The case report of maxillofacial prosthesis using a magnetic attachment after maxillary sinus cancer treatment

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Abstract

Patients with maxillary defects often experience serious difficulties in speech, swallowing, mastication, and esthetics, even if reconstructed using a flap. A 60-year-old Japanese male with squamous cell carcinoma of the right maxilla was referred to our department for prosthetic rehabilitation. He underwent radiotherapy and intraarterial chemotherapy, followed by total right maxillectomy and rectus abdominis muscle flap reconstruction. The first maxillofacial prosthesis was made after referral to our department, however, the remaining teeth worsened so that another maxillofacial prosthesis was required. Seven years after the first maxillofacial prosthesis was delivered, an overdenture type maxillofacial prosthesis with an OP anchor attachment on #23 and a magnetic attachment on #27 was applied. After the overdenture type maxillofacial prosthesis was applied, it was possible to obtain maxillofacial prosthesis stability. The objective hypofunction evaluation showed acceptable results and enabled the patient's quality of life to be improved.

Introduction

Treatment of head and neck cancer includes surgery, radiotherapy, and chemotherapy, which can alter oral functions, such as speech, mastication, swallowing and esthetics. Not only direct tissue loss and teeth loss due to surgical procedures, but also increased caries risk due to xerostomia caused by radiotherapy, which makes it difficult to keep the remaining teeth in optimal condition. For denture use, extensive tissue loss, including bone, increases the load on the remaining teeth, and xerostomia interferes with denture stability, making patients feel more pain. Nevertheless, maxillofacial prostheses to restore oral function are necessary for patients with head and neck cancer. It is important to provide appropriate rehabilitation of the patient as early as possible after surgery and at various phases during the perioperative and recovery phases. The use of magnetic attachments can often be very useful in poor remaining tooth conditions, like in maxillofacial prosthetics. On the other hand, magnetic resonance imaging (MRI) can be performed for postoperative patients with head and neck cancer for evaluation during follow-up period. The use of magnetic attachments should be chosen carefully, considering the effects of mechanical effects, temperature rise, and metallic artifacts associated with MRI use [1].

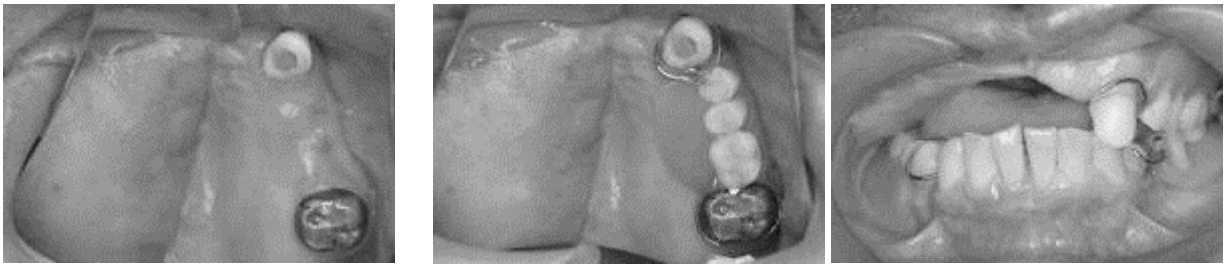
Clinical history

A 60-year-old Japanese male with squamous cell carcinoma of the right maxilla (T3M0N0) first visited Tokyo Medical and Dental University Hospital in June 2016 for prosthetic rehabilitation. His chief complaint

was the difficulty of eating because he could not chew foods properly. His medical history included radiotherapy (Total 40Gy/20Fr) and chemotherapy (Cisplatin 20mg/m^2 4 course) for right-sided maxillary sinus cancer in January 2016, right-sided total maxillectomy and reconstruction with a rectus abdominis flap in March 2016. No special concern was noted in his family history. Intraoral photographs with denture placement at the first visit are shown in Figure 1.

After maxillectomy, the first maxillary prosthesis was fabricated with a design that placed the artificial teeth in an anterior position to avoid the bulky flap in 2016. In 2017, the pulp of #27 was extracted due to caries. And after the prosthetic treatment at #27, the maxillary prosthesis was fabricated again in 2018 (Fig. 2). In 2023, the crown of #23 and both crowns and post cores of #27 and #34 dropped off due to caries. To improve the poor dental situation, additional repairs were performed to the maxillary and mandible prostheses. However, the maxillary prosthesis had lost its retention. A soft lining material was used for the prosthesis modification to obtain retention, however, it was insufficient, resulting in a demand for refabricating a maxillary prosthesis (Fig. 3).

The disease type classification of the Japan Prosthodontic Society was level III [2]. The overall diagnosis was mastication disorder caused by a maxillectomy and flap-reconstruction.



A B C

Fig.1 Intraoral views at first visit (3 months after surgery). A, Without denture. B, With denture. and C, Frontal view with denture.

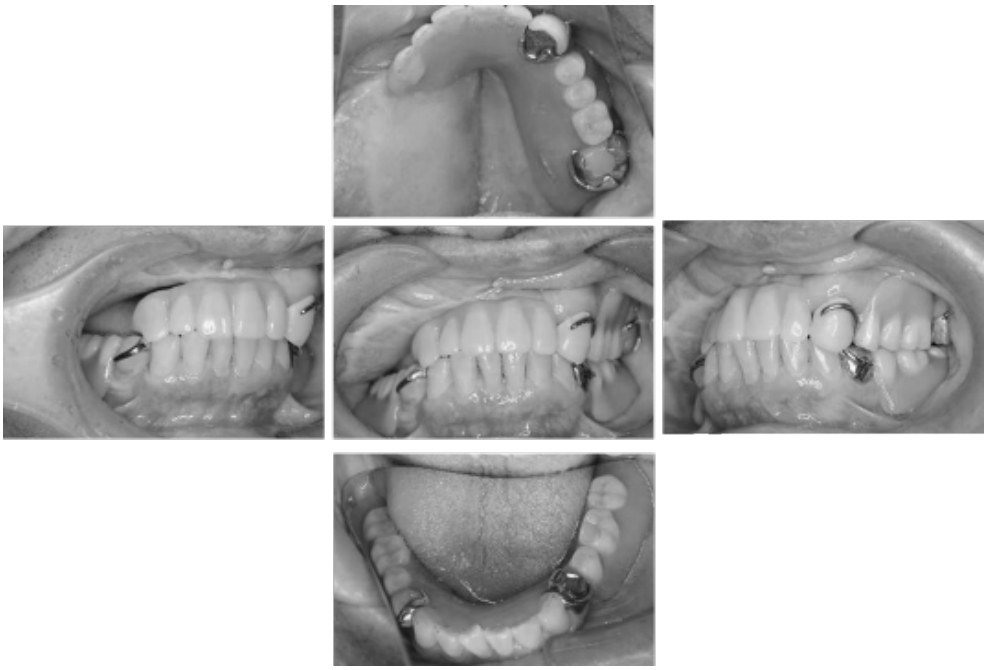


Fig.2 Intraoral views with first maxillary prosthesis (2 years after surgery).

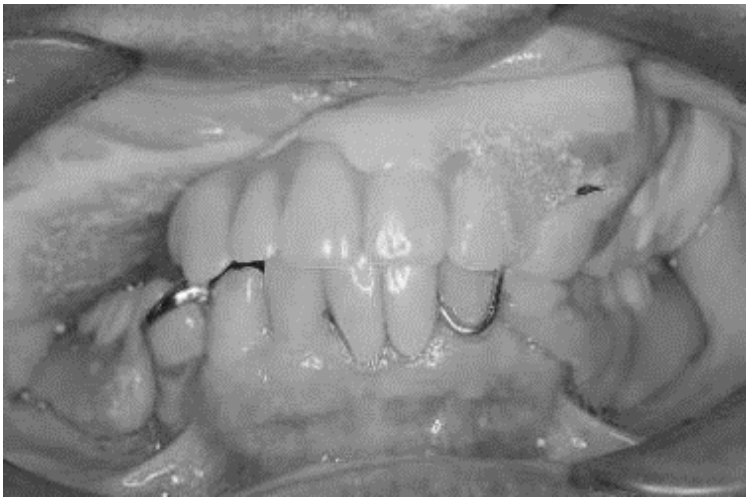


Fig.3 Intraoral views with modified first maxillary prosthesis (6 years after surgery).

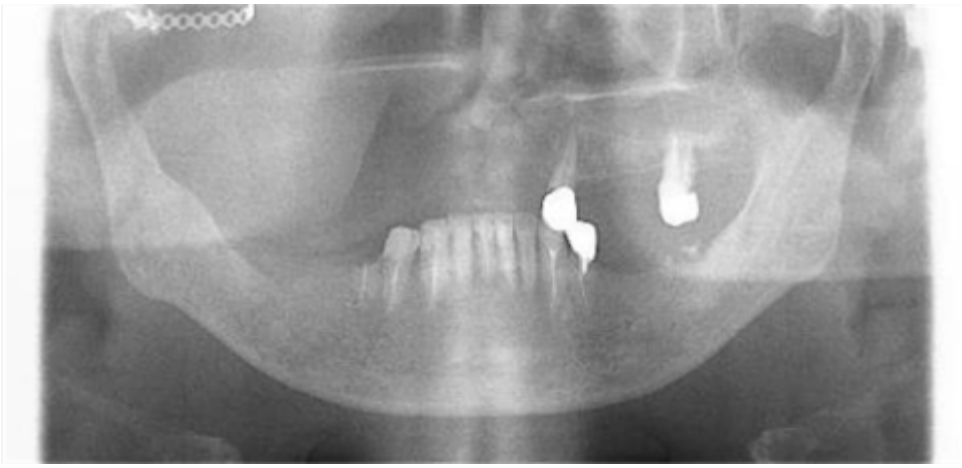


Fig.4 Panoramic radiograph taken 4 years after surgery.

Treatment procedure

As for the maxillary prosthesis, the denture base of the right molar part, which would be supported by the reconstructive flap, was designed to be smaller than a normal complete denture, and the base of the right anterior part was designed to be extended as much as possible to restore esthetics. The OP anchor attachment on #23 and the magnetic attachment (Magfit M600, Aichi Steel Corporation, Aichi, Japan) on #27 were incorporated into the maxillary prosthesis to obtain its retention. When the prosthesis was delivered, a rubber ring was placed into the maxillary prosthesis, which was equivalent to the female part of the OP anchor attachment on #23 (Fig 6).

The mandibular prosthesis wasn't provided occlusion on the right side due to the maxillary prosthesis design, but artificial teeth were arranged as a normal design to prevent residual food from entering the dead space. The mandibular prosthesis was designed with a wrought wire clasp on #33, a double Akers clasp on

#43 and #44, and occlusal rests on #33, #43, and #44. The prosthesis base was fabricated with a heat-cured acrylic resin (Acron No.3 Pink, GC Corporation, Tokyo, Japan). Because only left-sided occlusion was available for chewing, an Akers clasp with relatively strong retentive force was applied on the right side and designed to prevent harmful movement of the mandibular prothesis.

For both maxillary and mandibular prostheses, definitive impressions were taken with silicone impression material (Exahiflex regular type, GC Corporation, Tokyo, Japan) using custom trays fabricated on the diagnostic casts. The maxillomandibular registration was recorded using the occlusal rim in the adapted centric posture. The wax dentures with the artificial teeth were previously placed as try-ins to check the fitness of denture bases and maxillomandibular registration. The definitive prostheses were fabricated after confirming that there was no complication.

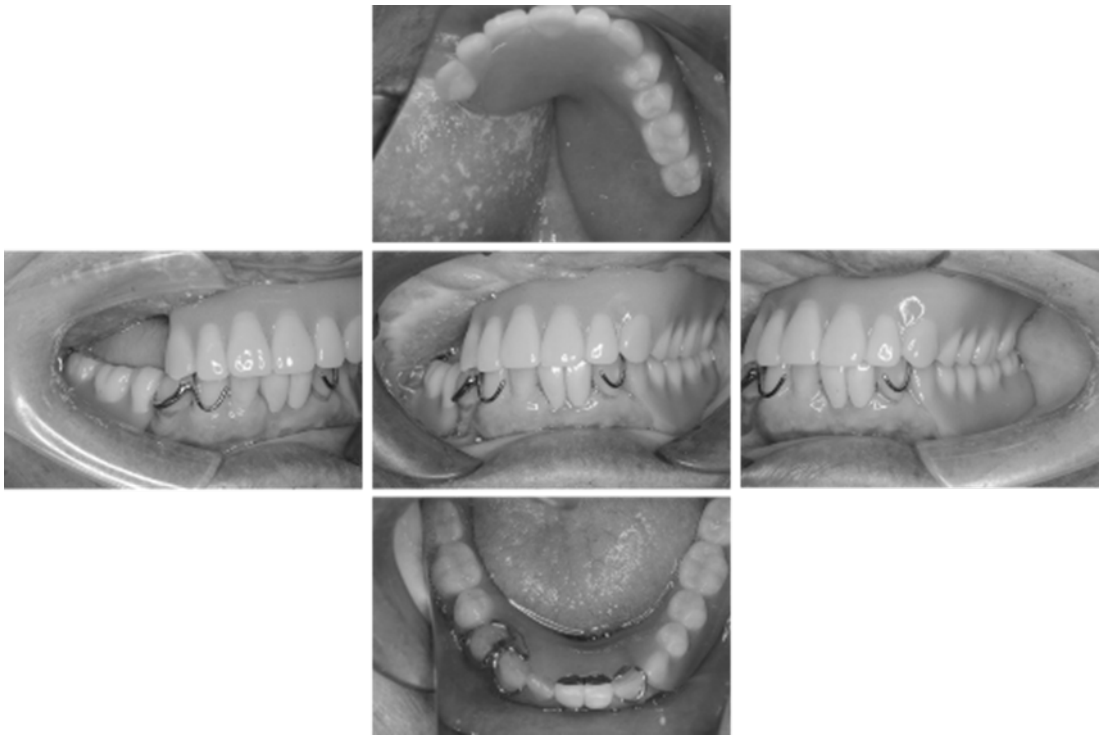


Fig.5 Intraoral views with treatment definitive prostheses placement (7 years after surgery).

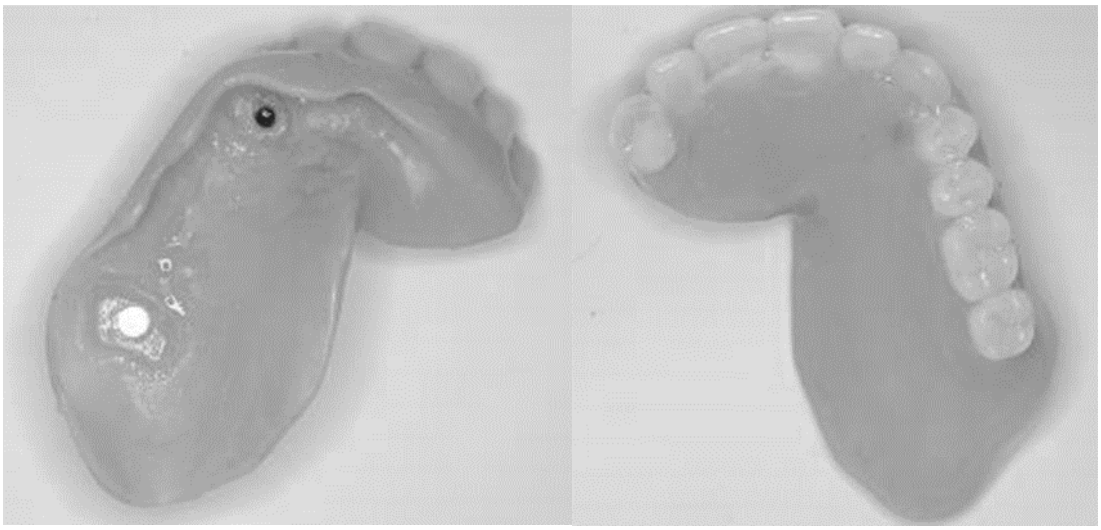


Figure 6. Definitive maxillary prosthesis after processing. A, Intaglio surface. B, Polished surface.

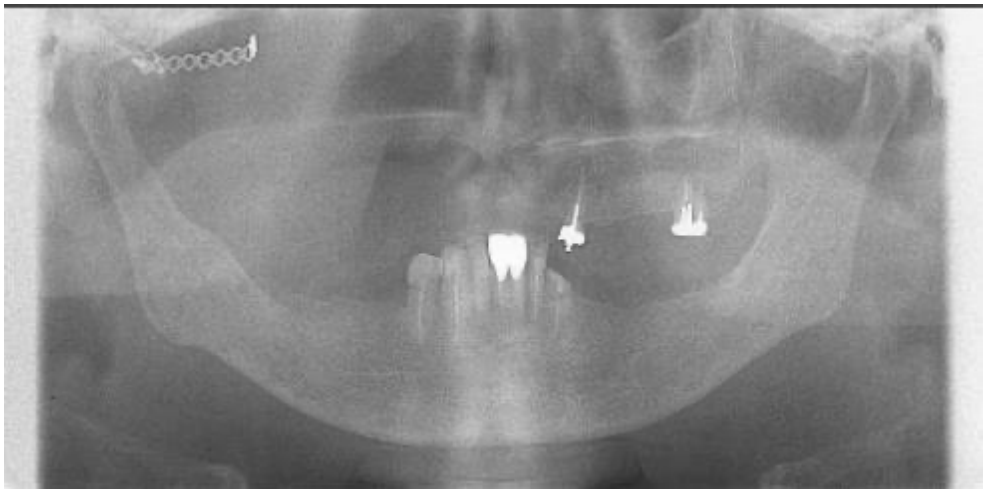


Fig.7 Panoramic radiograph taken 7 years after surgery.

Outcome of treatment

Three weeks after the magnet was incorporated into the denture, it was confirmed that the prostheses could be used without any problems. Then, the test of oral hypofunction was conducted. The results of the seven tests were presented in Table 1. For the item of occlusal force, the result of occlusal force test was 150.8 N, while the eligibility criterion was over 350 N. Meanwhile, for the item of hypokinesia of the tongue and lips, the result of hypokinesia of the tongue test was 5.0 times/s in “pa”, 5.6 times/s in “ta”, and 4.8 times/s in “ka”, whereas the eligibility criterion was 5.0 times/s in each sound. The results of these two items did not satisfy the eligibility criteria.

However, the result of oral hygiene test was 16.60 %, while the eligibility criterion was less than 50 %; the result of xerostomia test was 30.6 as a score, while the eligibility criterion was more than 27; the result of hypoglossal pressure test was 35.23 kPa, while the eligibility criterion was less than 30 kPa; the result of masticatory function test was 172 mg/dl, while the eligibility criterion was less than 100 mg/dl; and the result of dysphagia test was 0 point, while the eligibility criterion was more than 3 points.

Table1. Test results for items related to oral hypofunction.

Subordinate symptoms	Inspection item	Eligibility criteria	Inspection
①Poor oral hygiene	Degree of tongue coating	50 % ≦	16.60 %
②Xerostomia	Oral wetness	27 >	30.6
③Decreased of occlusal force	Occlusal force	350 N > (Dental Prescale Ⅱ with Filter)	150.8 N
④Hypokinesia of the tongue and lips	Oral diadochokinesis	Any one item is less than 6 times/s	【pa】5.0 times/s 【ta】5.6 times/s 【ka】4.8 times/s
⑤Hypoglossal pressure	Tongue pressure	30 kPa >	35.23 kPa
⑥Decreased masticatory function	Masticatory ability	100 mg/dl >	172 mg/dl
⑦Dysphagia	Screening test for swallowing (EAT-10)	3 ≦	0

Discussion

From a medical safety perspective, the placement of magnetic attachments on the most posterior molar (#27) is at a higher risk of falling into the oral cavity. In maxillofacial prosthetic cases, the risk of aspiration and ingestion is potentially higher than in normal prosthetic cases due to the presence of nasal perforation, tongue defect, and mandibular defect. Therefore, it is necessary to handle magnetic attachments with extreme caution.

In general, patients with demands to wear maxillofacial prostheses after treatment for head and/or neck cancer are at a relatively high potential for MRI. According to the previous report by Yasumatsu et al., it was indicated that the risk of head and neck cancer recurrence would be less than 7% after 4 years [3]. This case was judged to be applicable because five years had already passed after the surgery. However, the possibility of keeper removal should be explained to the patient and an MRI scan should be performed in case the risk of cancer recurrence has occurred.

Regarding occlusal forces, Nomura et al. reported 219.8 N of occlusal force as a mean value recorded in 40 elderly complete denture patients [4] and Kambara et al. reported 125.7 N of occlusal force as a mean value recorded in 20 patients with maxillary dentures [5]. From these reports, it can be inferred that the occlusal force revealed in the present case was acceptable as a result of treatment with an overdenture-type maxillary prosthesis. Additionally, the results of hypokinesia of the tongue and lips might be affected by the maxillary bone defect type and rectus abdominis flap valve after right total maxillectomy.

Conclusion

For the patient with maxillectomy and flap who was not eligible for implants due to radiotherapy, magnetic attachments were useful to obtain a stability of maxillary prosthesis. In this case, it was important to pay attention to MRI imaging after a sufficient follow-up period following head and neck cancer treatment. Adequate results were confirmed in oral hypofunction tests, resulting in a high level of patient satisfaction.

Acknowledgment

All the authors of this study would like to thank the patient who willingly consented to publish our treatment for him including his clinical history.

Conflict of interest statement

None.

Reference

1. The Japanese Society of Magnetic Application in Dentistry. The safety guidelines for magnetic attachments and MRI scans, <http://jsmad.jp/jjsmad/MRI-safety-GL-2022.pdf>; 2022 [accessed 24.01.24]
2. M. Hideshima, T, Ichikawa, Y. Tomotake, N. Yasuda, H. Sato, M. Hattori, T. Oyama: The judgement of treatment difficulty for partially and completely edentulous dental arch: The significance and application of the disease type classification -Approach for the definition of the clinical-path and disease type classification by the Japan Prosthodontic Society-, Shikai Tembo, 105, 825-833, 2005.
3. R.Yasumatsu: Recurrent and/or metastatic head and neck cancer, Stomato-pharyngology, 35(2), 123-128, 2022
4. S. Nomura, K.Yamamura, S.Kohno: State of Masticatory Function in Elderly Full Denture Wearers Hotetsushi,J Jpn Prosthodont Soc, 42, 194-200.1998
5. A.Kamohara, R.Aijima, A.Danjo, Y.Yamashita: Assessment of masticatory, swallowing, and articulatory functions in patients with maxillary prosthesis, Japanese Journal of Head and Neck Cancer, 48(1), 21-27, 2022