Case Report

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Digitally Fabricated obturator reinforced with silver nano particles – a case report"

Abstract:
This case report presents the fabrication of a maxillary obturator for a 55-year-old male patient with an upper left maxillary defect following partial maxillectomy due to osteosarcoma. The patient experienced difficulties with speech, mastication, and mouth opening due to the Aramany Class II defect. Intraoral scanning was utilized to capture the oral structures, leading to the creation of a precise 3D model for prosthesis fabrication. Acrylic resin was reinforced with silver nanoparticles to enhance strength and provide antibacterial properties. The final obturator was fabricated, polished, and adjusted to ensure optimal fit, function, and comfort. The patient was educated on oral hygiene and maintenance of the obturator. Regular follow-ups were scheduled to monitor the prosthesis's performance. This case emphasizes the benefits of combining digital technology and nanomaterials in prosthodontic rehabilitation for patients with maxillary defects.

Key-words: Maxillary obturator, silver nanoparticles, digital scanning, facial defect reconstruction, 3D printing.

Introduction:

Facial abnormalities may arise from trauma, tumor surgery, or congenital anomalies. Ideally, surgical reconstruction is recommended to restore both function and aesthetics. Nevertheless, the feasibility of surgical reconstruction may be hindered by factors such as the size or location of the defect.[1] The most prevalent form of facial abnormalities often involves defects in the maxilla. Maxillary defects resulting from surgical removal of any maxillary lesion necessitate correction due to the potential for creating abnormal connections between the oral and nasal cavities. This can have a considerable impact on patients' functionality and overall quality of life. Typically, substantial functional changes make individuals prone to hypernasal speech, compromised chewing abilities, and issues related to fluid leakage in the nasal and antral cavities.[2]

The prosthesis used to correct these defects is called a maxillary obturator.[3] An obturator is a prosthetic device employed to seal off an acquired or congenital aperture in tissue, typically located in the hard palate or adjacent soft tissue alveolar structures. Maxillary obturator prostheses play a crucial role in restoring functions such as chewing, swallowing, and phonation, while simultaneously providing support to the soft tissues, such as the lips and cheeks of the patient, resulting in an aesthetically pleasing appearance.[4]

The evolution of constructing maxillary obturator prostheses, historically employing diverse materials like acrylics and silicones, each possessing distinct benefits, has now integrated nano-particles. Silver nanoparticles added to acrylic resin inhibit the growth of such bacteria as Streptococcus mutans, Escherichia coli and Staphylococcus aureus. In addition to the antibacterial effects, acrylic resin incorporated with film of polymers obtain a maximum lethal

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effect on microbial cells without killing human cells. This advancement not only reinforces the prosthesis but also enables a more precise adaptation, promoting better functionality and comfort for the patient.[5-6]

In this case report maxillary obturator was made using acrylic resin incorporated with silver nanoparticle and for impression making of the maxillary and mandibular arch intra oral scanning was done.

Case report:

A male patient aged 55 years reported with an upper left maxillary defect. The patient faces difficulties with eating, speaking and mouth opening. (Fig. 1 &2) The patient's dental history reveals a chronological progression of significant events: initially diagnosed with osteosarcoma in the mandible, followed by the necessity of a glossectomy procedure and subsequent skin graft (Fig. 3). Subsequently, osteosarcoma manifested in the maxilla post-glossectomy, prompting a left-sided partial maxillectomy (Fig. 4). The patient was also on a ryles tube for the past 1 month. Intraoral examination showed Aramany Class II maxillary defect on the left maxilla, the defect not exceeding the midline, and the resection involved the hard palate, alveolar bone, teeth, and soft tissue. The missing teeth were 23, 24, 25, 26, 27. Hence, a digitally fabricated obturator reinforced with silver nanoparticles was selected as the treatment plan.

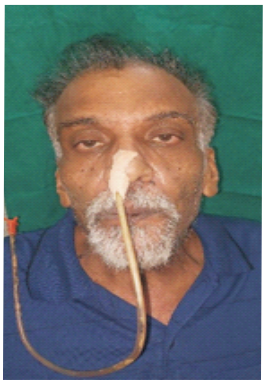

Fig. 1. Pre-operative photograph Fig. 2. Mouth Opening

Fig. 3. Mandibular arch with skin graft

Fig. 4. Maxillary arch with defect

During treatment planning, the design of the prosthesis was discussed with the patient, and treatment options were explained. Considering the size of the defect, an acrylic obturator with cast clasps was selected for ease of base adjustment and better retention. Fabrication of the obturator was done in the following steps-

The prosthetic process began with intra-oral oral scanning(Fig. 5), which captured detailed images of the oral defect. Subsequently, a meticulous analysis of the scans led to the creating of a 3D model, precisely replicating the patient's oral structure and the specific characteristics of the defect(Fig. 6). A confirmatory model was then produced based on a 3D-printed cast, ensuring accuracy in replication(Fig. 7).

Fig. 5. Intra-oral scanning of the defect

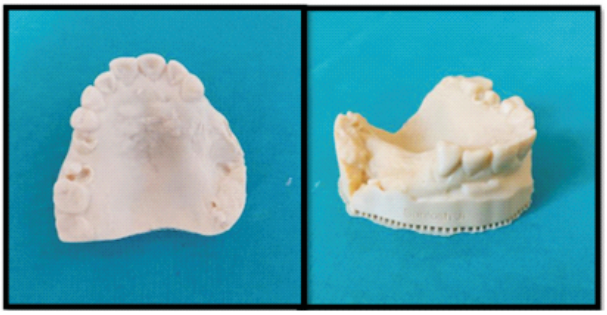

Fig. 6. 3D Printed Cast

Fig. 7. Confirmer

Due to the limitations of the 3D-printed cast in withstanding high temperatures, a duplicate cast was created for the subsequent processing steps. During processing of the final obturator, silver nanoparticles were incorporated into the design to enhance material properties, focusing on strength and antibacterial features. The addition of silver nanoparticles involved proportioning high-impact acrylic resin with recommended ratios and carefully mixing 99.9% pure powdered silver with PMMA resin.[5-7]

Post-fabrication, the obturator's surface underwent refinement and polishing to ensure comfort and an aesthetically pleasing appearance.(Fig 8) Necessary adjustments were made to guarantee a precise fit and optimal functionality (Fig. 9).

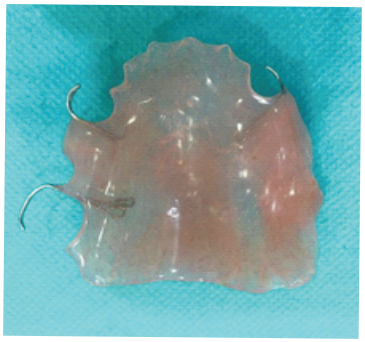

Fig. 8. Obturator

Fig. 9. Post insertion photographs

Upon insertion of the fabricated obturator, the patient received comprehensive education on oral hygiene and maintenance. The process concluded with regular check-ups scheduled to monitor the obturator's performance, address concerns, and make any necessary adjustments for continued satisfaction and functionality. This comprehensive approach not only addresses the technical intricacies of obturator fabrication but also emphasizes ongoing patient care and satisfaction throughout the prosthetic journey.

Discussion:

The transformative impact of integrating digital scanning precision and silver nanoparticles in the creation of maxillary obturator prostheses for patients dealing with facial defects. The shift from traditional materials to those infused with silver nanoparticles signifies a substantial advancement in prosthodontic practices.

The digital workflow, including intra-oral scanning and advanced manufacturing methods like 3D printing or milling, heralds a new era in customizing prosthetics.[7,8]

The inclusion of silver nanoparticles introduces valuable characteristics to the prosthetic material. This encompasses increased strength, antibacterial features, and heightened biocompatibility. These improvements underscore a transition toward materials that not only serve functional purposes but also prioritize ongoing oral health, providing a comprehensive approach to prosthetic care.[9,10]

The collaboration between digital precision and silver nanoparticles in the fabrication of maxillary obturator prostheses holds significant promise in prosthodontics.

Conclusion:

The integration of digital scanning technology and the incorporation of silver nanoparticles into acrylic resin represent significant advancements in the fabrication of maxillary obturators. The digital workflow ensures high precision in replicating the patient's oral structure, while the inclusion of silver nanoparticles enhances the strength, durability, and antibacterial properties of the prosthesis. This case underscores the potential of combining digital techniques with advanced biomaterials in prosthodontic care, offering a tailored approach to addressing both functional and aesthetic challenges in patients undergoing facial reconstruction.

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