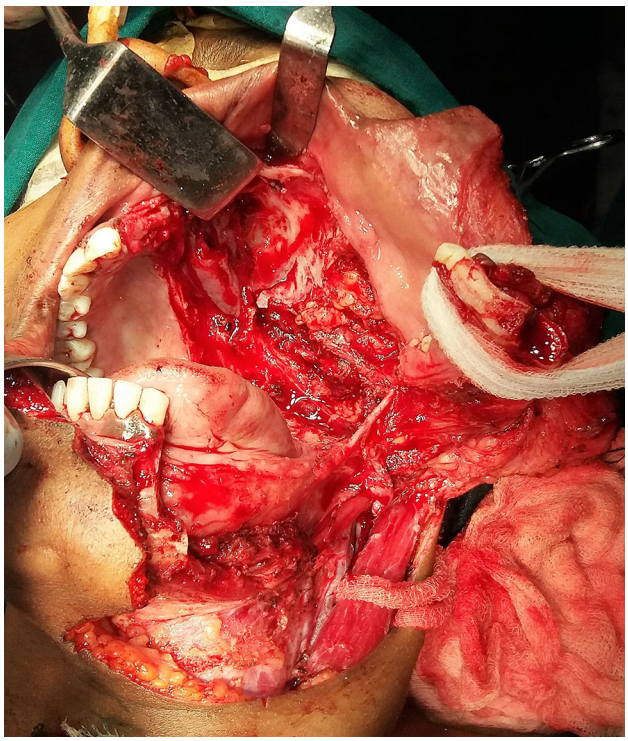

Fig. 3 Mandible swung and resection of primary tumour

exposed. Extended transfacial approach was used for the lesion extending into the medial orbital wall for orbital extenteration. Maxillectomy is performed either partially or totally depending upon the extent of the lesion. En bloc resection of the tumour is done along with clearance from infratemporal fossa region (Fig. 3). Resection is followed by reconstruction with temporalis myofascial flap, forehead flap and spilt thickness graft with obturator. Fixation of mandible is done using 2 miniplates (Fig. 4) followed by intraoral and extraoral closure along with parking of drain in the neck and temporal regions.

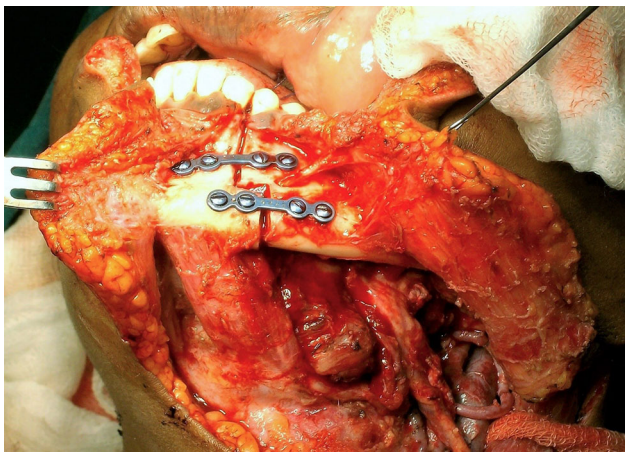

Fig. 4 Fixation of mandibulotomy site with miniplates

Results

A total of 20 patients, 12 males (60%) and 8 females (40%) with tumours of maxilla operated through lip split and mandibulotomy approach included in the study. Patient's age ranged from 35 to 71 years with a mean age of 48.8 years. Depending upon the site of involvement, in 12 (60%) patients right side of maxilla was involved, in 6 (30%) patients left side of maxilla was involved and 2 (10%) patients had hard palate. Again, based on extension into adjacent structures in 15 (75%) patients tumour was confined to maxillary sinus, 4 (20%) infratemporal fossa and 1(5%) had medial wall and floor of the orbit extension. Pathology of tumours was assessed using incisional biopsy preoperatively, and extension of the tumours and involved structures were accessed through preoperative PNS, CT and MRI. Sixteen patients (80%) had squamous cell carcinoma, 3 (15%) had mucoepidermoid carcinoma and 1 (5%) had adenoid cystic carcinoma.

All patients underwent supraomohyoid neck dissection with level III clearance. Five (25%) patients had undergone total maxillectomy, out of this one patient orbital exenteration. Fifteen patients (75%) had partial maxillectomy. Patients with squamous cell carcinoma received postsurgical adjuvant radiotherapy.

Reconstruction was done with temporalis myofascial flap in 14 patients (70%), forehead flap was used in 4 patients (20%), free fibula flap in 1 patient (5%), whereas split thickness graft with obturator in 1 patient (5%) (Table 1).

All the patients were followed at 3, 6 months and one-year follow-up period. Two patients (10%) had a local recurrence within a year. Six patients did not reported for follow-up after 2 years till then there were no recurrences. All the patients had aesthetically acceptable scar in the lip split region. All en bloc excised specimen was evaluated

Table 1 Tumour site, extent, type of carcinoma, procedure and reconstruction

	No. of patients	% of patients
Site		
Maxillary alveolus	18	90.00
Hard palate	2	10.00
Extension		
Maxillary sinus	14	70.00
Infratemporal fossa	4	20.00
Medial orbital wall and floor of orbit	2	10.00
Type of Ca		
SCC	16	80.00
MEC	3	15.00
ACC	1	5.00
Procedures		
SOHND, Level III + partial maxillectomy	15	75.00
SOHND, Level III + total maxillectomy	4	20.00
SOHND, Level III + partial maxillectomy + orbital extenteration	1	5.00
Reconstruction		
Temporalis myofascial flap	14	70.00
Forehead flap	4	20.00
SSG + obturator	1	5.00
Free fibula	1	5.00
Total	20	100.00

Table 2 Histopathology margins status, lymph node status and follow-up status wise distribution of patients

	No. of patients	% of patients
Histopathology margins status		
Free	18	90.00
Positive margin	2	10.00
Lymph node status		
Level Ib	18	90.00
Level Ib II a	0	0.00
Level Ib III	2	10.00
Follow-up status		
0–2 years	7	35.00
3–5 years	10	50.00
6–8 years	1	5.00
Recurrence	2	10.00
Total	20	100.00

hispathologically, and diagnosis was confirmed, tumour margins status was evaluated in which 2 patients (10%) had positive margins while 18 (90%) had negative margins. Two (10%) patients had positive lymph node one at level Ib and another level III (Table 2).

All the 20 patients underwent supraomohyoid neck dissection with a level III clearance having minimal complications. Two patients (10%) had intraoperative haemorrhage from vena comitans managed with ligation. There was no incidence of injury to major vessels. One patient (5%) had wound dehiscence in neck which was managed with regular local dressings. Resection and donor site morbidity was seen in 3 patients (13.3%), mainly fistula in one patient, infection in forehead flap tunnel site and skin graft area of defect, which were managed with appropriate culture and sensitivity antimicrobial therapy along with local dressing.

Assessment of lingual and inferior alveolar nerve was performed using two-point discrimination test. Three patients (15%) had lingual nerve hypoesthesia and 2 (10%) had inferior alveolar nerve hypoesthesia which recovered in 6-month post-op period. All other patients were symptom free. Restriction in the mouth opening measured by interincisal distance was a common complaint which is improved significantly over a period of time with mouth opening exercise and physiotherapy. Mouth opening ranged from 26 mm to 34 mm with a mean of 30.5 mm. Occlusion was maintained in all the patients. One patient (5%) had infection at the osteotomy site post-radiation which was managed through regular dressings and appropriate antibiotics therapy.

Discussion

Classically, maxillary tumours were approached through Weber–Ferguson [4] and its various modification incisions which resulted in unacceptable aesthetics in the form of

scarring and ectropion of the lower eyelid [11] also inadequate accessibility to the pterygomaxillary region for en bloc resection and limited surgical access in the presence of trismus. In 1981, Biller et al. described a transmandibular approach to skull base which was later adopted by Krespi et al in 1984 [12, 13].

This approach provides release of medial and lateral pterygoid muscle from mandible and temporal crest of infratemporal fossa with their origin intact, which brought about good exposure to the medial and lateral compartment of the middle cranial base, infratemporal fossa, parapharyngeal space, clivus, nasopharynx and offered vascular control in the neck, which was poorly accessible through the conventional maxillectomy approach.

In addition, the total maxillectomy procedure can be performed through lower midline lip split with mandibulotomy and extension of maxillary vestibular incision, which avoided facial incision. Mandibulotomy approach along with Weber–Ferguson and bicoronal incision can be used for the tumours involving the orbit wall and ethmoid with intracranial extension [14].

Shaheen described alternative approaches to the infratemporal fossa, stating that the route of access is determined by the position, extent and the nature of the disease in question. He approached the maxillary tumours, which invaded the infratemporal fossa through extended anterolateral approach with combined mandibulotomy and classical Weber–Ferguson incision [15]. Lawson et al. first reported combined median mandibulotmy with Weber–Ferguson approach for total maxillectomy for en bloc resection of pterygoid plates and infratemporal fossa muscle in account with maxillectomy specimen [16].

In 1980, Attenborough and Obwegeser in 1985 described the temporal approach for the lesion involving infratemporal fossa and pterygomaxillary area. In both techniques, multiple osteotomy of zygomatic arch and ramus of the mandible was performed, which resulted in drawbacks of multiple osteotomy sites, separation of masseter and temporalis fibres and dissection in a highly vascular zone [17, 18].

In 2000, Tiwari described transmandibular approach for total maxillectomy. He performed paramedian mandibulotomy with sublabial incision avoiding the need for the additional facial incision, and main advantage of this technique was clearance of the retro-maxillary area en bloc with the maxilla. Same technique was followed in our article, with difference of stripping of medial pterygoid fibres from medial aspect of mandible, using midline lower lip split rather than lateral split which resulted in minimal aesthetic and functional morbidity. This observation was consistent with study by Rapidis et al. and Nair et al. [19, 20].

In 2008, Balm et al. approached maxillary sinus tumours with infratemporal extension through cheek flap; with this approach, adequate exposure and resection was achieved. They also reported the far better exposure of the rim of mandible was possible with an excision in the region of ascending ramus [7]. Chatni et al. described the advantage of compartmental resection of infratemporal fossa tumours and maxillectomy [14]. Accessibility to maxilla in cases of trismus or tumours extending into the infratemporal fossa was achieved easily.

Hence, extension of tumour in the infratemporal fossa which bring about trismus was not considered as a contraindication to surgical excision.

In our study, all patients underwent adequate en bloc resection of the tumours, which were demonstrated macroscopically and microscopically except in 2 patients in whom superior margins were positive. One of the important intraoperative finding was profuse bleeding from pterygoid plexus and internal maxillary artery which was managed with hypotensive anaesthesia, continuous sew sutures for the pterygoid plexus and ligation of internal maxillary artery when encountered. Osteotomy site healed well in our all patients except in 1 patient (5%) in whom there was infection at the osteotomy site during post-radiation therapy which was managed through regular dressing and appropriate antibiotics therapy. Also, no patient underwent plate removal, whereas in a study conducted by Nair et al. incidence of infection at mandibulotomy site and hardware removal was 8.3%. Minimal neural morbidity was encountered in 4 patients (3 patients had lingual nerve hypoesthesia and 1 patient had inferior alveolar nerve hypoesthesia) which recovered in all 4 patients, over the 6th month post-operative period. Post-operative interincisal distance was satisfactory with a mean of 30.5 mm. Lateral swing of the mandible through mandibulotomy allows easily insertion of temporalis myofascial flap, forehead flap and free fibula flap. This also allowed easy anastomosis of pedicle to the neck vessels. Advantages of this approach are adequate accessibility to the tumours and its extensions into adjacent structures like maxillary sinus, infratemporal fossa, nasal cavity and orbit and most importantly in patients with trismus [20].

Fifteen patients (75%), mainly squamous cell carcinoma and adenoid cystic carcinoma, who were subjected to adjunctive radiotherapy did not have any bearing over the mandibular osteotomy site and resection region. The other advantages included en bloc resection of tumours with partial or total maxillectomy with adequate surgical clearance from infratemporal fossa region, minimal neural morbidity, ease of transferring reconstruction flaps.(temporalis myofascial, forehead and free flaps), normal healing at osteotomy site with normal occlusion and normal range of motion in all planes, adequate mouth opening, good vascular control from external carotid artery tributaries and

acceptable aesthetics with inconspicuous lower lip scarring.

Conclusion

Mandibulotomy with lip split is considered to be an ideal approach to access tumours of maxilla and its adjacent structures, SOHND with level III clearance. This approach provides excellent accessibility for en bloc resection of operable maxillary tumours with good outcome of resultant scar and minimal morbidity.

Acknowledgements Authors would like to thank Dr. Niranjan Kumar, Medical Director, SDM craniofacial research centre Dharwad and Dr. Srinath Thakur, Principal, SDM College of Dental Sciences, Dharwad for the encouragement and facilities provided.

Funding This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sector.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics Statement Approval for this retrospective study was obtained from the Institutional Review Board and Ethical committee (IRB. No. 2014/P/OS/25).

Informed Consent Informed consent was obtained from all patients who were enrolled in this study.

References

1. Stern SJ, Goepfert H, Clayman G, Byers R, Ang KK, el-Naggar AK et al (1993) Squamous cell carcinoma of the maxillary sinus. Arch Otolaryngol Head Neck Surg 119:964–969
2. Paulino AC, Marks JE, Bricker P, Melian E, Reddy SP, Emami B (1998) Results of treatment of patients with maxillary sinus carcinoma. Cancer 83:457–465
3. Le QT, Fu KK, Kaplan M, Terris DJ, Fee WE, Goffinet DR (1999) Treatment of maxillary sinus carcinoma: a comparison of the 1997 and 1977 American Joint Committee on cancer staging systems. Cancer 86:1700–1711
4. Fergusson W (1857) Plastic operations on the face. Br Med J 5:81
5. Tiwari R, Hardillo JA, Mehta D et al (2000) Squamous cell carcinoma of maxillary sinus. Head Neck 22:164–169
6. Choi EC, Choi YS, Kim CH et al (2004) Surgical outcome of radical maxillectomy in advanced maxillary sinus cancers. Yonsei Med J 45:621–628
7. Balm AJ, Smeele LE, Lohuis PJ (2008) Optimizing exposure of the posterolateral maxillary and pterygoid region: the lower cheek flap. Eur J Surg Oncol 34:699–703
8. Butlin HT (1885) Diseases of the tongue. Clinical manuals for practitioners and students of medicine. Cassell, London, p 331
9. Spiro RH, Strong EW, Shah JP (1997) Maxillectomy and its classification. Head Neck 19:309
10. Shah JP, Kumaraswamy SV, Kulkarni V (1993) Comparative evaluation of fixation methods after mandibulotomy for oropharyngeal tumors. Am J Surg 166:431–434
11. Sun J, Shen Y, Weng Y et al (2009) Lateral lip-splitting approach for total and subtotal maxillectomy. J Oral Maxillofac Surg 67:1197
12. Biller RF, Shugar MA, Krepsi YP (1981) A new technique for wide field exposure of the base of the skull. Arch Otolaryngol 107:698
13. Krepsi YP, Sisson GA (1984) Transmandibular exposure of the skull base. Am J Surg 148:534
14. Chatni SS, Sharan R, Patel D et al (2009) Transmandibular approach for excision of maxillary sinus tumors extending to pterygopalatine and infratemporal fossa. Oral Oncol 45:720
15. Shaheen OH (1982) Swellings of the infratemporal space. J Laryngol Otol 96:817
16. Lawson W, Naidu RK, Le Benger J et al (1990) Combined median mandibulotomy and Weber-Ferguson maxillectomy. Arch Otolaryngol Head Neck Surg 116:596
17. Attenborough NR (1980) Maxillectomy via a temporal approach (a new technique). J Laryngol Otol 94:149
18. Obwegeser HL (1985) Temporal approach to the TMJ, the orbit and the retromaxillary-infratemporal region. Head Neck Surg 7:185
19. Rapidis AD, Valsamis S, Anterriotis DA et al (2001) Functional and aesthetic result of various lip-splitting incisions: a clinical analysis of 60 cases. J Oral Maxillofac Surg 59:1292
20. Nair S, Sridhar KR, Shah A et al (2011) Maxillectomy through mandibulotomy—a retrospective clinical review. J Oral Maxillofac Surg 69:2040–2047