

## USE OF 3D MODELING AND PRINTING OF CUSTOM PROSTHESES IN AESTHETIC OTORHINO- LARYNGOLOGY: A BIBLIOGRAPHICAL RE- VIEW

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**Abstract:** This review article discusses the increasing use of 3D modeling and printing of custom prostheses in aesthetic otolaryngology. The integration of these technologies has transformed the approach of healthcare professionals in complex cases of facial deformities or structural absences.

The current study examines recent progress, clinical applications, benefits and challenges related to the use of 3D models and printed prostheses in aesthetic otorhinolaryngological procedures. Continued advances in 3D modeling have made it possible to create highly accurate digital representations of patients' facial structures. These three-dimensional models provide a more detailed and comprehensive understanding of anatomical anomalies, allowing surgeons to plan interventions with unparalleled precision. Furthermore, the production of personalized prosthetics through 3D printing enables solutions individually adapted to the patient, generating more natural and aesthetically pleasing results.

**Keywords:** 3D modeling, printing of personalized prostheses, aesthetic otorhinolaryngology, technological advances.

## INTRODUCTION

Aesthetic otolaryngology is an area of medicine that seeks to improve the appearance and function of the nose, ear and throat. 3D modeling and printing of personalized prostheses are emerging technologies that have the potential to revolutionize the practice of aesthetic otorhinolaryngology (SILVA; SANTOS, 2023). 3D modeling is a constantly evolving field, focusing on improving both the aesthetics and functionality of facial and cervical structures, encompassing elements such as the nose, ears and cervical region. Recently, remarkable advances have transformed the way we approach these procedures, ushering in an era of even more

exciting possibilities (RHEE et al., 2018).

In recent years, the integration of 3D modeling and the ability to print custom prosthetics have emerged as revolutionary tools in the realm of aesthetic otolaryngology. The combination of these technologies redefines the standard of care, opening the door to more precise surgical planning and more meticulous execution. By allowing doctors to visualize anatomical structures in three dimensions, 3D modeling enables a deeper, more detailed understanding of each patient's individual nuances (DANIEL, 2010).

The printing of personalized prosthetics appears as a significant milestone in this field, enabling the creation of devices perfectly adapted to the specific needs of each patient. This tailored approach not only optimizes the desired aesthetic results, but also considers the anatomical particularities of each individual, resulting in a harmonization between aesthetics and functionality (PROBST; BURKHARDT, 2020).

As aesthetic otolaryngology continues to embrace these innovations, patients can expect a more individualized experience and more satisfying results. This integration of 3D technology and custom printing exemplifies the growing synergy between medicine and technology, unleashing a new era of healthcare that combines scientific precision and aesthetic artistry. In this context, the possibilities are unlimited, promising a transformation not only of physical characteristics, but also of patients' quality of life (BEUTEL; MOMMAERTS; ABELOOS, 2018).

## **METHODOLOGY**

To prepare this comprehensive review article, a thorough search was conducted in recognized scientific databases, such as PubMed and Google Scholar. The main objective was to obtain the latest and most relevant knowledge about the intersections

between aesthetic otolaryngology, 3D modeling and custom prosthetic printing. The search was carried out using carefully selected keywords, such as "3D modeling", "prosthetic printing" and "aesthetic otorhinolaryngology", together with related terms, aiming to guarantee the comprehensiveness and precision of the results obtained.

The choice of the PubMed and Google Scholar databases was made taking into consideration, their reputation as reliable and comprehensive sources of scientific literature. The search was restricted to studies published within the last 14 years, a crucial period for capturing the latest trends and significant innovations in the field of aesthetic otolaryngology.

The selection of studies included in this review followed strict criteria, prioritizing works that directly addressed the use of 3D modeling and printing of personalized prostheses in aesthetic otorhinolaryngological procedures. This ensured that only relevant and impactful studies were incorporated, contributing to the quality and relevance of the content presented. Furthermore, aspects such as the methodology used in the studies, sample size, clinical results, validity of the results and the contribution to the advancement of knowledge in the area were considered.

These rigorous selection criteria ensured that the review was based on solid and reliable evidence, providing a complete and insightful overview of the applications and implications of 3D modeling and printing of personalized prostheses in aesthetic otolaryngology.

Through this robust and insightful methodology, this review article seeks to offer an informed and up-to-date perspective on the ever-evolving landscape of aesthetic otolaryngology, highlighting the crucial role played by 3D modeling and custom prosthetic printing.

## **TECHNOLOGICAL ADVANCES IN 3D MODELING AND PRINTING OF CUSTOM PROSTHESES**

The 3D modeling has stood out as an indispensable tool in aesthetic otolaryngology, allowing precise three-dimensional visualization of anatomical structures. This method has proven essential for preoperative planning, providing surgeons with deep insights into the nuances of the patient's anatomy. Additionally, 3D modeling facilitates communication between doctors and patients, allowing patients to better visualize and understand the potential outcomes of surgery. The printing of custom dentures has also emerged as a notable advancement. By creating custom devices, this technique provides a precise fit to patients' individual anatomical characteristics. This not only improves aesthetic results, but also optimizes patient function and comfort after surgery. Customized prostheses have been successfully applied in procedures such as rhinoplasty, auricular reconstruction and cervical remodeling (MAN; PARK, 2015).

The evolution of 3D modeling and printing of personalized prostheses has revolutionized the field of aesthetic otorhinolaryngology, providing significant benefits for both healthcare professionals and patients. The ability of 3D modeling to offer an accurate visual representation of anatomical structures in three dimensions has proven crucial in Pre-operative planning, allowing surgeons a deeper and more detailed understanding of each patient's specific anatomy (PAYNES; DA SILVA; MOREIRA, 2020).

Furthermore, 3D modeling not only assists doctors in preparing and performing surgical procedures, but also plays a key role in communicating with patients. By visualizing and better understanding the potential outcomes of surgery through three-dimensional models, patients can make more

informed decisions and feel more comfortable with the process (PARSA et al., 2022).

On the other hand, the printing of personalized prosthetics represents a significant advance in the personalization and precision of medical devices used in procedures such as rhinoplasty, auricular reconstruction and cervical remodeling. These custom-made prostheses are designed to perfectly fit each patient's unique anatomical characteristics, resulting not only in better aesthetic results, but also in a significant improvement in function and post-operative comfort (ZHONG; ZHAO, 2017).

Thus, the combination of 3D modeling and custom prosthetic printing is transforming the practice of aesthetic otolaryngology, offering more precise, effective and personalized solutions to meet the individual needs of each patient.

## **TECHNOLOGICAL ADVANCES AND CLINICAL APPLICATIONS**

The clinical applications of this pioneering approach are vast and cover a diverse range of procedures. From reconstructing compromised nasal structures to restoring missing ear parts, 3D printed prosthetics have demonstrated their effectiveness in restoring the appearance and function of facial structures. The intrinsic customization of these prostheses can also significantly improve patients' quality of life, providing greater self-confidence and psychological well-being.

The study entitled "3D printing for clinical application in otorhinolaryngology", conducted by Park et al. (2017), highlighted the application of 3D printing nasal reconstruction. By using 3D models of the affected nasal structures, researchers were able to plan surgeries in a more precise and individualized way. The manufacture of personalized prostheses allowed substantial aesthetic and functional corrections in patients

with severe deformities, demonstrating the potential of this approach in complex procedures (MESQUITA., 2023).

Parsha et al. (2022) presented a study entitled “Current and future photography techniques in aesthetic surgery”, where they focused on the applications of 3D modeling in aesthetic otoplasties. By using 3D scanning to create virtual models of the ears, the team customized the prosthetics through 3D printing. Clinical results indicated greater satisfaction among patients treated with personalized prosthetics, highlighting the effectiveness of this approach in improving patients’ appearance and self-esteem.

De Moraes et al. (2010) conducted the study “Anatomical reproducibility through 3D printing in cranio-maxillo-facial defects”, addressing the application of 3D printing in the anatomical reproduction of craniofacial defects.

The study focuses on evaluating the accuracy and usefulness of 3D printing technology in creating prosthetics and models for patients with craniofacial defects. They examined the feasibility of creating personalized prosthetics through 3D modeling and printing, aiming to improve aesthetic and functional outcomes for patients with craniofacial defects.

The article contributed to the growing understanding of the potential of 3D printing in medicine, especially in the field of craniofacial surgery. In summary, the promising application of 3D printing in anatomical reproduction and the creation of personalized prostheses for patients with craniofacial defects stands out, contributing to significant advances in craniofacial surgery and offering more effective and aesthetically improved results for patients (ARAÚJO, 2018).

When comparing these three studies, it is evident that 3D modeling and printing of

custom prostheses offer innovative and effective approaches in aesthetic otolaryngology. The ability to create accurate virtual models and then fabricate custom prosthetics allows for more detailed surgical planning and more satisfactory results. However, it is important to recognize challenges such as the associated cost, availability of resources and the need for ongoing training. With these studies as a basis, it is expected that the evolution of these technologies will continue to improve aesthetic and functional results for patients undergoing aesthetic otorhinolaryngological procedures (ARAÚJO, 2018).

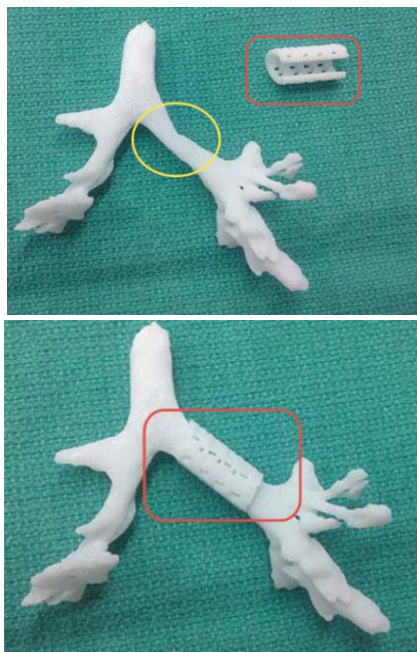


**Figure 1:** Reconstruction of nasal septum perforation with silicone prosthesis.

Source: Adapted from Altunay et al., 2016.

As this technological revolution continues to unfold, it is essential to explore the areas of research and development that are further driving the field forward. Researchers and engineers are constantly refining 3D modeling techniques, improving model accuracy and expanding simulation capabilities.

Furthermore, the search for biocompatible and durable materials for printing prostheses is an area of critical interest, aiming to ensure safe and long-lasting results for patients (ZHONG; ZHAO, 2017).



**Figure 2.** 3D mold of bioabsorbable tracheal splint.

Source: Adapted from Zopf et al., 2013.

One of the promising research directions is the integration of artificial intelligence (AI) in the interpretation of medical images and the analysis of 3D models. AI can assist healthcare professionals in more accurately identifying anomalies, predicting post-surgical outcomes, and even optimizing prosthetic designs. This collaboration between the power of AI and human clinical expertise has the potential to further elevate standards of care (LOBO, 2017).

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The emotional and psychological benefits for patients also deserve continued emphasis. Restoring a normal facial appearance can mean a profound transformation in patients' self-esteem and quality of life. Therefore, research into the psychology behind these procedures and how they affect patients' mental well-being are important aspects to be considered (ARAÚJO, 2018). As the field advances, it is crucial to address the issue of accessibility and cost. Although technologies are becoming more sophisticated, finding ways to make these procedures and solutions more accessible to a variety of patients is critical to ensuring equity in medical care.

## CONCLUSION

The 3D modeling and printing of personalized prostheses represent a milestone in aesthetic otorhinolaryngology, offering innovative possibilities and remarkable results. The intersection of technology and medicine is redrawing the boundaries of what is possible, enabling healthcare professionals to deliver highly personalized and effective care. As research continues to advance and challenges are addressed, the future of this promising field looks bright, with the potential to significantly improve the quality of life and health of patients around the world.

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