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CASE REPORT

Piezography approach to denture fabrication for a partial glossectomy patient: A clinical report

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ABSTRACT

To provide a mandibular complete denture for a patient with a partial glossectomy and partial mandibulectomy, the denture space was captured using a piezography technique involving silicone impression materials with two different viscosities. Artificial teeth were arranged within the obtained piezographic index, and the denture was processed in the conventional manner. Using the piezography technique described enables physiologically appropriate complete dentures to be fabricated based on the neutral zone concept. (*Int J Maxillofac Prosthetics 2021;4:37-42*)

INTRODUCTION

Tumor invasion of the mandible by intraoral squamous cell carcinoma tends to be treated surgically by mandibulectomy, which may include partial or total glossectomy.[1] The procedure can also involve removing part of the mandible, the floor of the mouth, and large portions of the tongue and local lymphatic system. Subsequently, patients may have great difficulty moving their tongue and lips, leading to dysfunction in swallowing, mastication, and speech.[2,3] Depending on the size and location of the cancer, surgical reconstruction is performed immediately and generally involves transplantation of flaps. For those patients after glossectomy, prosthetic rehabilitation using complete dentures is usually indicated when they are edentulous, regardless of reconstruction is performed.[4]

There are some benefits to using complete dentures for edentulous patients after glossectomy. Using removable complete dentures facilitates follow-up consultations and increases the chance of the dentist and patient noticing tumor recurrence. Complete dentures can also be used as a radiographic and/or surgical guide for implant placement. However, rehabilitation using complete dentures may be challenging. Surgical anatomical changes in edentulous patients after glossectomy can complicate denture fabrication and make it difficult to balance the prosthetic, achieve retention and stability, and provide support.[5] After glossectomy, the available restorative space is grafted with a skin flap, which often obliterates the labial, buccal, and lingual vestibules. The reconstructed tongue may deviate frontally, preventing it from reaching the palate vertically. It may sometimes even remain tethered under the occlusal plane. Changes in the morphology of the tongue and soft tissues as well as in the movement of the tongue and lips may complicate denture fabrication, especially in edentulous patients.

Therefore, defining the available space for the denture base and teeth is important. Some researchers have suggested that a functional approach

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should be used to obtain denture stability and retention in such cases.[6,7] When fabricating the complete denture, utmost consideration should be given to the relationship between the polished surface contour and the surrounding tissues in order to provide denture stability.[1,6] One of the most common solutions is to arrange the teeth bucco-lingually in a position that conforms to the neutral zone, so that the teeth do not to interfere with normal muscle function, and instead use the muscle forces to stabilize the prosthesis. In contrast to techniques that determine the neutral zone based on swallowing, piezography records the shape and volume of the neutral space based on the pressure generated during speech.[8] Various procedures for piezography, including those that use impression materials or tissue-conditioning materials, have been reported since Klein first reported on piezography in 1988.[9-13]

This case report describes the use of a piezography technique to fabricate a removable complete denture for a patient with a partial glossectomy and partial mandibulectomy who, because of excessive salivation and drooling, had experienced speech difficulties for 20 years after undergoing the glossectomy.

CASE REPORT

In 2012, an 82-year-old man visited the Clinic for Maxillofacial Prosthetics at Tokyo Medical and Dental University with the chief complaint of discomfort with his complete dentures. He was first referred to us by the Oral Surgery Department in 1993 when he was 63 years old. He had undergone right partial glossectomy, floor of mouth resection, right marginal mandibulectomy, and modified radical neck dissection for squamous cell carcinoma, and his tongue had been reconstructed with a forearm vascularized free flap. In 1994, conventional complete dentures were fabricated for initial rehabilitation. Because he complained that the prostheses were uncomfortable and that he could not speak well with them because of excessive salivation and drooling, new complete dentures with reasonable stability and aesthetics were fabricated on several occasions, but the speech and functional problems caused by excessive salivation persisted.

Intraoral examination revealed the patient was edentulous with severe resorption of the mandibular alveolar ridge. The right tongue defect was covered by a skin graft (Fig 1). Because of scar contracture and inadequate tongue bulk, tongue movement was impaired, and lower lip movement was wider than normal. To address his chief complaint of excessive salivation when speaking, fabrication of new prostheses based on the piezography technique was planned.



Fig 1. Patient's mandibular edentulous ridge with limited tongue movement caused by a partial right glossectomy.

Clinical procedures

The preliminary steps were carried out following standard clinical procedures. Maxillary and mandibular casts were fabricated based on final impressions and using custom trays and polyvinylsiloxane (PVS) material (Examixfine, Regular type; GC Corp., Tokyo, Japan). The final casts were poured with Type IV die stone (New Fujirock; GC Corp) (Fig 2A). The occlusal plane was determined from the lower border of the upper lip and set parallel to Camper's plane. The maxillo-mandibular relationship was recorded in a centric relation after determining the vertical dimension of occlusion (Fig 2B).The maxillary and mandibular working casts were mounted on a semi-adjustable articulator. A base plate was fabricated using self-polymerizing resin (Ostron II; GC Corp.) to be used as a tray for recording piezography (Fig 3). After adhesive material was applied to the base plate, two types of PVS impression materials were used to record the piezographic space in a 3-step procedure in which the patient was asked to pronounce distinct sounds repeatedly. First, PVS impression material with low flow hardness (Examixfine, Regular Hard Type; GC Corp.) was injected on the base plate. The plate with the impression material was then inserted into the oral cavity, and the patient was asked to say "**PaPaPa**," "**MaMaMa**," "**MuMuMu**," "**TsuTsuTsu**," and other syllables in Japanese (Fig 4) until the PVS material was completely set on the base plate. Next, the base plate of the piezographic record was placed on the articulator. The maxillo-mandibular relationship was examined and excess impression material on the occlusal plane was trimmed off. The procedure of adding the impression material, repeating syllables, and trimming excess material was repeated, but this time using regular type PVS with regular flow hardness (Examixfine, Regular type; GC Corp) (Fig 5A).

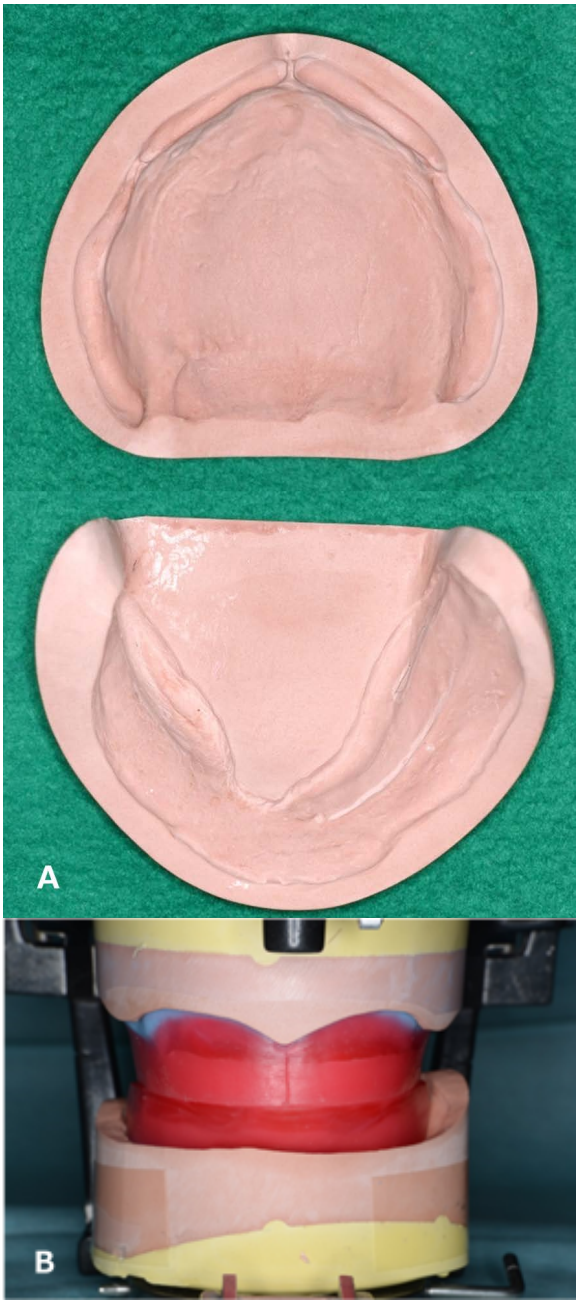


Fig 2. **A**). Maxillary and mandibular working casts. **B**). Conventional recording of the maxillo-mandibular relationship while placed on an articulator.

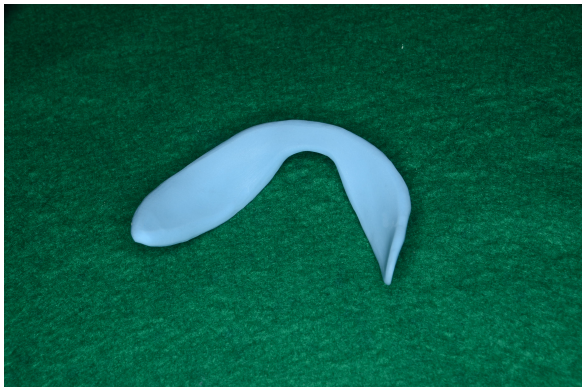


Fig 3. Mandibular piezographic base plate.

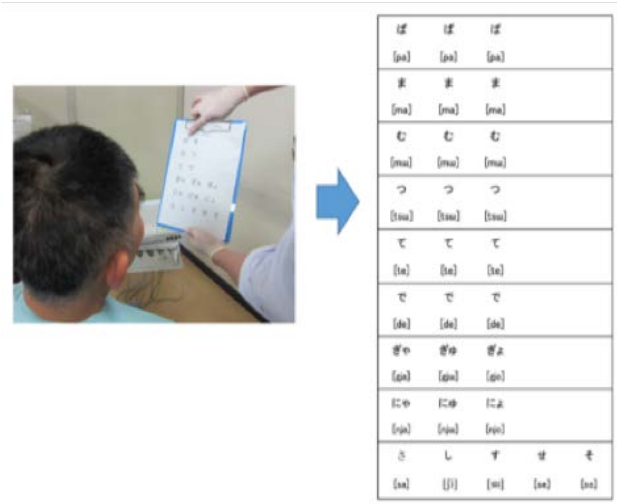


Fig 4. List of selected Japanese syllables used.

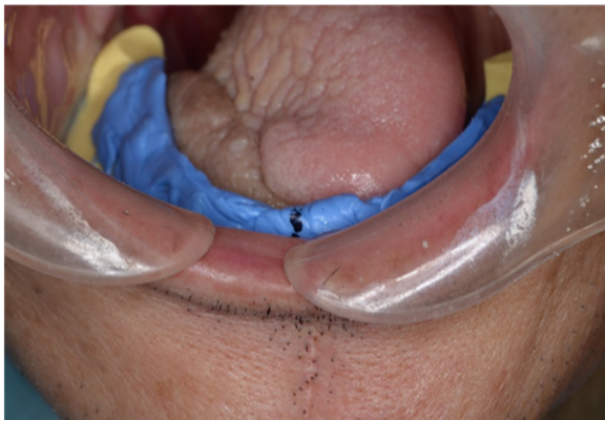


Fig 5A. Completed piezographic impression.

The piezographic record was then placed on the working cast (Fig. 5B) and the external surface was recorded using putty PVS impression material (Coltoflax; Coltene/Whaledent Inc., Cuyahoga Falls, OH) as an index for the neutral zone.

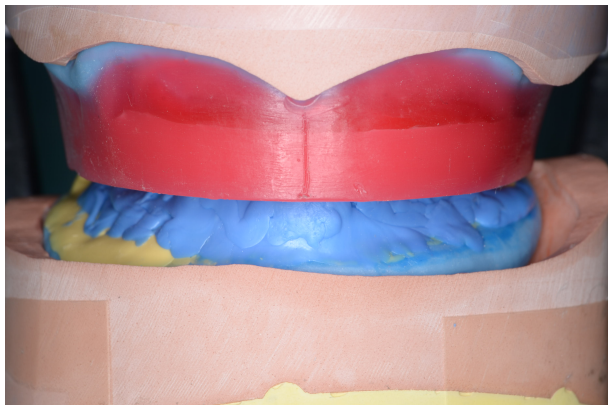


Fig 5B. Piezographic structure placed on the articulator for excess impression material on the occlusal plane to be trimmed off.

After removing the piezographic record from the working cast, artificial teeth (Duradent, GC Corp.) were arranged following the piezographic index and wax was festooned on a new record base (Fig 6). Arrangement of the mandibular artificial teeth was done intraorally for evaluation of denture stability during jaw movement and speech. The trial denture was processed in the conventional manner with denture base acrylic using the lost wax technique (Acron, dark pink; GC Corp) (Fig 7).

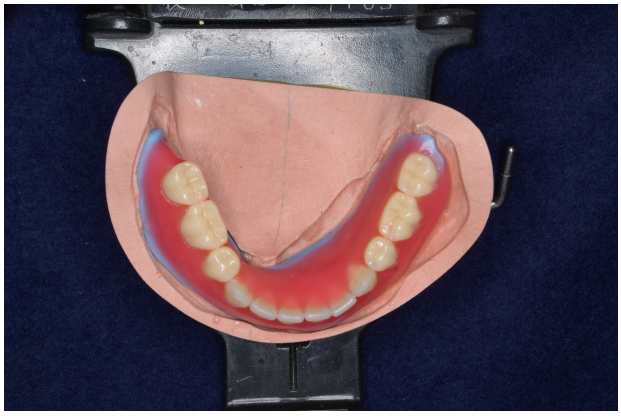


Fig 6. Arrangement of artificial teeth within the piezographic index.



Fig 7. Completed mandibular piezographic denture.

Evaluation of artificial tooth position

After completion of treatment, the relationship between the position of the artificial teeth and the alveolar crest was evaluated using cone-beam computed tomography (Figs 8A, B), as described in our previous report13. Compared with the line of the alveolar crest, the center lines of the occlusal surface of the piezography impression in the molar areas were located lingually and the anterior part was located labially (Fig 8C).

DISCUSSION

This patient with a partial glossectomy had experienced problems with speech, excessive salivation, and drooling for 20 years. He was satisfied with the new prosthesis that we fabricated using the described piezography technique because he no longer had salivation problems, making it easier for him to talk.

An advantage of the piezography technique is its accuracy in defining the neutral zone. The term “neutral zone concept” was coined by Beresin and Schiesser in 1976 and is defined as “a potential space between the lips and cheeks on one side, and the tongue on the other; that area or position where the forces of the tongue pressing outward are neutralized by forces of the cheeks and lips pressing inward.”[14-16] They suggested that denture teeth should be arranged in the neutral zone, where they will not interfere with normal muscle function and where the forces exerted by the musculature against the denture are more favorable for stability and retention. Fahmi reported that patients had greater comfort and improved intelligibility when using dentures fabricated using the neutral zone technique compared with conventionally manufactured dentures.[17]

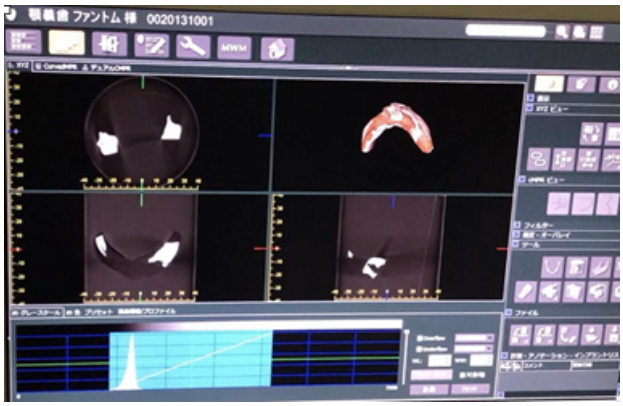


Fig 8A. Scanned piezographic impression saved as a DICOM file.

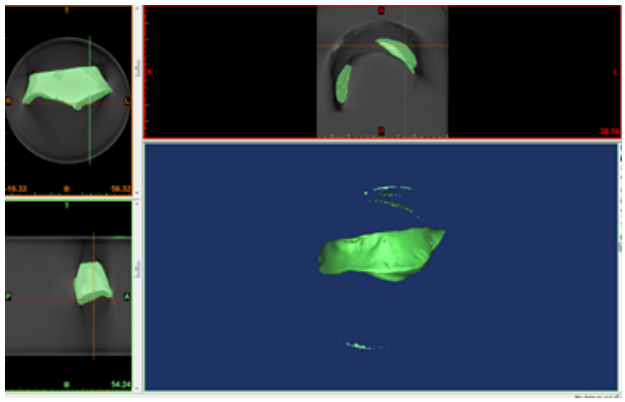


Fig 8B. DICOM data imported using 3D modeling software and saved as an STL file for evaluation of the denture space.

The present report describes prosthetic rehabilitation using piezography to record the denture space in an edentulous patient who had undergone a partial glossectomy. The technique has several advantages. First, it requires the patient only to speak. Because

swallowing function is not required, it is safer than other techniques, especially for glossectomy patients who are at high risk of aspiration. Also, patients can practice before taking the impression. Second, compared with conventional materials, the silicone impression materials used in piezography have better viscoelasticity, have ample working and setting times, can be injected gradually over several applications, are easier to handle, and are more comfortable for the patient. Third, the outcome does not depend on the skill of the clinician because the piezography structure is constructed by the patients' own contribution during phonation.

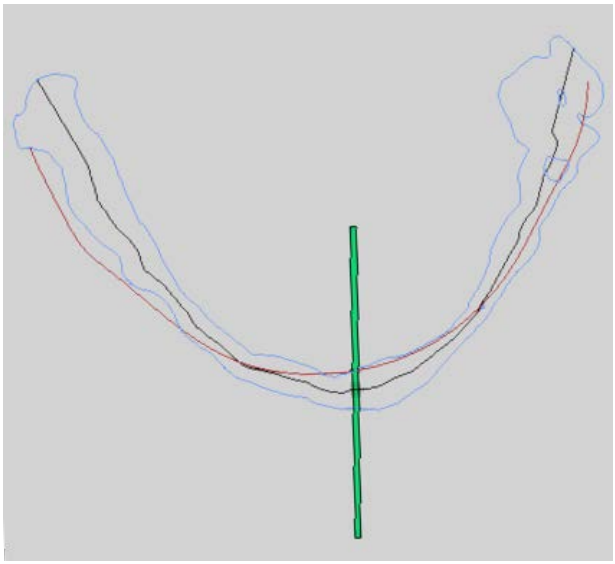


Fig 8C. The artificial tooth position(black line) compared to the alveolar ridge line(red line).

Fahmi reported that the centerline of the neutral zone was located to the buccal side of the alveolar crest in healthy edentulous patients.[17] The 3D evaluation of our patient's records showed that the artificial teeth were slightly to the lingual side of the residual alveolar ridge in the posterior part and to the labial side in the anterior part. It is possible that tongue resection and reconstruction affects not only tongue volume, movement, and force, but also lip and cheek movements, which might have led to the unusual positioning of the artificial teeth in this patient. Yoshi et al. reported that the area bound by the lingual surface of the denture space between the right and left sides showed some variation in glossectomy patients.[12] Awuti et al. also reported that simulated positioning of artificial teeth on the occlusal surface between the right and left sides was asymmetrical in glossectomy patients.[13]

The findings in the present case suggest the need to reconsider the denture space under conditions of different soft tissue movements caused not only by tumor resection, but also by other factors. As the global population ages, it is predicted that the number of patients with cerebral infarction and various tumors will continue to increase in the near future. Thus, accounting for the complex and highly individual muscular functions of the tongue, lips, cheeks, and floor of the mouth should not be overlooked. Using dental implants is one means of achieving proper denture retention. However, an inadequately designed prosthesis can hinder the movement of surrounding tissues, so the denture space must be considered on an individual level in order to determine the appropriate positioning of artificial teeth and the morphology of the polished surface.

CONCLUSION

By using the piezography technique described, the denture was successfully delivered and the partial glossectomy patient was satisfied because he no longer salivated excessively, making it easier for him to talk. The denture space must be carefully considered to determine the neutral position for artificial teeth and the denture base, in order to fabricate a prosthesis with an optimal external shape for speech and other functions.

Clinical implication

The piezography technique helped determine the appropriate positioning of the artificial teeth and the morphology of the polished surface.

ACKNOWLEDGMENTS

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