Review Article

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Techniques of hollow maxillary dentures: a literature review

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ABSTRACT

Clinically, the management of severy atrophic maxilla might represent a significant challenge for the attending dentists and surgeons to successfully perform and achieve fabricated complete maxillary dentures. Making a hollow denture base for these defects has also been previously reported as a valid approach that can be used to decrease the weight of the maxillary prosthesis. Many modalities have been proposed for these procedures with favorable outcomes, and variable events of disadvantages and adverse events. This literature review aims to collect enough evidence regarding the different reported techniques of the hollow maxillary denture, according to the different studies. Many techniques have been previously reported as using magnets, using implants, intramucosal inserts, springs, suction disks, lightweight dentures, and modified impression techniques. Many materials have been previously used with the 3D spacers of the lightweight denture techniques as dental stone, silicon putty, cellophane-wrapped asbestos, light-body coated gauze, modeling clay, salt, thermocol, caramel, and glycerine soap. Favoring one of the modalities over the other requires the inauguration of future studies with an adequate sample size to validate the efficacy and safety of these modalities. All of this information is furtherly discussed within the manuscript based on the collected evidence from the different studies in the literature.

Keywords: Dentistry, Prosthodontics, Hollow maxillary denture, Technique, Management

INTRODUCTION

Clinically, the management of severly atrophic maxilla might represent a significant challenge for the attending dentists and surgeons to successfully perform and achieve fabricated complete maxillary dentures. Moreover, it can also be sometimes noticed that furtherly reduced retention of the prosthesis is another significant challenge, which is mainly attributable to the potential increase within the

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interridge space, leading to the development of heavy complete maxillary denture. Previous studies have demonstrated the potential favorable events and clinical outcomes that might result from decreasing the weight of the maxillary prosthesis as a result of founding an obturator to be used for restoring huge maxillofacial defects.^{1,2} Making a hollow denture base for these defects has also been previously reported as a valid approach that can be used to decrease the weight of the maxillary prosthesis. Many modalities have been proposed for these procedures with favorable outcomes, and variable events of disadvantages and adverse events.3-8 However, they are still scattered among the different studies in the literature, which makes it hard to compare the different modalities and decide what is best and more suitable. Accordingly, we decided to conduct this literature review aiming to collect enough evidence regarding the different reported techniques of the hollow maxillary denture, according to the different studies.

METHODOLOGY

A systematic search was conducted to identify relevant studies in the following databases: PubMed, Medline, Web of Science, Embase, Google Scholar, and Scopus. The following search terms were used ("prosthodontics") AND ("hollow maxillary denture") AND ("technique") AND ("management"). The Reference lists were manually searched to identify additional relevant studies meeting inclusion criteria. We included any study that reports orthodontic management of dental trauma. No restrictions were applied.

DISCUSSION

Techniques of hollow maxillary dentures

Many techniques have been previously developed for the hollow maxillary denture. However, most of them were reported in single case reports and were not validated by big studies to investigate the efficacy and safety of these modalities. In this section, the main purpose to report as many techniques as that can discuss the advantages and disadvantages of these modalities according to studies in the literature. For instance, using implants was previously proposed as an efficacious modality for managing partial and complete hollow maxillary dentures and preservation of the residual alveolar bone. Additionally, a previous review by Wyatt et al reported that using implants is the most efficacious modality to restore a missing tooth in cases of complete partial alveolar bone loss.9 Using magnets was also effectively validated in prosthetic dentistry as a safe and efficacious modality. It has been previously reported as a common modality that was previously used for the attachment of the removable prosthesis to either of osseointegrated implants and retained roots. 10 Although the modality has been indicated in many procedures as a result of the various magnetic materials that have been proposed with the modality, it was also reported that it might be associated with some

disadvantages, including the potential corrosion of the approached magnetic materials within the moths of the affected patients. Accordingly, it was concluded that future modalities might overcome this advantage with and without the use of the different magnetic materials.¹¹ Intramucosal inserts have also been previously reported among studies in the literature and validated as an efficacious modality for managing hollow maxillary dentures. A previous trial by Gonçalves et al investigated the efficacy of intramucosal zirconia inserts in improving the potential retention of maxillary dentures and included 12 patients in their study for this purpose. 12 The authors reported that insertion of the intramucosal zirconia was effective in improving dental maxillary denture in the included patients and was well-tolerated in the mouths of the included participants with less frequent inflammatory response, indicating the biocompatibility of this material and its efficacy in obtaining favorable outcomes. Moreover, previous investigations have reported the efficacy and safety of suction disks and springs in obtaining favorable outcomes with patient comfort and enhanced quality of life for the affected patients underlying retention of hollow maxillary denture procedures.¹³ The use of lightweight dentures was also previously reported among the different studies in the literature. Fattore et al concluded that the modality is an effective adaptation for the previously commonly used double-flask technique, which has been previously used to fabricate the hollow bulb portions of the affected maxillary obturators.⁸ It has been reported that the modality is better to be used with patients suffering from large interocclusal distances than usual and others with atrophic maxillary alveolar ridges. However, it cannot be used with other disorders because applying the modality with these disorders will not effectively be associated with proper fabrication of the observed hollow maxillary dentures. 14,15 Resorption of the residual ridges is achieved by decreasing the size of the bony ridges beneath the underlying mucoperiosteum. It has been previously reported that the process of resorption usually occurs at a faster rate in the mandibular than in the maxillary arches. Nevertheless, it has also been noticed that the clinical management of severely atrophic maxillae is often challenging due to the potential presence of large interridge distances which requires the integration of great efforts to successfully fabricate the complete maxillary denture. The case report by Radke et al developed a novel technique for the management of such cases with favorable advantages and some disadvantages that should be considered in clinical settings. 14 The authors reported that the technique should be used in managing patients with increased interridge distances and resorbed residual ridges with the following advantages: a significant successful reduction in the leakage where the two points of the denture meet, the materials that are used for fabrication in this technique are commonly used with others are not very novel and are available, and significant enhancement in the retention which is probably owing to the significant successful reduction in the weight of the prosthesis. However, some advantages as time consumption, the potential difficulty that is usually faced when removing the

putty from the cavity, and the proven fact that some of the hollow dentures are usually prone to fractures.

Additionally, previous studies have demonstrated the favorable effects that can be obtained from a weight reduction of maxillary prosthesis aiming at obturator construction for the adequate and successful restoration of huge maxillofacial defects.^{2,16} Many materials have been previously reported to be efficacious for the process of of hollow maxillary fabrication dentures vinylpolysiloxane, which has been reported with many advantages as the ability to be carved, stability, and when being set, it does not adhere to acrylic resin. Moreover, it has been reported to be not interfering with the polymerization process of acrylic resin while the subsequent processing is being performed, however, it has been previously reported that the potential eradication of the substance from the cavity, especially in the region between the canines can be difficult and needs special skills, which makes the approach and application of the modality time-consuming. 17,18 Another modality, which is the modified impression technique, was also reported in the literature as efficacious approaches for the hollow maxillary denture procedures. For instance, a previous investigation reported the effective management of atrophic or flat mandibular ridges in an edentulous patient using these techniques.¹⁹ Currently, lightweight techniques are the most commonly used approaches for hollow maxillary denture procedures and are mainly based on the induction and creation of hollow cavities within the bodies of dentures. Furthermore, creating a void is also necessary for the success of this procedure, and it is usually done by using a 3D spacer. This whole process aims at reducing the weight of the volume and weight of the base of the denture material, which enables the dentist to overcome the difficulties and hazards that are usually observed and faced when dealing with heavy prostheses.

It was previously reported that both single and double flask techniques are now frequently used for the management of hollow dentures. For instance, a previous investigation by Jhanji et al reported the effective utilization and fabrication of hollow dentures using silicon putty with single flask techniques.⁷ This was also indicated by another investigation by O'Sullivan et al which also reported the efficacy of the single flask techniques with silicon putty to successfully fabricate hollow dentures, in addition to creating alternative holes that can be used for retrieving the material of the spacer.¹⁷ On the other hand, other investigations also reported the efficacy of using double flask techniques, which mainly act by processing the hollow dentures in two separate procedures including cameo surface and tooth-bearing portions as the first part, and the intaglio surfaces as the second procedure. ^{6,8,14} It was recently reported that these two procedures and steps might be joined in a single step by using heat polymerizing or auto polymerizing acrylic resin. Using the double flask technique was also reported in a novel investigation that aimed to assess the efficacy of using the modality with 3D printed SG resin templates in obtaining successful hollow

cavity maxillary dentures. The authors reported that the approached modality had the main advantage among all other modalities, which was the non-urgent need to retrieve the biocompatible spacer following the final assessment of the procedure. For this purpose, the used material for the 3D spacer was the photopolymer resin (Dental SG resin, Formlabs Inc, USA), which has been previously reported to be effectively used as a modality to print the surgical parts that can be used for the effective processing of the procedure and are reportedly containing a photoinitiator and methacrylic ester 20 (Figure 1). It should be noted that the double flask technique is a sensitive modality because of the clinical observation that the two used flasks might not adequately fit leading to the development of a potential inadvertent increase within the vertical diameters. Moreover, it was also previously reported that the used two parts of the denture used in the procedure might discolor, fracture, or leak with time, which might reduce the efficacy and safety of the modality. 15,21 Therefore, it should be approached with caution, and considering other modalities should also be prioritized when such adverse events are suspected to maintain adequate patient safety and comfort.



Figure 1: An example of a hollow denture showing that resin spacer stays within the denture following adequate conventional polymerization.²⁰

For performing 3D space-based procedures, many materials have been previously proposed to achieve this purpose and successfully produce a hollow cavity after the initial processing using the technique. For instance, the dental stone was previously reported to effectively obtain one-piece hollow obturator following partial maxillectomy procedures.²² Cellophane-wrapped asbestos was also previously reported as a valid substance in a technique that was primarily used to decrease the thickness of hollow obturator prostheses.⁵ Silicon putty was also previously validated among the different studies in the literature which reported the efficacy, safety, and biocompatibility of the substance on the mouth tissues. 17,23 Light-body coated gauze was also previously reported in the study by Caculo et al for retrieval of severely atrophic ridges. For severely resorbed alveolar ridges, a previous investigation by Aggarwal et al reported the efficacy of lost salt techniques for the effective management of these

lesions with favorable efficacy and safety outcomes. 15,24 A previous investigation by Gundawar et al also previously reported the potentially favorable outcomes after using modeling clay in lightweight hollow maxillary dentures. 25 The same effects were also reported by using the same techniques. However, the substance was thermocol in a previous case report by Shetty et al. 18 In the same context, Qanungo et al26 also reported the efficacy and safety of the outcomes following the administration of the lightweight techniques using glycerine soap in hollow maxillary complete dentures.

CONCLUSION

In this literature review, the discussion was around many techniques that have been previously reported among studies in the literature for hollow maxillary dentures. Many techniques have been previously reported as using magnets, using implants, intramucosal inserts, springs, suction disks, lightweight dentures, and modified impression techniques. Many materials have been previously used with the 3D spacers of the lightweight denture techniques as dental stone, silicon putty, cellophane-wrapped asbestos, light-body coated gauze, modeling clay, salt, thermocol, caramel, and glycerine soap. Favoring one of the modalities over the other requires the inauguration of future studies with an adequate sample size to validate the efficacy and safety of these modalities.

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