

Rehabilitation of a Patient With Mandibular Resection Using Osteointegrated Implants: A Case Report

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This case report details a 65-year-old male patient who underwent mandibular resection and radiotherapy as treatment for squamous cell carcinoma of the right mandible. The patient was rehabilitated with an implant-supported fixed partial denture and a maxillary occlusal ramp. The patient has been wearing his prosthesis for 2 years with no complaints.

Key Words: *mandibular resection, tooth-implant connection, maxillary occlusal guide*

INTRODUCTION

Management of malignant tumors of the tongue, floor of the mouth, mandible, and adjacent areas represents a challenge for the clinician. Resection of the site, together with large parts of surrounding structures and regional lymphatic tissue, is often required. However, this may result in impaired speech and articulation; difficulty in chewing and swallowing; retrusion and deviation of the mandible towards the surgical side, with altered movement due to loss of continuity of the mandible and motor and sensory deficiencies of the jaw and lower lip; compromised control of salivary secretions; facial asymmetry; and severe cosmetic disfigurement.¹⁻³ Surgical treatment must often be combined with radiation therapy, which further worsens oral functioning. Opportunities for dental treatment are limited by the lack of tissue support following surgery, which tends to severely inhibit the stability and function of conventional dentures. Given the importance of avoiding unnecessary trauma to the mandible caused by mobile dentures and retaining healthy soft tissue coverage in order to prevent

bone exposure and osteoradionecrosis, a fixed prosthesis may offer the best solution.^{2,4}

One of the basic objectives of rehabilitation is to retrain the muscles for mandibular denture control and repeated occlusal approximation. Due to the unstable interocclusal relationship that results from lack of posterior support and vertical overlap, it is important to provide the patient with a mandibular positioning and guidance device to help establish an acceptable interocclusal relationship in centric occlusion and during lateral movement so as to improve mastication and mandibular function.⁴ However, neither reconstructive surgery nor conventional prosthodontic techniques have been able to address these problems successfully. A combination of appropriate reconstruction and implant-supported or implant-retained prosthodontics such as a tooth-implant supported fixed partial denture (FPD) may provide better oral rehabilitation in terms of both function and esthetics.⁴⁻⁶

This article describes the treatment sequence and considerations in the rehabilitation of a patient with an implant-supported fixed prosthesis together with a palatal guide ramp-positioning device following mandibular resection and radiation therapy.

CLINICAL REPORT

A 65-year-old male patient was referred to the Ankara University Faculty of Dentistry with the chief

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complaint of pain and insensitivity in the body of his right mandible. The patient's history and consultation with his previous oral surgeon revealed a firm, diffuse, immobile mass on the retromolar area of the mandible. A panoramic radiograph showed a radiolucent lesion surrounding an impacted mandibular right third molar (tooth number 32). An excisional biopsy was performed, and the lesion was diagnosed as squamous cell carcinoma. The patient was referred to the Department of Otorhinolaryngology, where a radical neck dissection and right segmental mandibulectomy (including condyle, ramus, corpus, and angle of the mandible) were performed. Mandibular continuity was restored with a titanium reconstruction plate, and the patient underwent postoperative radiation therapy (total cumulative dose: 5300 cGy). One month later, extraoral plate exposure was observed as a complication of radiation therapy, and partial removal of the plate was required.

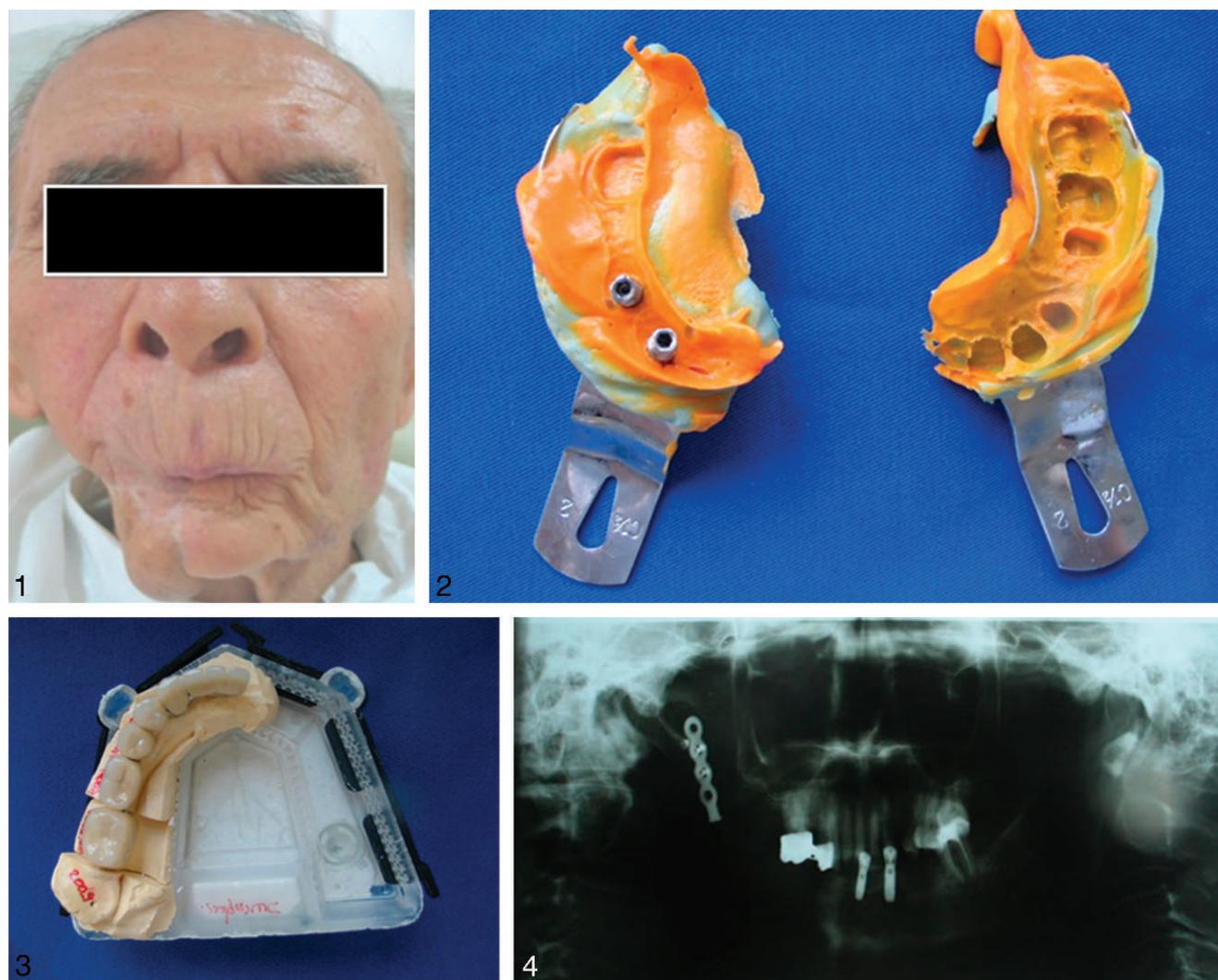
Two years after the conclusion of oncologic treatment, the patient was referred to our clinic for oral prosthetic rehabilitation. Facial examination revealed asymmetry caused by depression and drooping of the right corner of the mouth (Figure 1). Loss of motor and sensory innervation of the right lower lip caused by the mandibular resection was also observed, and a combination of missing teeth and the mandibular defect adversely affected the patient's appearance as well as his ability to chew, swallow, and speak intelligibly. Extraoral examination revealed retrusion of the mandible and deviation towards the surgical side on mouth opening, which was limited. Intraoral clinical and panoramic radiographic examination revealed a mandibular discontinuity extending to the anterior of the mandible. An endodontically treated healthy left mandibular second molar (tooth number 18) was detected on the panoramic radiograph and was maintained for prosthodontic support. A maxillary right fixed partial prosthesis was left in place, and an additional fixed partial prosthesis was constructed to treat a missing left first maxillary premolar (tooth number 12). In addition, 2 implants (Swiss Plus Implant System, Zimmer Dental Inc, Carlsbad, Calif) were placed in the irradiated residual unresected alveolar ridge without applying hyperbaric oxygen therapy (HBO). One implant (10×3.7 mm diameter) was placed in the canine incisor region (tooth number 22) and a second (10×3.7 mm

diameter) in the second premolar region (tooth number 20). An implant could not be placed in the more posterior region due to the compromised interarch space (Figure 2). In order to enhance osseointegration, implants were submerged for a 1-year period, after which time they were uncovered, and healing caps attached.

At the start of the prosthodontic rehabilitation process, the left maxillary canine (tooth number 11), left maxillary second premolar (tooth number 13), and left mandibular second molar (tooth number 18) were prepared for a metal-ceramic FPD. Putty-wash impressions were made using a dental impression tray having 2 identical half parts. Silicone elastomere (Zetaplus, Oranwash, Zhermack, Rovigo, Italy) was used as an impression material to fabricate 3-unit metal-ceramic FPD for maxilla and tooth-implant supported, cemented, metal-ceramic FPD for mandible with impression copings (Figure 3). The implant analogs were inserted in their respective places in the mandibular impression, and final casts (both maxillary and mandibular) were poured from type IV improved stone (Moldano, Bayer Co, Leverkusen, Germany). A low vertical dimension of occlusion was established in order to facilitate insertion of the bolus between both jaws. The maxillomandibular relationship was obtained by laterally manipulating the mandible to the most advantageous position possible for the patient. The casts were then mounted in an articulator, and the prostheses were completed using conventional prosthodontic guidelines (Figures 4 and 5).

In order to improve esthetics, 3 incisive teeth crowns were used as cantilevered pontics in the mandible. After try-in, the restorations were completed and then cemented with resin-modified glass ionomer cement (Aqua-Cem, DeTrey Dentsply, Weybridge, Surrey, UK).

In addition, a maxillary occlusal ramp was planned to facilitate the guidance of the mandible into a more desirable maxillomandibular relationship and to provide a broad area of occlusal contact. The framework of the mentioned ramp with clasp retainers on the opposing maxillary 3-unit FPD was designed to include a saddle on the unresected side that provided mechanical retention for acrylic resin. The mandible was manipulated laterally to the desired position, and occlusal contact with the maxillary guide prosthesis was noted by placing the wax ramp on a saddle along the lateral and anterior



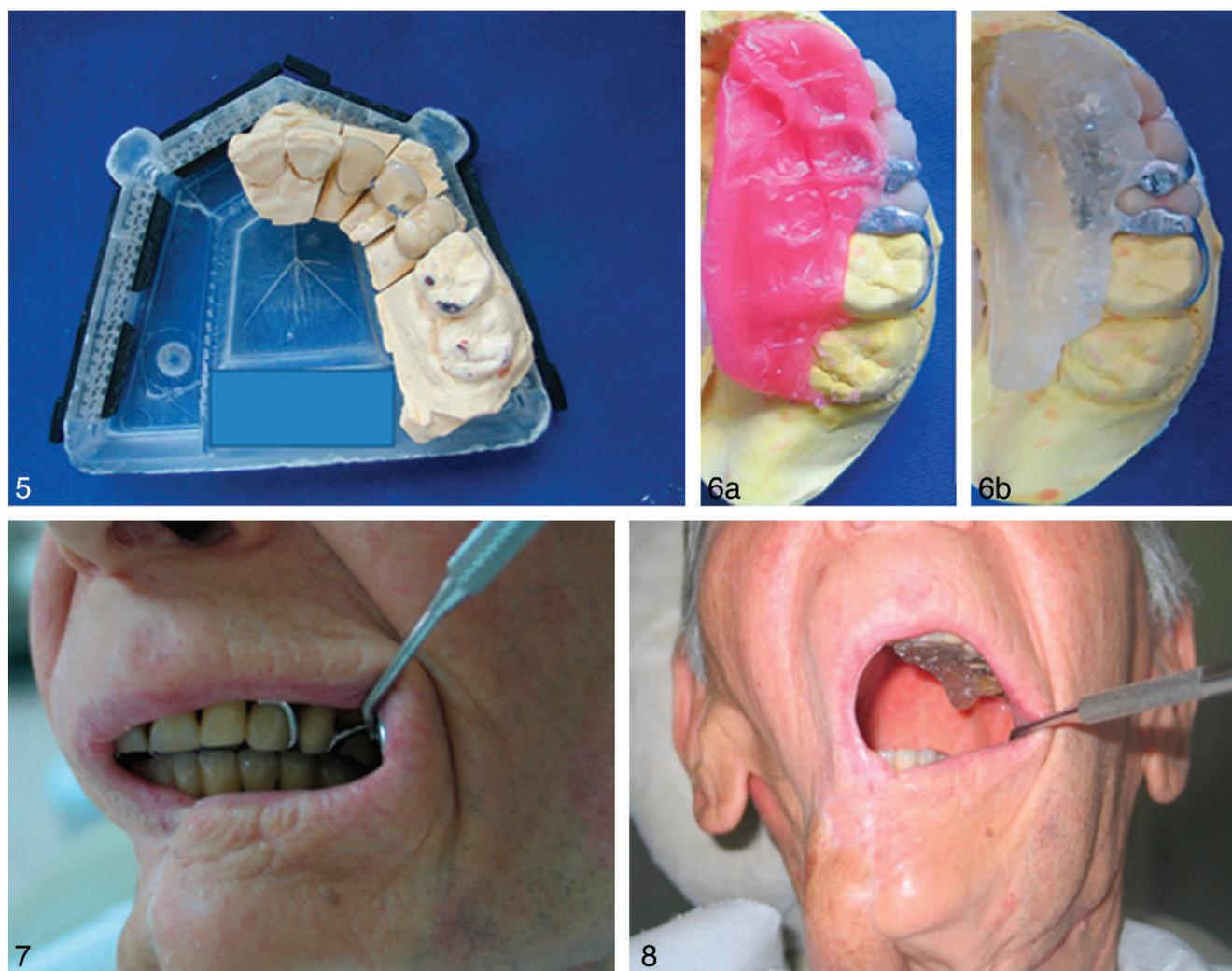
FIGURES 1–4. **FIGURE 1.** Extraoral appearance of the patient. **FIGURE 2.** Putty-wash impressions using silicone elastomer for the mandible with impression copings and a 3-unit metal ceramic fixed partial denture for the maxilla. **FIGURE 3.** The completed tooth/implant-supported prosthesis with a cantilever for the mandible. **FIGURE 4.** Panoramic radiographic view of the patient after placement of 2 dental implants in the irradiated mandible.

borders in the nondefect side (Figure 6a). The wax index was duplicated in heat-polymerized acrylic resin (Figure 6b). After adjustment and smoothing, the ramp was inserted, and the patient was instructed to wear it continuously. The patient was instructed in appropriate oral hygiene and recalled on a 3-month basis (Figures 7 and 8). The patient has been wearing the prosthesis for 2 years with no complaints.

DISCUSSION

Osseointegrated implants offer major advantages in the reconstructive management of patients with oral neoplasms. Rehabilitation of oral function can

be accomplished with the placement of endosseous implants to support and improve the stability and retention of dental prostheses.^{7,8} However, implants placed in irradiated bone have been reported to show progressive loss for up to 6 years after placement. Failure rates of mandibular implants placed in bone irradiated with more than 5000 cGy have been reported to be as high as 33%.⁹ For this reason, a minimum of 9–12 months between radiation therapy and implant placement is recommended to allow for the regeneration of depressed bone segments.¹⁰ Despite the high rate of implant loss, radiation therapy cannot be considered an absolute contraindication to mandibular dental implants,¹¹ as recent reports have indicated that



FIGURES 5–8. **FIGURE 5.** The completed 3-unit metal ceramic FPD for the maxilla. **FIGURE 6.** (a) Index of occlusal contact on the wax ramp. (b) Framework guide with acrylic resin on the model. **FIGURE 7.** Intraoral photograph of the patient rehabilitated with an implant-supported fixed prosthesis and maxillary guide. **FIGURE 8.** Intraoral view of maxillary guide.

implants may be successfully placed into an irradiated mandible without HBO,^{11,12} as was the case here. In addition, authors of a recent published case report described a 1-step implant surgery protocol combined with immediate functional prosthetic loading before radiation therapy. According to the authors, the mentioned protocol decreased the possibility of osteoradionecrosis occurrence, and clinical evaluation of the patient 2 years after radiation therapy without HBO was completed revealed osseous consolidation.¹³

In the case reported here, the patient was informed about treatment options, which included removable partial dentures and a tooth/implant-supported fixed prosthesis, as well as the associated risks. Assuming an uneventful 2-year post radiation

therapy period, an implant-supported fixed partial prosthesis for the right mandible was recommended.

Preparation of implant-supported or retained prostheses for oncologic patients requires much more work than for other patients. For patients who have suffered extensive soft tissue loss resulting from tight wound closure, radiation therapy, and classical radical neck dissection, individualized and often imaginative solutions are required, as in the case presented here. The method of rehabilitation selected will depend upon the number, arrangement, and status of residual teeth (eg, periodontal health and remaining tooth structure); the adequacy of remaining bone to support dental implants; cost; and the wishes of the patient. Tooth-to-

implant-connected prostheses are generally considered when anatomic structures (eg, maxillary sinus, mental foramen) and reduced bone height, volume, and quality restrict insertion of additional implants.^{14,15} Tooth-to-implant connections also offer other advantages, such as protection of the proprioceptive mechanism; the need for fewer implants; low cost; additional support for the total load on dentition; and splinting of natural teeth.^{13,15–18} However, some studies have reported mechanical and biologic complications with tooth-to-implant connections, such as damage to teeth, implants, implant components, and suprastructures due to differences in mobility characteristics in tooth-implant supported fixed partial prostheses.^{14–19} In the case presented here, a tooth-implant supported prosthesis was preferred because the patient had a compromised interarch space that did not provide adequate room for implant placement in the posterior region.

In the present case, the fixed partial prosthesis was supported by an endodontically treated left mandibular second molar (tooth number 18), which maxillomandibular relationship sufficient remaining tooth structure and bone support, together with 2 implants in the anterior mandibular region. The literature contains limited and conflicting data regarding the inclusion of endodontically treated abutment teeth in a tooth-implant supported prosthesis.¹⁴ In our case, no complications have been reported in connection with the endodontically treated tooth over a follow-up period of 2 years.

The literature supports the position that a rigid connection between tooth and implant will usually prevent tooth intrusion and that restorations with rigid connections have higher success rates than those with nonrigid connections.²⁰ In line with this understanding, in this case, a rigid connection (one-piece casting) was used between tooth and implant, and permanent cementation was used to enhance rigidity.

High-risk adjacent cantilevered pontics with minimal abutment support should be expected to have a higher failure rate compared to cantilevered pontics with good abutment support even though these treatment plans may benefit certain patients.¹⁴ In general, it has been wise to use 2 or more implant abutments when designing cantilevered prostheses. This general rule may be affected

by the anticipated or lack of forces on the prostheses and the size of a cantilever pontic.²¹ In the case reported here, when planning the location and size of a cantilever pontic, it was considered that the loads applied in the anterior region would be less. In addition, the use of 3 cantilevered pontics resulted in improved esthetics.

Previous studies have suggested that maxillary fixation, palatal guide ramps, and mandibular guide flange prostheses can be of help to dentate patients who are capable of achieving proper occlusal contact, but who are unable to reorientate the mandible into a functional position.^{22,23} In the present case, a maxillary occlusal ramp was used to enlarge the occlusal contact area and act as a guide to achieve functional occlusion.

Ultimately, the patient was provided with a stable, tooth-implant supported fixed prosthesis that allowed for an appropriate interocclusal relationship and occlusal scheme that was predetermined by the guidance-positioning device. Moreover, the fixed prosthesis limited mechanical irritation to the tongue and soft tissue and provided sufficient tongue space for efficient mastication.

ABBREVIATIONS

FPD: fixed partial denture
HBO: hyperbaric oxygen therapy

REFERENCES

1. Schneider RL, Taylor TD. Mandibular resection guidance prostheses: a literature review. *J Prosthet Dent.* 1986;55:84–86.
2. Beumer J, Marunick MT, Curtis TA, Roumanas E. Acquired defects of the mandible. Etiology, treatment, and rehabilitation. In: Beumer J, Curtis TA, Marunick MT, eds. *Maxillofacial Rehabilitation: Prosthodontic and Surgical Considerations.* 1st ed. St Louis, Mo: Ishiyaku EuroAmerica; 1996:183–189.
3. Kurtulmus H, Kumbuloglu O, Saygi T, User A. Management of lateral mandibular discontinuity by maxillary guidance. *Br J Oral Maxillofac Surg.* 2008;46:123–125.
4. Dan Oelgiesser, Levin L, Barak S, Schwartz-Arad D. Rehabilitation of an irradiated mandible after mandibular resection using implant/tooth-supported fixed prosthesis: a clinical report. *J Prosthet Dent.* 2004;91:310–314.
5. Esser E, Wagner W. Dental implants following radical oral cancer surgery and adjuvant radiotherapy. *Int J Oral Maxillofac Implants.* 1997;12:552–557.
6. Niimi A, Ueda M, Keller EE, Worthington P. Experience with osseointegrated implants placed in irradiated tissues in Japan and the United States. *Int J Oral Maxillofac Implants.* 1998;13:407–411.
7. Cuesta-Gil M, Ochandiano Caicoya S, Riba-García F, Duarte Ruiz B, Navarro Cuéllar C, Navarro Vila C. Oral rehabilitation with

osseointegrated implants in oncologic patients. *J Oral Maxillofac Surg.* 2009;67:2485–2496.

8. Meijer GJ, Dieleman FJ, Bergé SJ, Merx MA. Removal of an oral squamous cell carcinoma including parts of osseointegrated implants in the marginal mandibulectomy. A case report. *J Oral Maxillofac Surg.* 2010;14:253–256.

9. Granström G. Osseointegration in irradiated cancer patients: an analysis with respect to implant failures. *J Oral Maxillofac Surg.* 2005;63:579–585.

10. Esser E, Wagner W. Dental implants following radical oral cancer surgery and adjuvant radiotherapy. *Int J Oral Maxillofac Implants.* 1997;12:552–557.

11. Schoen PJ, Raghoobar GM, Bouma J. Rehabilitation of oral function in head and neck cancer patients after radiotherapy with implant-retained dentures: effects of hyperbaric oxygen therapy. *Oral Oncol.* 2007;43:379–388.

12. Franzen L, Rosenquist R, Rosenquist KI, Gustafsson I. Oral implant rehabilitation of patients with oral malignancies treated with radiotherapy and surgery without adjunctive hyperbaric oxygen. *Int J Oral Maxillofac Implants.* 1995;10:183–187.

13. Odin G, Balaguer T, Savoldelli C, Scortecchi G. Immediate functional loading of an implant-supported fixed prosthesis at the time of ablative surgery and mandibular reconstruction for squamous cell carcinoma. *J Oral Implantol.* 2010;36:225–230.

14. Greenstein G, Cavallaro J, Smith R, Tarnow D. Connecting teeth to implants: a critical review of the literature and presentation of practical guidelines. *Compend Contin Educ Dent.* 2009;30:440–453.

15. Hoffmann O, Zafiropoulos GG. The tooth-implant connection: a review. *J Oral Implantol.* 2012;38:194–200.

16. Gunne J, Astrand P, Lindh T, Borg K, Olsson M. Tooth-implant and implant supported fixed partial dentures: a 10-year report. *Int J Prosthodont.* 1999;12:216–221.

17. Hosny M, Duyck J, Van Steenberghe D, Naert I. Within-subject comparison between connected and nonconnected tooth-to-implant fixed partial prostheses: up to 14-year follow-up study. *Int J Prosthodont.* 2000;13:340–346.

18. Kindberg H, Gunne J, Kronstrom M. Tooth- and implant-supported prostheses: a retrospective clinical follow-up up to 8 years. *Int J Prosthodont.* 2001;14:575–581.

19. Nickenig HJ, Spiekermann H, Wichmann M, Andreas SK, Eitner S. Survival and complication rates of combined tooth-implant-supported fixed and removable partial dentures. *Int J Prosthodont.* 2008;21:131–137.

20. Nickenig HJ, Schäfer C, Spiekermann H. Survival and complication rates of combined tooth-implant-supported fixed partial dentures. *Clin Oral Implants Res.* 2006;17:506–511.

21. Becker CM, Kaiser DA. Implant-retained cantilever fixed prosthesis: where and when. *J Prosthet Dent.* 2000;84:432–435.

22. Hasanreisoglu U, Uçtasli S, Gurbuz A. Mandibular guidance prostheses following resection procedures: three case reports. *Eur J Prosthodont Restor Dent.* 1992;1:69–72.

23. Aramany M, Myers E. Dental occlusion and arch relationship in segmental resection of the mandible. In: Sisson GA, Tandy ME, eds. *Plastic and Reconstructive Surgery of the Face and Neck.* 1st ed. New York, NY: Grune & Stratton; 1977:251–253.