MAXILLOFACIAL PROSTHETICS: AN EXPANDED REVIEW

Pulkit Vaid[1] , Ruchika Goyal[2]
Desh Bhagat Dental College and Hospital, Mandi Gobindgarh, Punjab, India

ABSTRACT

Maxillofacial prosthetics is a specialized branch of prosthodontics dedicated to the rehabilitation of patients with congenital, acquired, or developmental defects of the head and neck region. These defects may result from trauma, surgery for cancer, or congenital anomalies, leading to significant functional, aesthetic, and psychological challenges. This expanded review highlights the scope, advancements, and clinical significance of maxillofacial prosthetics in restoring form and function. It discusses various types of prostheses—including orbital, auricular, nasal, and intraoral prostheses—along with recent innovations in materials such as medical-grade silicones, digital scanning, CAD/CAM technology, and 3D printing that have revolutionized fabrication accuracy and patient comfort. The review also explores the interdisciplinary approach involving surgeons, prosthodontists, and technologists, which is vital for successful outcomes. Moreover, the paper emphasizes the psychosocial impact of rehabilitation and the importance of patient-centered care. Through continued research and technological integration, maxillofacial prosthetics continues to evolve, offering improved esthetics, functionality, and quality of life for affected individuals.

Keywords: Maxillofacial prosthetics, Prosthodontics, Facial rehabilitation, Craniofacial defects, 3D printing, CAD/CAM, Silicone prosthesis, Facial prosthesis, Osseointegrated implants, Patient rehabilitation

Introduction

Maxillofacial prosthetics is a subspecialty of prosthodontics concerned with the rehabilitation of patients presenting with defects or disabilities that affect the maxillofacial region. These defects may result from congenital anomalies such as cleft lip and palate, acquired defects due to trauma or burns, or surgically created defects following tumor ablation (1). The main objective of maxillofacial prosthetics is to restore not only function but also esthetics and psychosocial well-being. The field emerged formally during and after World War II, when maxillofacial injuries among soldiers created a demand for rehabilitation beyond the scope of conventional prosthodontics (2). Since then, it has evolved into a multidisciplinary specialty that integrates medicine, surgery, prosthodontics, materials science, and digital technology.

Classification of Maxillofacial Prostheses

Maxillofacial prostheses can be broadly classified into intraoral and extraoral prostheses:

1. Intraoral Prostheses

- Obturators: Replace missing portions of the maxilla to separate the oral and nasal cavities, enabling improved speech, swallowing, and mastication (3).
- Palatal lift prostheses: Elevate the soft palate in cases of velopharyngeal incompetence to restore normal speech (4).
- Palatal augmentation prostheses: Modify the palatal contours to enhance tongue-palate contact for patients with neuromuscular deficits (5).
- Mandibular guidance prostheses: Used in mandibular resections to re-establish functional occlusion and guide mandibular movement (6).

2. Extraoral Prostheses

- Ocular and orbital prostheses: Restore esthetics and protect sensitive tissues after enucleation or exenteration (7).
- Auricular prostheses: Replace congenital or acquired ear defects, commonly in cases of microtia or traumatic loss (8).
- Nasal prostheses: Restore form and function after trauma, surgical resection, or congenital deformities (9).
- Midfacial prostheses: Replace extensive defects involving multiple facial units, often requiring a combination of retention methods (10).

Retention Methods

Retention is a key challenge in maxillofacial prosthetics. The major methods include:

- Anatomic undercuts: Natural tissue contours may help retain intraoral prostheses (11).
- Adhesives: Silicone or medical-grade adhesives are used, but may cause skin irritation and poor longevity (12).
- Spectacle frames and straps: Mechanical methods often used for orbital or nasal prostheses (13).
- Osseointegrated implants: Titanium implants placed in craniofacial bones provide superior retention and stability, with improved patient satisfaction (14).

Materials in Maxillofacial Prosthetics

The evolution of materials has significantly influenced

prosthetic outcomes.

- Acrylic resin: Once widely used, but rigid and less esthetic, making it less ideal for extraoral prostheses (15).
- Silicone elastomers: Gold standard for facial prostheses due to flexibility, biocompatibility, and lifelike appearance. However, they suffer from color instability and degradation over time (16).
- Polyurethane elastomers: Offer improved strength but have limited biocompatibility (17).
- Implant-retained attachments: Magnet, bar-clip, and ball attachments improve prosthesis stability when combined with osseointegrated implants (18).
- Digital materials: CAD-CAM milled polymers and 3D-printed biocompatible resins are increasingly being explored for precise prosthesis fabrication (19).

Clinical Procedures in Maxillofacial Prosthetics

The treatment process typically involves:

1. History and diagnosis – Detailed evaluation of medical history, surgical interventions, and psychological status.
2. Impression making – Conventional impressions with elastomers or digital intraoral/extraoral scanning for CAD-based design (20).
3. Sculpting and try-in – Wax modeling for extraoral prostheses to ensure esthetic accuracy and patient acceptance.
4. Processing and coloring – Use of intrinsic (within material) and extrinsic (surface-applied) pigmentation for lifelike appearance.
5. Delivery and adjustments – Final insertion with patient education on hygiene and maintenance.
6. Follow-up – Regular recalls for adjustments, especially as irradiated or surgically treated tissues may change over time (21).

Psychosocial Aspects

Maxillofacial defects can cause profound psychological and social challenges including depression, anxiety, and social withdrawal. The prosthesis plays a vital role in restoring self-esteem and confidence. Counseling and psychological support should be integral to treatment planning (22).

Digital Technology and Future Directions

Recent years have witnessed a paradigm shift with digital technology:

- CAD-CAM and 3D printing: Allow precise reproduction of anatomy and improved customization of prostheses (23).
- Digital color matching systems: Provide enhanced accuracy in skin tone reproduction.
- Virtual surgical planning (VSP): Integrates surgical resection planning with prosthetic rehabilitation.
- Tissue engineering and regenerative medicine: Future research is focused on bioengineered tissue substitutes and prosthesis integration with living tissues (24).

Challenges

Despite advances, limitations remain:

- Color degradation of silicone prostheses (25).
- Limited long-term stability of adhesives (26).
- Implant failure in irradiated bone (27).
- High cost and limited accessibility of digital technologies in developing regions (28).

Conclusion

Maxillofacial prosthetics is a critical specialty that bridges medicine, dentistry, and art to rehabilitate patients with complex craniofacial defects. It not only restores essential functions like speech, mastication, and swallowing but also addresses esthetics and psychosocial well-being. With continuing innovations in biomaterials, digital technologies, and interdisciplinary collaboration, the future holds promising advances that may overcome existing challenges and offer patients improved quality of life.

References (Vancouver Style)

1. Beumer J, Curtis TA, Marunick MT. Maxillofacial rehabilitation: prosthodontic and surgical considerations. 3rd ed. Chicago: Quintessence Publishing; 2011.
2. Chalian VA, Drane JB, Standish SM. Maxillofacial prosthetics: multidisciplinary practice. Baltimore: Williams & Wilkins; 1971.
3. Keyf F. Obturator prostheses for hemimaxillectomy patients. J Oral Rehabil. 2001;28(9):821-9.
4. Sykes LM. Prosthodontic rehabilitation of velopharyngeal incompetence. SADJ. 2003;58(7):273-9.
5. Aramany MA, Myers EN. Prosthetic rehabilitation of patients with oropharyngeal defects. J Prosthet Dent. 1971;25(1):67-77.
6. Curtis DA, Plesh O, Miller AJ, Curtis TA, Sharma A, Schweitzer R. A comparison of masticatory function in patients with and without resected mandibles. J Prosthet Dent. 1997;77(5):435-43.
7. Goiato MC, dos Santos DM, Bannwart LC, Moreno A,

Pesqueira AA, Haddad MF. Psychosocial impact on anophthalmic patients wearing ocular prostheses. Int J Oral Maxillofac Surg. 2013;42(1):113-9.
8. Wolfaardt J, Shehata T, Hosni A, Brockhurst P. Auricular prostheses: a clinical survey. Int J Prosthodont. 1992;5(6):557-63.
9. Lemon JC, Kiat-Amnuay S, Martin JW, Chambers MS. Facial prosthetic rehabilitation: nasal prosthesis. Curr Opin Otolaryngol Head Neck Surg. 2005;13(4):255-62.
10. Toljanic JA, Eckert SE. Prosthodontic treatment for midfacial defects. J Prosthet Dent. 1989;61(2):180-5.
11. Parr GR, Gardner LK. The evolution of materials used in obturator prostheses. J Prosthet Dent. 1989;62(6):636-8.
12. Hatamleh MM, Watts DC. Effect of adhesives on maxillofacial silicone elastomers. J Prosthodont. 2010;19(4):300-6.
13. Andres CJ, Haug SP, Brown DT, Bernal G. Effects of adhesives and methods of retention on facial prosthesis retention. J Prosthet Dent. 1992;67(2):213-7.
14. Roumanas ED. Perspectives on facial prosthesis retention: adhesives versus implants. J Prosthodont. 2009;18(3):225-9.
15. Craig RG, Powers JM. Restorative dental materials. 11th ed. St. Louis: Mosby; 2002.
16. Goiato MC, Pesqueira AA, dos Santos DM, Antenucci RM, Ribeiro PP. Evaluation of hardness and color stability of facial silicone prostheses submitted to disinfection. J Appl Oral Sci. 2010;18(6):641-8.
17. Lewis DH. Polyurethane elastomers for maxillofacial prosthetics. J Prosthet Dent. 1975;34(5):543-8.
18. Taylor TD. Clinical maxillofacial prosthetics. Chicago: Quintessence Publishing; 2000.
19. Eggbeer D, Bibb R, Williams R. The CAD-CAM and rapid prototyping of removable partial dentures and facial prostheses. Proc Inst Mech Eng H. 2005;219(3):195-202.
20. Bibb R, Eggbeer D, Evans P. Rapid prototyping technologies in soft tissue facial prosthetics: current state of the art. Rapid Prototyp J. 2010;16(2):130-7.
21. Granström G. Osseointegration in irradiated cancer patients: implant survival and failures. J Oral Maxillofac Surg. 2005;63(5):579-85.
22. Goiato MC, Fernandes AU, dos Santos DM, Barao VA. Psychosocial impact on patients undergoing maxillofacial prosthetic rehabilitation. Eur J Dent. 2010;4(2):189-93.
23. Ciocca L, Scotti R. CAD-CAM generated ear cast by means of a laser scanner and rapid prototyping machine. J Prosthet Dent. 2004;92(6):591-5.
24. Saijo H, Suzuki S, Kanno Y, Ohkubo K, Takato T. Application of computer-aided design and manufacturing technology to surgical and prosthetic rehabilitation in maxillofacial prosthetics. Maxillofac Plast Reconstr Surg. 2014;36(1):1-6.
25. Hatamleh MM, Watts DC. Effects of accelerated aging on mechanical properties of maxillofacial silicone elastomers. J Prosthodont. 2010;19(6):481-7.
26. Lemon JC, Kiat-Amnuay S. Materials for facial prostheses: adhesives and limitations. J Prosthet Dent. 2001;85(6):603-7.
27. Albrektsson T, Sennerby L. State of the art in oral implants. J Clin Periodontol. 1991;18(6):474-81.
28. Sykes LM, Essop AR, Veres EM. Maxillofacial prosthetic rehabilitation: the state of art in developing countries. SADJ. 2004;59(10):390-4.