Intraoral Rehabilitation After Marginal Mandibulectomy

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Marginal mandibulectomy is a surgical procedure recommended for resection of oral cancers in which only the alveolar crest of the mandible, usually above the mandibular canal, is excised, with or without a portion of the lingual cortex (Fig 1). This approach is indicated when there is minor cortical erosion of the alveolar process or lingual cortex of the mandible without any invasion of the cancellous part of the bone.1–3 The goal of this procedure is to retain continuity of the mandibular arch and preserve form and function of the oral cavity with a conservative but oncologic safe resection.3,4 Alteration of the postoperative intraoral anatomy greatly influences the options for intraoral rehabilitation. Absence of opposing teeth or interocclusal space limitations may also be a prohibitive factor for optimal intraoral rehabilitation.5

Assessment of intraoral anatomy for the feasibility of mandibular resection prosthesis fabrication can be done in three different subgroups: completely edentulous patients, partially edentulous patients, and dentate patients who had marginal mandibulectomy in a non–tooth-bearing area (ie, ascending ramus of the mandible). The completely edentulous patient has limited opportunities for intraoral rehabilitation and to describe the factors that impact the selection of a mandibular resection prosthesis.

Materials and Methods: A retrospective review of patients who had undergone marginal mandibulectomy over a 14-year period at a tertiary care cancer center was undertaken. Measurements of the vertical height and width of the mandible and the distance between the alveolar crest and mandibular canal were measured after marginal mandibulectomy. The feasibility and success of tooth-borne or implant-supported resection prostheses were measured.

Results: Following marginal mandibulectomy, the median heights between the alveolar crest and lower border of the mandible were 21.8 mm, 17.7 mm, and 14.3 mm in the anterior, premolar, and molar regions, respectively. However, the median distances between the alveolar crest and the mandibular canal in the premolar and molar regions were only 3.98 and 3.4 mm, respectively. These residual bone measurements are not satisfactory for implant-supported mandibular resection prostheses, which can be considered only in the anterior region of the mandible. Patients with marginal mandibulectomy in the premolar and molar regions can only be rehabilitated with removable dentures, provided they have remaining stable teeth to clasp and anchor the removable denture. Conclusion: Implant-supported resection prostheses after marginal mandibulectomy are feasible only in the anterior segment of the mandible and are not possible in the premolar and molar regions. Int J Prosthodont 2019;32:241–247. doi: 10.11607/ijp.6181

Purpose: To report the feasibility of oral rehabilitation in patients who had undergone marginal mandibulectomy and to describe the factors that impact the selection of a mandibular resection prosthesis.
following marginal mandibulectomy as an atrophic edentulous mandible with or without compromised tongue function is generally considered a poor prognostic factor for conventional mandibular prosthesis fabrication. In addition, many edentulous patients will have a loss of mandibular sulci, causing difficulty in retention of the mandibular resection prosthesis. Furthermore, absence of opposing teeth makes it impossible to achieve any meaningful occlusion with such a prosthesis.8

In partially edentulous patients, removable mandibular resection prostheses can be fabricated based on the status of the remaining dentition.9 The retention of a removable mandibular resection prosthesis anchored with clasps on the remaining mandibular abutment teeth is a crucial factor in achieving satisfactory restoration of mastication.10

Dentate patients who undergo marginal mandibulectomy of a non-tooth-bearing portion of the mandible may not need intraoral prosthetic rehabilitation following marginal mandibulectomy. However, if the patient ultimately loses posterior dentition from the marginal mandibulectomy, they can be easily rehabilitated with a conventional removable mandibular resection prosthesis.

In patients in whom satisfactory mandibular resection prostheses cannot be fabricated, it may be desirable to utilize endosseous implants.9,11

However, the feasibility of endosseous implant placement is dependent on the available alveolar bone and the proximity of the alveolar crest to the inferior alveolar canal.12 To date, there are limited data on this topic as it relates to marginal mandibulectomy patients. The purpose of this study was to retrospectively evaluate the osseous anatomy of patients who had undergone marginal mandibulectomy over a 14-year period at the authors’ institution. This study also describes a treatment algorithm for oral rehabilitation based on the dental status of the patient after marginal mandibulectomy.

MATERIALS AND METHODS

A retrospective review was undertaken of all patients (n = 256) who underwent marginal mandibulectomy for squamous cell carcinoma from 2000 to 2014 at a tertiary care cancer center. Postoperative computed tomography (CT) imaging of the mandible was required for inclusion in this study.

RESULTS

During the 15-year study period, 52 of 256 (20%) patients who underwent marginal mandibulectomy for squamous cell carcinoma of the oral cavity met the inclusion criteria and had postoperative CT scans of the mandible available (Fig 4). The mean age of the patients at the time of surgery was 67 years (range 43 to 103 years), and 56% were men. The demographic characteristics of the study group are shown in Table 1. The median follow-up for surviving patients was 38 months (range 3 to 150 months).

Marginal mandibulectomy was performed in the anterior region in 8 (15%) patients, in the posterior region in 40 (77%) patients, and in the retromolar trigone region in 4 (8%) patients. After resection, the median height between the lower border of the mandible and the alveolar crest in the anterior region was 21.8 mm, and in the premolar and molar regions was 17.8 mm and 14.9 mm, respectively. However, the median height between the alveolar crest and the upper border

Fig 1 Representation of marginal mandibulectomy, which offers oncologically complete composite resection of oral cancer with preservation of the arch of the mandible. Reprinted with permission from Head and Neck Surgery and Oncology, ed 3 (Shah J).

Fig 2 Three-dimensional reconstruction of computed tomography scan of a totally edentulous patient after marginal mandibulectomy. This patient is not suitable for any prosthetic rehabilitation.
of any part of the mandible. Dental prosthetic rehabilitation can provide esthetic (ie, lip support, facial symmetry) and functional (speech articulation, mastication, support during oral phase of deglutition) improvements that positively impact patient quality of life. However, pretreatment evaluation is a crucial factor to determine the feasibility of rehabilitation for such patients (Table 4). This process is multifactorial and requires careful study of the

### DISCUSSION

Oral rehabilitation is a pivotal factor for complete restoration of function in patients who have undergone oral cancer surgery requiring resection of any part of the mandible. Dental prosthetic rehabilitation can provide esthetic (ie, lip support, facial symmetry) and functional (speech articulation, mastication, support during oral phase of deglutition) improvements that positively impact patient quality of life. However, pretreatment evaluation is a crucial factor to determine the feasibility of rehabilitation for such patients (Table 4). This process is multifactorial and requires careful study of the
oral anatomy, including: the health of the oral mucosa; laxity of the intraoral tissues; dental status; interocclusal space; extent of xerostomia (if any); presence of lingual and buccal sulci; extent of atrophy of the mandible; effacement of the alveolar crest in the edentulous mandible; and finally, the vertical height of the residual mandible, as well as the available bone height between the alveolar crest and the mandibular canal. Satisfactory prosthetic dental rehabilitation is not possible in geriatric patients with completely edentulous mandibles that are atrophic, have a loss of lingual and buccal sulci, and/or have effacement of the alveolar ridge. Unfortunately, these patients have no prospect of any meaningful dental rehabilitation. Patients who have stable and healthy remaining dentition are potential candidates for removable mandibular resection prostheses clasped on the remaining teeth, provided the sulci are adequate at the site of marginal mandibulectomy for stability of the resection prosthesis. Even in such patients, preoperative masticatory function is not fully achieved due to mobility of the prosthesis during mastication. If there is loss of sulci after marginal mandibulectomy, a secondary oral anatomy, including: the health of the oral mucosa; laxity of the intraoral tissues; dental status; interocclusal space; extent of xerostomia (if any); presence of lingual and buccal sulci; extent of atrophy of the mandible; effacement of the alveolar crest in the edentulous mandible; and finally, the vertical height of the residual mandible, as well as the available bone height between the alveolar crest and the mandibular canal. Satisfactory prosthetic dental rehabilitation is not possible in geriatric patients with completely edentulous mandibles that are atrophic, have a loss of lingual and buccal sulci, and/or have effacement of the alveolar ridge. Unfortunately, these patients have no prospect of any meaningful dental rehabilitation. Patients who have stable and healthy remaining dentition are potential candidates for removable mandibular resection prostheses clasped on the remaining teeth, provided the sulci are adequate at the site of marginal mandibulectomy for stability of the resection prosthesis. Even in such patients, preoperative masticatory function is not fully achieved due to mobility of the prosthesis during mastication. If there is loss of sulci after marginal mandibulectomy, a secondary

<table>
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<tr>
<th>Table 2</th>
<th>Height (mm) of the Remaining Mandible in Different Regions After Marginal Mandibulectomy</th>
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<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Anterior region (n = 8)</td>
<td>21</td>
</tr>
<tr>
<td>Premolar region (distance from the upper border of inferior alveolar canal) (n = 29)</td>
<td>3.87</td>
</tr>
<tr>
<td>Premolar region from lower border of mandible (n = 29)</td>
<td>17.8</td>
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<tr>
<td>Molar region (distance from the upper border of inferior alveolar canal) (n = 40)</td>
<td>3.229</td>
</tr>
<tr>
<td>Molar region (from lower border of mandible) (n = 40)</td>
<td>15.2</td>
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<td>Anterior region (n = 8)</td>
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<tr>
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</tr>
<tr>
<td>Molar region (n = 40)</td>
<td>10.862</td>
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<th>Table 4</th>
<th>Pretreatment Evaluations for Oral Rehabilitation and the Type of Mandibular Resection Prosthesis After Marginal Mandibulectomy</th>
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<tr>
<td>Favorable</td>
<td>Unfavorable</td>
</tr>
<tr>
<td>Anatomical</td>
<td>Broad, tall, round ridge Overlying mucosa or tissue Defined lingual and vestibular sulci Adequate interocclusal space Healthy tissue</td>
</tr>
<tr>
<td>Mechanical</td>
<td>Present healthy posterior teeth Present opposing teeth</td>
</tr>
<tr>
<td>Neuromuscular</td>
<td>Mobile tongue No trismus</td>
</tr>
<tr>
<td>Other factors</td>
<td>Good oral hygiene No head and neck radiation therapy</td>
</tr>
<tr>
<td>Fixed restoration</td>
<td>Anterior defect Tooth- or implant-bounded defect Adequate saliva</td>
</tr>
<tr>
<td>Removable restoration</td>
<td>Anterior defect Tooth- or implant-bounded defect Healthy teeth in mandible Teeth or implants present for prosthetic retention Adequate saliva</td>
</tr>
<tr>
<td>Consideration for dental implants</td>
<td>Adequate height of inferior alveolar canal (&gt; 2 mm) Adequate width of alveolar ridge (&gt; 7 mm) Adequate attached gingival tissue/mucosa</td>
</tr>
<tr>
<td></td>
<td>Inadequate height from inferior alveolar canal Osseous undercuts or other unfavorable surgical anatomy (endosseous implants must be completely placed in bone) Irradiated tissue (&gt; 50 Gy) Inadequate interocclusal space for implant surgery and/or prosthetic restoration</td>
</tr>
</tbody>
</table>

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surgical procedure of vestibuloplasty may be necessary. These prostheses can be fabricated for any region of the mandible, as determined by the local factors mentioned above. An implant-supported or retained fixed or removable mandibular resection prosthesis would solve many of these problems; however, postsurgical mandibular anatomy can create challenges for completion of prosthetic rehabilitative options that are feasible in the patient.

Marginal mandibulectomy defects can be divided into three groups: anterior, posterior, and ramus regions. For patients with anterior defects, the vertical height and width of the residual mandible are adequate for consideration of implant-based removable or fixed resection prostheses (Fig 5). Thus, these patients have a choice between a removable mandibular resection prosthesis (tooth abutment–retained) or implant-supported/retained, fixed/removable resection prostheses. If the abutment teeth are stable, the removable resection prosthesis is quite satisfactory (Fig 6). On the other hand, due to the availability of adequate bone height, an implant-supported resection prosthesis is also feasible in this location (Fig 7).

Lack of sufficient bone height following marginal mandibulectomy in the posterior region of the mandible often restricts the placement of endosseous dental implants and presents a challenge for clinicians due to the proximity of the inferior alveolar canal to the alveolar crest after marginal mandibulectomy. The location of the mandibular canal influences the feasibility of dental implant surgery, since it is not possible to perform implant surgery through the canal due to the resultant injury to the inferior alveolar nerve. This would result in paresthesia and injury to the inferior alveolar artery, damaging the endosteal blood supply to the remaining mandible. The median height in the patients in this study group was 3.98 mm and 3.4 mm in the premolar and molar regions, respectively. The vertical height of the remaining alveolar bone above the mandibular canal is simply not enough to receive even mini-implants, which require at least 6 mm of bone height above the mandibular canal, for satisfactory implant placement.
Available bone height between the inferior alveolar canal and the alveolar crest. Presurgical multidisciplinary treatment planning should include a detailed discussion regarding the feasibility of postoperative dental rehabilitation if this is the ultimate goal. A change in the surgical plan to consider segmental mandibulectomy and fibula free flap reconstruction with immediate implant placement over marginal mandibulectomy may be indicated to facilitate the desired rehabilitation outcome (Fig 9). Preoperative planning and a multidisciplinary consultation with the head and neck surgeon, the prosthodontist, and the plastic surgeon are crucial to facilitate the selection of the appropriate ablative procedure for esthetic and functional restoration.

Based on previous studies of the mandible after marginal mandibulectomy and clinical observation of patients in the postoperative period, the authors propose the following algorithm for dental rehabilitation after marginal mandibulectomy for patients with oral cancer:

- Completely edentulous: If the ridge is thin, short, and narrow (unfavorable ridge) and/or lingual and vestibular sulci are not defined, it is unlikely to be restored. If the ridge is broad, tall, and round (favorable ridge) and lingual and vestibular sulci are defined, a removable resection prosthesis is feasible.
- Partially edentulous: For a favorable ridge and tooth-bounded anterior defect, an implant-supported/retained mandibular resection prosthesis is warranted. For a favorable ridge and tooth-bounded posterior defect, a conventional mandibular resection prosthesis is recommended.

CONCLUSIONS

After marginal mandibulectomy for oral cancer, dental rehabilitation with a stable implant-supported or retained removable or fixed mandibular resection...
prosthesis is feasible in the anterior segment of the mandible. Lack of sufficient vertical height of remnant bone above the inferior alveolar canal prohibits consideration of this in patients undergoing marginal mandibulectomy in the premolar or molar regions. In such patients, a conventional removable mandibular resection prosthesis is the current available approach for oral rehabilitation.

ACKNOWLEDGMENTS

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REFERENCES