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Fabrication of a Hollow Obturator as a Single Unit for Management of Bilateral Subtotal Maxillectomy

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Keywords
Prosthodontic rehabilitation; processing technique; obturator retention.

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Accepted May 21, 2011

doi: 10.1111/j.1532-849X.2011.00799.x

Abstract

Prosthetic rehabilitation with an obturator for a total or subtotal maxillectomy patient is a challenging task, as there are little or no residual maxillary structures to depend on for support, retention, and stability of the prosthesis. This clinical report describes the prosthodontic management of a patient operated on for a bilateral subtotal maxillectomy secondary to ameloblastoma of the palate with a closed hollow obturator. The processing technique described in this article to fabricate the hollow obturator is a variation of other well-known techniques. The variation comprises the use of a wax bolus to maintain a predictable internal dimension for a hollow obturator. This technique allows fabrication of a complete hollow obturator prosthesis as a single unit in heat-polymerized acrylic resin using a single-step flasking procedure.

The term maxillectomy refers to partial or total removal of the maxilla in patients suffering from benign or malignant neoplasms.[1] An ameloblastoma of the hard palate is a benign neoplasm treated with surgical excision.[2] The resultant surgical defect often includes part of the hard and soft palates, which may result in oroantral and/or oronasal communication. The reconstruction or obturation of the surgical defect prevents air, liquid, and food from escaping into the maxillary sinus and nasal cavities, thus restoring normal speech and swallowing function and ultimately quality of life.[3] Total or subtotal absence of the maxilla creates a very difficult problem in rehabilitation, as there are little or no residual maxillary structures for support, retention, and stability of prostheses.[4] Retention of the prosthesis is often difficult to achieve in such situations due to absence of teeth and lack of favorable tissue undercuts. Bilateral undercuts in the lateral aspects of the resulting defect are favored and may assist with retention of the obturator. The prosthesis becomes thick and bulky to replace extensive maxillary defects. The increased weight is one of the major concerns for retention of the obturator prosthesis.

Wu and Schaaf[5] designed different types of obturator prostheses (both solid and hollow) based on Aramany's classification and evaluated for weight reduction. They concluded that hollow obturator prostheses had significantly increased weight reduction, from 6.55% to 33.06% depending on the size of the defect. Numerous methods have been described to fabricate the open and closed hollow obturator prostheses to make them lightweight.[6–30] Most of these methods have their own limitations, such as multiple processing techniques. Osseointegrated implants have been successful in providing retention, stability, and support of dental and craniofacial prostheses. Unfortunately, in many situations, the loss of adequate osseous structures makes implant placement difficult and less predictable.[31] This article describes a patient who had undergone bilateral subtotal maxillectomy, secondary to ameloblastoma, rehabilitated with an interim hollow obturator prosthesis. A new processing technique is also described to fabricate a closed-hollow obturator prosthesis in heat-polymerized acrylic resin as a single unit using a one-step processing procedure.

Clinical report

A 25-year-old male patient, diagnosed with follicular ameloblastoma of the palate, was referred to the Department of Prosthodontics for preoperative evaluation and prosthetic treatment planning. Clinical examination revealed massive pendulous swelling covering the entire hard palate (Fig 1). The right maxillary posterior teeth were displaced facially and inferiorly due to the expansion of the palatal bone, resulting in intrusion of the mandibular posterior teeth. All mandibular teeth were free of caries and periodontal disease. A panoramic radiograph revealed a large radiolucency covering the entire right maxillary region with involvement of the maxillary sinus and partial left maxillary region up to the first molar. On the basis of clinical and radiographic examination, the patient was classified as Class IV (severely compromised) according to the ACP Prosthodontic Diagnostic Index for partially edentulous patients described by McGarry et al.[32] Presurgical impressions

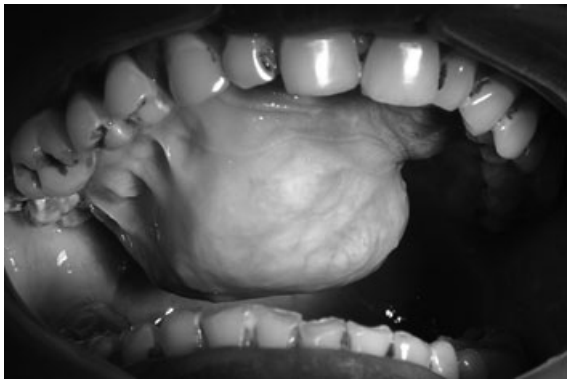

Figure 1 Presurgical intraoral view.

Figure 2 Healing completed 4 months after surgery.

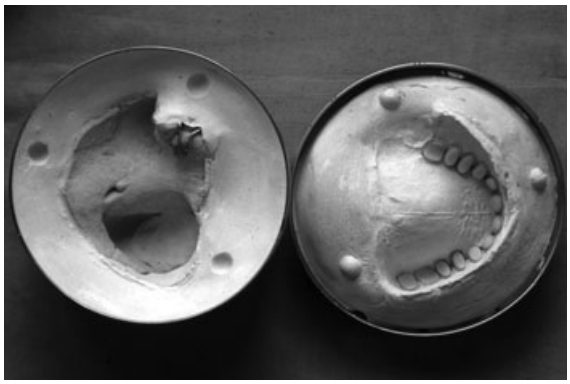

Figure 3 Dewaxed cast and plaster surfaces.

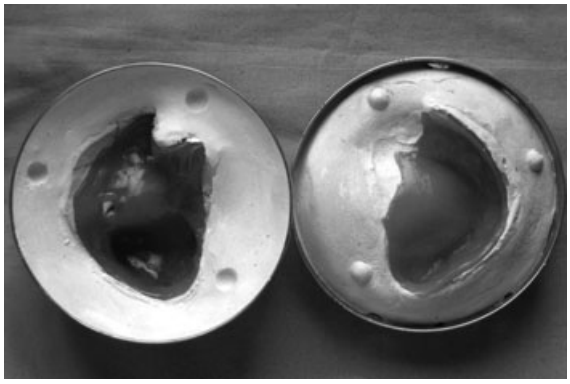

Figure 4 Two thickness baseplate wax adapted on dewaxed surfaces of both flasks.

Figure 5 Wax bolus shaped according to the space remaining between two adapted wax sheets. Note the stops on the shaped wax bolus marked with blue pencil.

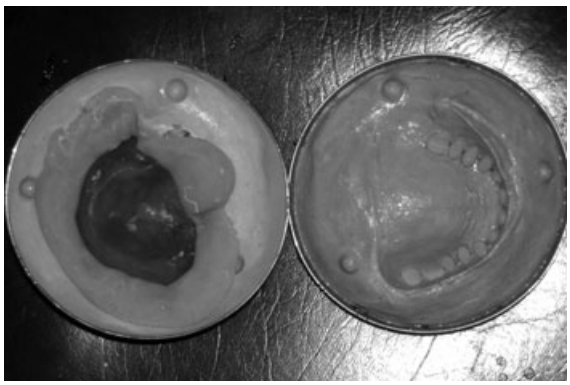

Figure 6 Wax bolus pressed over the mixed acrylic resin and seated in previously confirmed position.

were not made, as they would not be useful for prosthesis fabrication, because total maxillary resection was planned. The patient was sent to the oral surgery department for surgical excision of the neoplasm. The surgeons were successful in conserving the left maxillary second and third molars. The patient was fed through a nasogastric tube for the first 10 days postsurgically. After 10 days, an interim obturator was fabricated as per Ortegon et al's guidelines.[7] Thereafter, the patient ate orally.

Four months after the surgery, examination of the tissues in the defect area showed complete initial healing (Fig 2). The deep surgical defect on the right side was blocked out with a gauze pack, and a preliminary impression was made with a high-viscosity irreversible hydrocolloid (Dentalgin; Prime Dental Products, Mumbai, India). The impression was poured in type III gypsum material (Kalstone; Kalabhai Karson, Mumbai, India). A custom impression tray was fabricated and border molded to the defect with modeling plastic impression

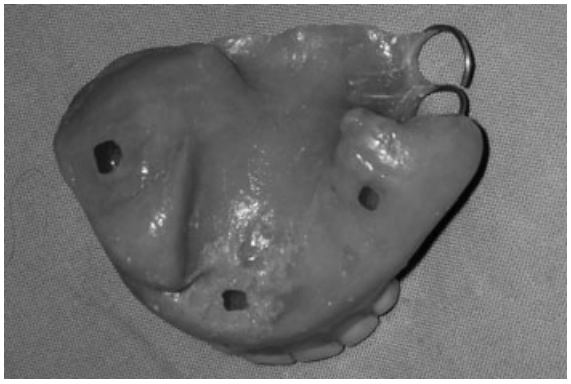

Figure 7 Hollow space created inside the heat-polymerized acrylic resin obturator.

Figure 8 Completed prosthesis.

Figure 9 Intraoral view of prosthesis in occlusion.

compound (ISO Functional; GC Corp., Tokyo, Japan). The impression compound was cut back, and a physiologic definitive impression was made of the defect using a medium viscosity poly(vinyl siloxane) impression material (Reprosil; Dentsply DeTrey GmbH, Konstanz, Germany). Conventional prosthodontic protocols of boxing and pouring the impression were used with type III gypsum material to create a definitive cast. Major undercuts were blocked with baseplate wax (Modeling wax; Deepti Dental Products, Ratnagiri, India), and the gauze pack area on the cast was scraped to form a smooth flat surface. A 19-gauge hard, round, stainless steel orthodontic wire (KC Smith & Co., Monmouth, UK) was manipulated to make "C" clasps on left maxillary second and third molars. A provisional record base was fabricated with autopolymerizing acrylic resin (DPI Cold Cure; Dental Products of India, Mumbai, India) using a wax template technique.[33] The baseplate wax was used to make an occlusion rim and to contour the palate arbitrarily. A maxillomandibular relation record was made and mounted on an articulator (Hanau H2; Teledyne Technologies, Los Angeles, CA). Denture teeth (Acryrock; Ruthinium Group Dental Manufacturing, Badia Polesine, Italy) were arranged and evaluated intraorally. Pressure indicating paste (Mizzy Inc, Cherry Hill, NJ) was placed on the arbitrarily contoured wax palate, and the vault was adjusted based on phonetics and swallowing.

Processing technique to fabricate hollow obturator

Waxing and carving of the gingival and palatal portions of the obturator were completed. The molar clasps were freed by removing the surrounding acrylic resin from the record base and readapted on the master cast in the original position. The finished waxed-up obturator was reseated on the master cast, and all the borders were sealed with the baseplate wax. The free area surrounding the readapted clasps was also filled with the baseplate wax. The waxed-up obturator was invested in a custom-made base flask. Three half-round indentations (indices) were created on the invested plaster of the base flask to aid in repositioning of a counter flask. The flasking procedure was completed by closing the counter flask in close approximation under a mechanical clamp (Handler Manufacturing, Westfield, NJ). The flask/clamp assembly was kept at room temperature for 24 hours. Dewaxing was performed, and the record base was removed from the flask (Fig 3). Double thickness hard baseplate wax was adapted on the maxillary cast (invested in the base flask) and on the dewaxed plaster surface (in the counter flask), and three widely located windows (3×3 mm^2) were cut in adapted wax on the maxillary cast in the base flask (Fig 4). Vaseline petroleum jelly (Unilever, Epping, Australia) was applied to both adapted wax sheets.

A wax bolus was formed by softening the hard baseplate wax enough to accommodate free hollow space between the two adapted wax sheets after closing the flasks. The bolus was uniformly softened in a moldable consistency and placed into the base flask. The flasks were closed in close approximation under the mechanical clamp and kept under cold water for 10 minutes. When the wax bolus hardened inside, the flasks were separated. Excess wax flash was removed, and flasks were again closed to ensure complete closure. The softened wax bolus, meanwhile, had taken the shape of the free space, which was present between two adapted wax sheets. The bolus was removed and examined for the three stops (elevations), which formed corresponding to the windows in the adapted wax sheet on maxillary cast (Fig 5). Adapted wax sheets were removed from both flasks. The wax bolus was reseated on the maxillary cast with the help of the three elevated stops to confirm their positions. The wax bolus was a uniform distance (two baseplate thickness) away from the cast surface except the stops.

The bolus was removed from the flask and placed under cold water for 10 minutes to harden. Once again, the position of the wax bolus was confirmed by reseating it on the base flask with reference to stops to rule out the possibility of wax contracture during bolus cooling. Three identification lines were drawn with a marking pencil on the wax bolus, directed toward the center of the three indices (on the investment plaster in the base flask). These markings would guide initial orientation of the wax bolus during packing. Meanwhile, heat-polymerized acrylic resin (Lucitone 199; Dentsply Intl., York, PA) was mixed according to the manufacturer's instructions and placed into the base flask covering entire maxillary cast area. The wax bolus was pressed over the mixed acrylic resin until all three elevations of the wax bolus rested on the cast surface in the previously confirmed position (Fig 6). The mixed acrylic resin was taken in excess, placed in the counter flask, and subsequently trial packed under pressure. The flasks were separated, and the excess flash was removed. The flasks were finally closed in close approximation under the mechanical clamp. The flask/clamp assembly was placed at room temperature for 24 hours for early bench polymerization of the resin obturator so the wax bolus could maintain a stable form before any temperature rise occurred. The curing cycle (165°F for 12 hours) followed by cooling was carried out as per the manufacturer's instructions. After completion of polymerization, flasks were deflasked and finished in the usual manner.[34] The three openings were formed (corresponding to the stops) in the processed obturator. The wax bolus, completely enclosed by the acrylic resin, was partially melted and came out of the obturator through the three openings. The remaining portion of the wax bolus was removed by immersing the obturator in hot water (45–60°C) just to soften the wax inside the resin hollow obturator followed by steam cleaning. Care was taken not to immerse the obturator in hot water for a long period of time to prevent any distortion of the prosthesis. The forceful steam applied through one of the three holes completely removed the remaining portion of the wax, automatically forming a hollow space inside with the exact shape of the wax bolus (Fig 7). The processed hollow obturator was finished and polished in the usual manner.[34] The small amount of autopolymerizing acrylic resin was mixed separately on a glass slab, picked up on the fingertip of one hand, and applied to one of the obturator openings by holding the obturator with the other hand in an inverted position to seal the opening. The same procedure was repeated to seal the remaining two openings followed by finishing and polishing (Fig 8). The seal of the obturator was initially checked by immersing it in the water bath and checking for air bubbles. The obturator was found to be airtight, as air bubbles were not observed.

Obturator delivery and postinsertion care

The completed prosthesis was remounted to equilibrate occlusion before final insertion. The prosthesis was fitted in the patient's mouth, and final occlusal equilibration was carried out. The prosthesis was delivered to the patient (Fig 9). Oral hygiene instructions were reinforced, and recall appointments were scheduled on a regular basis for examination of the tissues and modification of the appliance. The last follow-up of the patient was 12 months following the insertion of the new prosthesis. The obturator prosthesis had not leaked at 12 months of use, as the area sealed with autopolymerizing acrylic resin was relatively very small compared to the total tissue surface area in heat-polymerizing acrylic resin as a single unit. The tissue appeared healthy, and the prosthesis restored speech, mastication, deglutition, esthetics, and psychological well-being.

Discussion

Various methods have been described in the literature to fabricate closed-hollow obturators.[9-30] The classic technique for hollowing the obturator is to grind out the interior of the obturator after processing while monitoring the thickness of the walls.[9] Once the obturator becomes hollow, a lid may be secured to the obturator by various methods.[9-11] Some methods include the use of materials such as sugar[9,12] and ice to create the hollow section.[10] Methods consisting of processing the obturator in two halves and luting the segments with autopolymerizing resin have also been described.[13,14] Previous well-known techniques described the fabrication of a hollow obturator with either a two-step processing technique[15,16] using preformed plastic shapes[17] or using a plaster matrix.[18] Chalian and Barnett[19] advocated the placement of an acrylic resin shim, whereas Tanaka et al[20] suggested the incorporation of polyurethane foam into the defect area of the prosthesis to create the hollow section. Additional techniques include the use of combinations of casts, impressions, and complex laboratory procedures, rendering them time-consuming and limited in application.[21-30] The predictable internal dimension of the hollow space cannot be achieved by most of the techniques previously described. The few techniques with which uniform wall thickness is achieved are complex and time-consuming. This article describes a new, relatively simple, and less time-consuming technique to fabricate a closed hollow obturator. The technique is a variation of other well-known techniques.[9,10,12,17,19,20] The variation consists of using a wax bolus to maintain a predictable internal dimension for the hollow obturator. This technique is different from all other previously described techniques in two ways. First, it provides a complete prosthesis as a single unit in heat-polymerized acrylic resin. Second, it allows a uniform thickness of the acrylic resin all around the hollow portion of the obturator.

Some of the details regarding the technique should be carefully observed to achieve predictable results, as discussed. Chances of dimensional change in the wax bolus resulting from curing temperature can adversely influence the uniformity of resin thickness. The time left for the early bench polymerization of the heat-polymerizing acrylic resin prosthesis before any temperature rise occurs eliminates this problem. The reliability of proper seating of the wax bolus in polymerizing resin during the packing procedure is one of the concerns with the technique. The use of prior identification markings on the investment plaster or flask walls correlating to the corresponding markings on the wax bolus surface can be a guide for reliable initial orientation of the bolus during packing. There may be a risk of displacing the wax bolus during final closure of the flask.

The sufficient hardness of the wax bolus achieved by cooling it and reliable seating during final closure may reduce this risk. This technique uses sealing of the openings (windows) with autopolymerizing acrylic resin that may create a site of potential water leakage. Paprocki et al[35] evaluated five techniques using various materials for their ability to produce a watertight seal between obturator and lid and concluded that only the two-flask technique sealed with heat-processed acrylic resin produced a watertight seal in all specimens.

In our case, autopolymerizing resin is used to seal the openings, and the sealed area is relatively small compared to total tissue contact area, and thus can be easily controlled during the sealing process. Hence, the chances of water leakage can be minimized compared to the other lid-closing techniques previously described. Paprocki et al[35] also concluded that any method that is clean, without contamination, and uses various resins will seal a prosthesis. Roughening the small area of the heat-polymerizing resin surface surrounding the window openings, and cleaning and wetting it well with the autopolymerizing acrylic resin-monomer prior to sealing can facilitate watertight closure. The obturator prosthesis had not leaked when checked after 12 months of use with this patient, thus indicating a satisfactory seal. To detect the leakage of an obturator in a short period of time, immersion of the obturator under pressure (30 psi for 1 hour) is advocated.[35] Dimensional changes and properties of the processed resin resulting from this technique may be one of the major issues. We have used this technique for fabrication of both definitive and interim closed hollow obturators for 12 patients in the last 2 years in our hospital. All the prostheses have been well made with clinically acceptable properties of the processed resin except one, which had to be reprocessed due to generalized porosities. Future research studies are required to check the properties of resin processed with this technique.

Conclusion

This report reveals that an attempt to conserve the maximum possible number of normal teeth simplifies the retention problem of obturators in such complex situations. The ability of the technique described in this article to provide a predictable internal dimension for the hollow obturator in a one-step processing procedure justifies its novelty.

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