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Case Report

Dentistry Section

Incorporation of Double Salivary Reservoirs in Maxillary Denture of an Edentulous Patient with Post-mandibular Resection: A Case Report

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ABSTRACT

The treatment of mandibular deviation in a completely edentulous patient (after segmental resection of the mandible) without osseous reconstruction consists of a twin-table maxillary complete denture occluding with a mandibular segmental denture at deviated position. Salivary reservoirs incorporated into the maxillary complete denture provide a potential solution to the ill effects of xerostomia, which is the most common post-irradiation complication. Hereby, the authors presents a case report of 62-year-old male patient with a unique method of incorporating two salivary reservoirs: one in the center of the palatal surface and the second beneath the additional palatal row of prosthetic teeth, with an approximate capacity of 7 mL. The novel design includes a removable silicone lid with an escape hole, allowing the patient's tongue to control the release of the salivary substitute. It provided ease of removal of the lid, as well as cleaning and refilling of the reservoir. The design allowed area under the second row of teeth was utilised effectively without adding to the bulk of the denture.

Keywords: Artificial saliva, Deviation, Hemimandibulectomy, Xerostomia

CASE REPORT

A 65-year-old completely edentulous male patient was referred to the Department of Prosthodontics. The patient had undergone surgery 6 months prior for squamous cell carcinoma of the left side of the mandible, which involved a segmental resection that included the condylar process, coronoid process, ramus, and body of the mandible up to the midline. Osseous reconstruction of the resected side with a free fibular or iliac crest flap had not been performed.

The patient was completely edentulous in both arches, with a period of maxillary complete edentulism lasting approximately one year. The mandibular teeth on the right side (both anterior and posterior) had been extracted prior to surgery due to chronic infection. The patient had been guided to perform hand manipulation exercises immediately after surgery to reduce the degree of mandibular deviation. The extent of deviation toward the resected left side was around 5 to 7 mm and was not evaluated to be significant. The patient's oral mucosa was found to be significantly dry, with minimal salivary flow. This was attributed to the radiation therapy (50 Gray units or Gy) that the patient had undergone after surgery. The patient's mouth opening, measured at approximately 50 mm, and tongue movements were assessed as satisfactory.

Treatment Rationale

Prosthetic rehabilitation focused on management of two problems: Achieving stable occlusion at the deviated mandibular position and counteracting the effects of xerostomia. To address these issues, a maxillary complete denture and a mandibular segmental denture were fabricated. An additional row of posterior teeth was added on the right side of the maxillary denture to allow for function in the deviated position. Two salivary reservoirs were incorporated in the maxillary denture—one in the center of the palatal surface and the other beneath the second row of teeth.

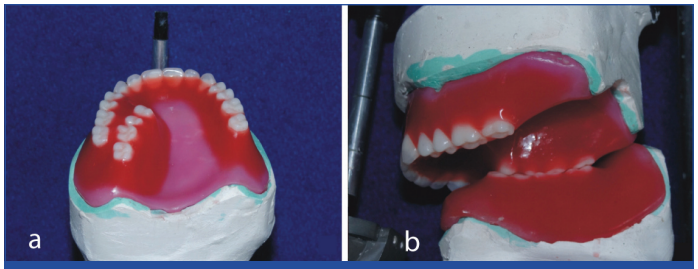
Treatment Phase

Primary impressions of both edentulous arches were made with condensation silicone elastomer (Zetaplus, Zhermack Clinical) using stock impression trays. Border molding was done with addition silicone elastomer of putty consistency (Betasil, Vario Putty Soft), followed by final impressions using a light-bodied consistency (Betasil, Vario Light).

Permanent denture bases of the maxillary complete and mandibular segmental arches were fabricated from heat-cured acrylic resin (Dental Products of India (DPI, heat cure). Both record bases were evaluated intraorally for retention and stability. The maxillary record base had less-than-optimal retention due to the patient's xerostomic condition. To address this issue, it was decided to use a denture adhesive {Fix-on, Indian Cooperative Pharmacy Allotment Health Products Limited (ICPA)} for registering the jaw relationship. The retention and stability of the mandibular record base were found to be adequate, owing to the broad crest and high parallel walls of the remaining residual ridge. The record bases were then blocked out on the impression surface, and working casts were obtained. Wax occlusion rims were fabricated to the recommended dimensions (Hindustan Modelling Wax No. 2, Hindustan Dental Products).

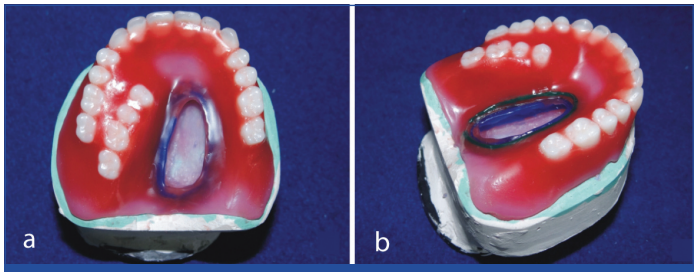
The maxillary rim was contoured to provide satisfactory lip support and visibility at the rest position. The plane of occlusion was then established. Both wax rims were broadened to ensure a stable platform for the patient to make contact against during closure (on the right side in the deviated position). Vertical jaw relation was established using Niswonger's and Silverman's closest speaking space techniques. Nick and notches were made in both rims, and the horizontal jaw relation at the deviated position was registered using bite registration paste (Virtual, Ivoclar Vivadent). Orientation jaw relation was finally recorded using a facebow (Hanau Springbow, Waterpik), and the maxillary and mandibular casts were transferred to the semi-adjustable articulator (Hanau Wide Vue, Waterpik).

Teeth arrangement was done keeping in account the deviation of the segmental mandible toward the left side. Semi-anatomic artificial denture teeth (Acry-Rock, Ruthenium) were used. The mandibular posteriors were positioned at the center of the crest of the residual ridge to ensure sufficient stability. An additional palatal row of teeth was arranged on the right side of the maxillary trial denture to occlude in the deviated position [Table/Fig-1a,b]. A try-in was then done to verify the jaw relations, aesthetics, and phonetics. The final wax-up of the trial dentures was completed.



[Table/Fig-1]: a,b) Additional palatal row of teeth.

The area where the reservoir was to be placed was delineated and deepened with a carbide bur in order to make space for the reservoir. Care was taken to ensure that the permanent denture base did not perforate. A rope of inlay wax was then used to bead the mouth of the reservoir, merged with the rest of the waxed-up denture. The rope was further undermined from the inside to allow for a tighter seal of the lid of the reservoir (to be made later with a flexible, resilient silicone liner material). The superior surface of the beaded wax was flattened to ensure a positive stop for the lid, and a 90-degree butt joint was created along its outer surface with a second rope of wax. This would allow for the determination of the exact extent of the lid [Table/Fig-2a,b].



[Table/Fig-2]: a) Beading of mouth of salivary reservoir; b) Butt joint created along lid outline.

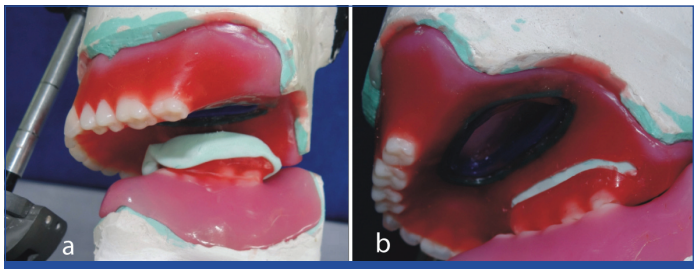
The potential reservoir space was filled with water, and the capacity was determined to be about 4 mL. This was felt to be insufficient, so it was decided to incorporate a second reservoir beneath the additional palatal row of teeth. This would further aid in reducing the weight of the maxillary denture.

The mandibular trial denture was processed (prior to beginning the wax-up of the second salivary reservoir), with the permanent denture base being incorporated into the final denture. The mandibular segmental denture was remounted on the articulator against the maxillary trial denture, and the occlusion was verified.

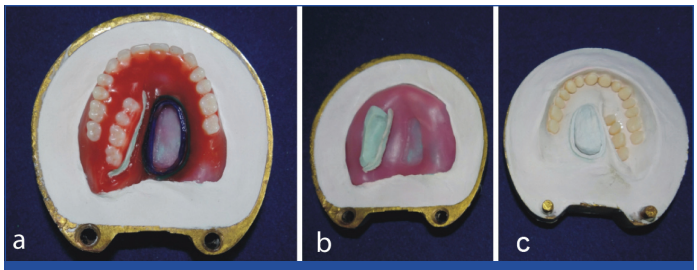
Wax-up for salivary reservoir beneath palatal row of teeth: The design requirement for this reservoir was to create a hollow space beneath the palatal row. The palatal row of teeth was first removed in one segment from the trial denture, exposing the denture base in this area. Wax on the underside of the removed segment was trimmed and smoothed. Small acrylic blobs (three in number) were added to the exposed denture base area using self-cured acrylic resin (DPI-RR, Dental Products of India) [Table/Fig-3]. The purpose of these blobs was to help in the orientation of the silicone putty segment used to hollow out the reservoir space during processing (as described next). The segment of the palatal row of teeth was now sealed in occlusion to the opposing teeth of the mandibular segmental denture with wax.

Condensation silicone of putty consistency was mixed and added to the reservoir area (on top of the acrylic blobs). The articulator was then closed, ensuring that the incisal pin made positive contacted the incisal table to maintain the vertical dimension [Table/Fig-4a,b]. The seal between the maxillary and mandibular teeth was broken, and the occlusion was verified. The excess silicone putty was carefully trimmed back to create sufficient space for the lid of the reservoir to be made after processing [Table/Fig-5]. The final wax-up of the maxillary trial denture was completed.

[Table/Fig-3]: Removal of teeth segment and acrylic orientation blobs.



[Table/Fig-4]: a) Silicone putty adapted into reservoir space; b) Silicone putty cutback to create space for lid.



[Table/Fig-5]: a) Base flasking of maxillary trial denture; b,c) Silicone putty segment reoriented after dewaxing.

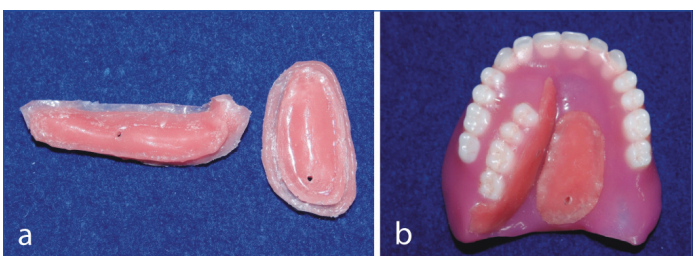
Base flasking of the maxillary trial denture was done keeping in mind that the permanent denture base would be incorporated into the final denture. After dewaxing, the silicone putty segment was repositioned on the acrylic blobs, and heat-cure resin was packed around it [Table/Fig-5a-c]. After processing, the silicone putty segment was removed, thus creating the desired space for the salivary reservoir [Table/Fig-6]. Both dentures were remounted on the articulator, and selective occlusal shaping was done to compensate for changes in occlusion due to polymerisation shrinkage. The resin beneath the teeth was further trimmed to increase the area for the salivary substitute without compromising the rigidity of the segment. An additional 3 mL of salivary substitute could be added to this reservoir. The positive stop for the lid of each reservoir was refined along the entire periphery with a straight fissure carbide bur. The maxillary denture was now finished and polished.

Lid fabrication for both reservoirs: The lids were fabricated individually. The borders of the reservoirs were slightly undermined for better engagement of the flexible lid. Condensation silicone of putty consistency was mixed and adapted into the reservoir space up to a level approximately 1 mm short of the undermined borders. A coat of petroleum jelly was applied around the reservoirs and on the silicone putty. Resilient soft silicone liner (GC Reline Soft, GC India) was used for lid fabrication. The relining material was injected onto the putty and the surrounding denture base around the borders of the reservoir space, avoiding air bubble entrapment [Table/Fig-7]. The material was smoothed with fingers and allowed to bench cure.

[Table/Fig-6]: Finished dentures with space for salivary reservoirs.

[Table/Fig-7]: Resilient silicone liner injected to form lid.

Upon completion of curing, the flexible lid was gently pried out. Any excess material was cut with scissors, and the lids were finished with a varnish coat following the manufacturer's instructions. The silicone putty was removed from the reservoir space, and the lids were repositioned to check for fit and retention. The reservoir spaces were filled with a salivary substitute (Wet Mouth, ICPA Health Products Ltd.) using a 5 cc syringe, and the lids were placed to check for any leakage at the borders. Both lids had an excellent seal at the periphery. A single escape hole was drilled at the approximate center of each lid using a small round carbide bur [Table/Fig-8a,b]. The reservoir was filled again with the salivary substitute, and the lids were positioned. Slight finger pressure was given on the lids, and led to oozing of the artificial saliva from the reservoir through the holes. It was anticipated that a similar pressure given by the patient's tongue would allow for release of the salivary substitute intraorally.

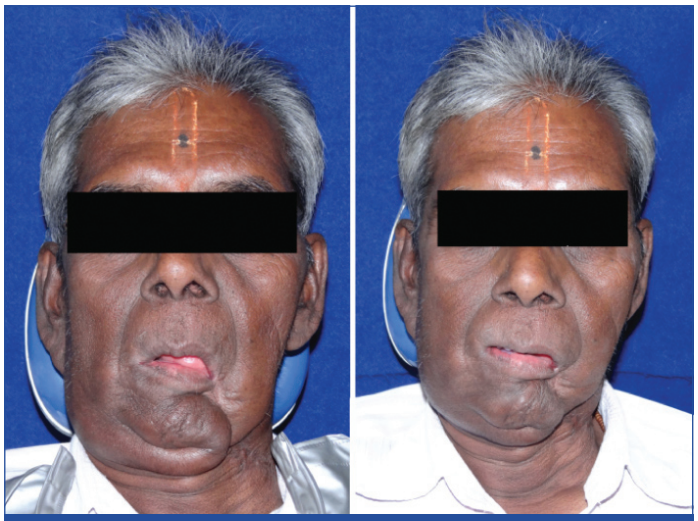


[Table/Fig-8]: a,b) Escape hole at center of both lids.

Both dentures were inserted and checked first for occlusion [Table/Fig-9]. The patient was taught how to apply positive pressure on the lids with the help of his tongue to initiate the oozing of the salivary substitute from both reservoirs. Besides routine denture insertion instructions, the patient was trained in filling the reservoir (using a 5-cc syringe), lid placement and removal, and cleaning the reservoirs. The reservoirs were to be cleaned once daily using soapy water and a soft brush (a paintbrush with synthetic bristles), followed by drying with a tissue paper or a paper towel.

[Table/Fig-9]: Intraoral- denture insertion.

At the 24-hour follow-up, the patient expressed satisfaction with the degree of mucosal lubrication achieved by the salivary reservoirs. The retention of the maxillary denture was rated as satisfactory. The patient was recalled on days 3, 7, 15, and 30 after denture insertion. The patient wore the dentures comfortably, and there was a sufficient amount of moisture in the oral mucosa. Additionally, the patient was able to fill the reservoirs with ease. The patient is now on a three-month follow-up protocol [Table/Fig-10].



[Table/Fig-10]: Preoperative and postoperative image. (Images from left to right)

DISCUSSION

Mandibular deviation towards the resected side is the most common complication observed after segmental mandibulectomy without osseous reconstruction [1-3]. The loss of occlusion on the non resected side compromises function and is corrected through a combination of hand manipulation exercises and the use of a guidance prosthesis, which may be either a palatal ramp prosthesis or a guiding flange prosthesis [1-4].

Prosthetic treatment for a completely edentulous patient who has undergone irradiation after segmental mandibulectomy (without further osseous reconstruction) is influenced by three factors. Firstly, correction of the resultant mandibular deviation towards the resected side with the aid of a guidance prosthesis is not possible due to the absence of natural teeth. The recommended management is to provide a maxillary complete denture that occludes with a mandibular segmental denture positioned at the deviated position. This is achieved by incorporating an additional palatal row of teeth in the maxillary denture on the non resected side [5-8]. Secondly, dental implants have been reported to significantly improve denture retention and stability in mandibulectomy patients. Higher success rates are achieved when the irradiation dosage is

maximum 50 Gy and when the implants are placed approximately one year after irradiation [9-11]. Finally, irradiation leads to a detrimental changes in the patient's denture foundation, with xerostomia causing difficulties in mastication and deglutition, as well as dryness, cracking, and ulceration of the oral mucosa; these factors contribute to poor retention and stability of the removable prostheses. Salivary reservoirs can be incorporated into the denture design to counteract these effects [12-16].

The patient reporting to the department clinic was completely edentulous and had undergone surgical resection of the mandible on the left side up to the midline (Cantor and Curtis Class III) [17]. Osseous reconstruction with a free fibular or iliac crest flap had not been performed. The period after surgery was approximately four months, during which he had received an irradiation dosage of 50 Gy. Clinically, a mandibular deviation towards the left side was observed. The irradiation had caused severe xerostomia with the oral mucosa dry and atrophic oral mucosa.

Prosthetic treatment consisted of a maxillary complete denture and a mandibular segmental denture that occluded at the deviated position, aided by an additional palatal row of teeth on the right side. These two rows of teeth gave a wider occlusal table. Semi-anatomic teeth were used as they reduce lateral forces on the denture, thereby reduce the chance of denture displacement [7,8]. One of the problems faced with the additional row of teeth was the reduced tongue space, which may cause difficulty in speech [8]. Both prostheses were tissue-supported and would be converted to implant-supported prostheses one year after irradiation. A salivary reservoir could be incorporated into both arches; however, this would increase the bulk of the dentures and encroach upon the space of the oral tissues [13]. Hence, salivary reservoirs were incorporated only into the design of the maxillary complete denture. Mandibular salivary dentures frequently have blocked drainage, as the opening of the reservoir gets clogged by pooling food particles and fluids in the lower arch. Thus, a maxillary salivary reservoir is better as compared to a mandibular reservoir [12].

Certain aspects of the procedure merit discussion. The decision to incorporate a second reservoir beneath the palatal row was made after determining the capacity of the first reservoir at the center of the palatal surface. This was measured to be 4 mL, which was deemed insufficient. The added capacity of the second reservoir (3 mL) served to further improve mucosal lubrication. Also, hollowing out the denture base beneath the palatal row (for the reservoir space) helped reduce the weight of the maxillary denture. Noted benefits of this reservoir design included:

- **Controlled release of the salivary substitute:** The patient's tongue could exert pressure on the resilient lid, resulting in the release of the substitute.
- **Improved handling:** Ease of removal of the lid, cleaning and refilling of the reservoir by the patient.

Lids for both reservoirs were made with a resilient soft silicone liner material. Other materials mentioned in the literature include thermoplastic sheet (ethylene vinyl acetate), latex, acrylic resin, and cast metal [12,18-23]. The silicone material used offered several advantages: flexibility that allows for ease of removal and placement; good peripheral adaptation into the undermined borders with sufficient tear strength; and compressibility, which facilitates the release of the salivary substitute from the escape hole when tongue pressure is applied. The size of the hole could be easily modified depending upon the amount of saliva required to lubricate the oral cavity. Both lids could be easily remade chairside in the future when required due to the simplicity of the technique used.

In a split mandibular denture salivary reservoir, the patient can easily visualise saliva content in the reservoir as the base of the split denture is made of clear acrylic [16]. However, in the present technique, the patient cannot visualise the amount of saliva in the reservoir, which is one of the drawbacks of the technique.

The fabrication of permanent denture bases in heat-cured acrylic resin proved beneficial for two reasons: a) it allows for accurate registration of the deviated jaw position due to better retention and stability compared to a temporary record base; and b) retention of the silicone putty segment used to maintain space (during processing) for the salivary reservoir beneath the second palatal row of teeth. Metallic denture bases could have been given as they reduce the weight of the denture [21]. But this process is time-consuming, and incorporating the second row of teeth would have been difficult on a metallic denture base.

CONCLUSION(S)

The prosthetic rehabilitation of a completely edentulous patient who has undergone segmental resection of the left mandible (without osseous reconstruction) has been described. A maxillary complete denture, featuring an additional palatal row of teeth, and a mandibular segmental denture were given to occlude in the deviated position. Management was satisfactorily achieved by incorporating two salivary reservoirs into the design of the maxillary denture: one at the center of the palatal surface and another beneath the additional palatal row of teeth.

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