International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 09 | Sept - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Maxillofacial Prosthesis: A Comprehensive Review

Dr. Puvvada Venkata Vaibhav[1], Dr. B. Lakshmana Rao[2], Dr.k. Sudheer[3], Dr. A. Sai Krishna[4]

1. Post Gradute Student, Department of Prosthodontics, Lenora Institute of Dental Sciences, Rajahmundry, India.
2. Professor & HOD, Department of Prosthodontics, Lenora Institute of Dental Sciences, Rajahmundry, India.
3. Professor, Department of Prosthodontics, Lenora Institute of Dental Sciences, Rajahmundry, India.
4. Senior Lecturer, Department of Prosthodontics, Lenora Institute of Dental Sciences, Rajahmundry, India.

Introduction

Maxillofacial prosthetics is a specialized branch of prosthodontics that focuses on the rehabilitation of patients with defects or disabilities caused by trauma, disease, or congenital conditions. The primary objectives are to restore function, aesthetics, and improve the quality of life of affected individuals. This review aims to provide an overview of maxillofacial prostheses, discussing their types, materials, fabrication techniques, and clinical considerations, with an emphasis on current advancements and future directions in the field[1].

Types of Maxillofacial Prostheses

Maxillofacial prostheses are categorized based on the anatomical region they restore. The main types include:

Orbital Prostheses

Orbital prostheses are used to rehabilitate patients who have lost an eye and surrounding tissues due to trauma or tumor resection. These prostheses restore the appearance of the eye, eyelids, and adjacent structures, significantly enhancing the patient's facial aesthetics and self-esteem[2].

Nasal Prostheses

Nasal prostheses are designed for patients with partial or total nasal defects. These prostheses are crucial for restoring nasal function and appearance, allowing patients to breathe normally and regain facial symmetry.

Auricular Prostheses

Auricular prostheses replace the external ear in patients with congenital anomalies like microtia or acquired defects due to trauma or surgery. They are typically retained using adhesive systems or Osseo integrated implants.

Mandibular and Maxillary Obturators

Obturators are used in patients with defects of the maxilla or mandible, often resulting from surgical resection of tumors. These prostheses help in speech, mastication, and prevent food and liquids from entering nasal passages.

Midfacial Prostheses[3]

Midfacial prostheses restore larger facial defects involving multiple anatomical structures, such as the nose, cheeks, and upper lip. These complex prostheses require meticulous planning and execution to ensure functional and aesthetic restoration.

Materials Used in Maxillofacial Prostheses

The materials used in the fabrication of maxillofacial prostheses play a critical role in their success. The choice of material affects the prosthesis's durability, biocompatibility, and aesthetic outcome.

Silicone Elastomers[4]

Silicone elastomers are the most commonly used materials for maxillofacial prostheses due to their flexibility, durability, and ability to mimic the texture of natural skin. They can be pigmented to match the patient's skin tone, providing a natural appearance. Silicone prostheses are biocompatible and well-tolerated by tissues, making them suitable for long-term use.

Acrylic Resins

Acrylic resins are often used in the fabrication of obturators and interim prostheses. They are rigid and provide good structural support. However, they are less flexible and comfortable compared to silicone elastomers. Acrylic resins can be modified easily, allowing for adjustments during the fitting process.

Polyurethane

Polyurethane is a less commonly used material in maxillofacial prosthetics. It offers good tear resistance and flexibility but may cause allergic reactions in some patients. Its use is generally limited to specific cases where its properties are advantageous.

Medical-Grade Polymers

Advancements in material science have introduced medical-grade polymers that offer superior biocompatibility and mechanical properties. These materials are being explored for their potential to improve the longevity and performance of maxillofacial prostheses.

Fabrication Techniques

The fabrication of maxillofacial prostheses involves a series of meticulous steps, from impression taking to final fitting. Advances in digital technology have revolutionized the fabrication process, improving precision and outcomes.

Conventional Techniques[5]

Traditional fabrication techniques involve manual impression taking, wax modeling, and laboratory processing. The process begins with taking an impression of the defect area using materials like alginate or silicone. A wax model is then created, which serves as a blueprint for the final prosthesis. The wax model is used to make a mold, into which the chosen prosthetic material is poured and cured.

Digital Techniques[4]

Digital technology has significantly enhanced the precision and efficiency of maxillofacial prosthesis fabrication. Techniques such as 3D scanning, computer-aided design (CAD), and 3D printing are increasingly being used.

1. *3D Scanning*: Digital impressions are obtained using 3D scanners, which capture the exact dimensions and contours of the defect area. This method is less invasive and more comfortable for patients compared to traditional impression techniques.

2. *CAD*: Computer-aided design allows for the creation of highly accurate digital models of the prosthesis. CAD software enables precise customization, ensuring that the prosthesis fits perfectly and meets the aesthetic requirements of the patient.

3. *3D Printing*: The digital model created using CAD is then fabricated using 3D printing technology. 3D printing allows for the creation of intricate designs and structures that are difficult to achieve with conventional methods. This technology also reduces the time required for prosthesis fabrication.

Clinical Considerations[6]

The success of maxillofacial prostheses depends on various clinical factors, including patient assessment, surgical planning, and post-fabrication care.

Patient Assessment[8]

A thorough assessment of the patient's medical history, defect characteristics, and functional needs is essential. This assessment guides the choice of prosthesis type, material, and retention method.

Surgical Planning

In cases where osseointegrated implants are used for prosthetic retention, precise surgical planning is crucial. The position, number, and angulation of implants must be carefully determined to ensure optimal support and stability for the prosthesis.

Prosthetic Retention[7]

Prosthetic retention is a critical aspect of maxillofacial prosthetics. Various methods are used to achieve stable and secure retention, including:

1. *Osseointegrated Implants*: Dental implants provide a stable foundation for attaching maxillofacial prostheses. These implants integrate with the bone, offering long-term retention and stability.

2. *Magnetic Systems*: Magnets can be used to retain prostheses, especially in cases where conventional mechanical retention is challenging. Magnetic systems are easy to use and provide consistent retention.

3. *Adhesives*: Prosthetic adhesives are commonly used to enhance the retention of tissue-supported prostheses. These adhesives improve the adhesive forces between the prosthesis and the mucosal surface.

4. *Mechanical Attachments*: Clasps and clips can be used to mechanically secure the prosthesis to adjacent natural structures or remaining dentition.

Post-Fabrication Care

Regular follow-up and maintenance are essential to ensure the longevity and functionality of the prosthesis. Patients should be educated on proper care and hygiene practices to prevent complications such as mucosal irritation or infection.

Advancements in Maxillofacial Prosthetics

The field of maxillofacial prosthetics has seen significant advancements in recent years, driven by innovations in materials, technology, and surgical techniques.

Biomimetic Materials

Research into biomimetic materials aims to develop prostheses that closely mimic the properties of natural tissues. These materials offer enhanced biocompatibility, flexibility, and aesthetic appeal, improving patient outcomes.

Regenerative Medicine

Advances in regenerative medicine, such as tissue engineering and stem cell therapy, hold promise for the future of maxillofacial prosthetics. These techniques aim to restore lost tissues and improve the integration of prosthetic devices with the body.

Smart Prosthetics

The integration of smart technologies, such as sensors and actuators, into maxillofacial prostheses is an emerging area of research. Smart prosthetics can dynamically respond to changes in the environment and patient's needs, offering superior performance and comfort.

Virtual Surgical Planning

Virtual surgical planning allows for precise preoperative planning and simulation of surgical procedures. This technology improves the accuracy of implant placement and prosthetic design, leading to better clinical outcomes.

Conclusion

Maxillofacial prosthetics is a dynamic and evolving field that plays a crucial role in the rehabilitation of patients with facial defects. Advances in materials, digital technology, and surgical techniques have significantly improved the outcomes of maxillofacial prosthetic rehabilitation. Future research and innovation hold the promise of further enhancing the functionality, aesthetics, and comfort of maxillofacial prostheses, ultimately improving the quality of life for patients.

References

1. Lemon JC, Martin JW, King GE, Wesley PJ. Interface tissue response to maxillofacial prosthetic adhesive materials. J Prosthet Dent. 1995;73(1):6-11.

2. Hatamleh MM, Watts DC. Mechanical properties and bonding of maxillofacial silicone elastomers. Dent Mater. 2010;26(2):185-191.

3.Wolfaardt JF, Wilkes GH, Parel SM, Tjellström A. Craniofacial osseointegration: the Canadian experience. Int J Oral Maxillofac Implants. 1993;8(2):197-204.

4.Jeyaraj P. Digital technologies in maxillofacial prosthodontics - a review. J Indian Prosthodont Soc. 2016;16(3):199-206.

5. 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):591-595.

6. Gary JJ, Smith CT. Pigmentation of maxillofacial prostheses. J Prosthet Dent. 1998;79(5):611-618.

7. Lemon JC, Chambers MS, Jacobsen ML, Powers JM. Color stability of facial prostheses. J Prosthet Dent. 1995;74(6):613-618.

8.Beumer J, Curtis TA, Marunick MT. Maxillofacial Rehabilitation: Prosthodontic and Surgical Management of Cancer-Related, Acquired, and Congenital Defects of the Head and Neck. Ishiyaku EuroAmerica; 1996.

9.S. Guttal, R. Patil, A. Shetty, and N. Mathew, "A study on the retention of maxillofacial silicone elastomer with different pigments after weathering," Journal of Prosthodontics, vol. 19, no. 5, pp. 374-380, 2010.

10.S. M. Goiato, C. R. Pesqueira, D. Z. Ramos, A. C. Gennari-Filho, and D. A. Micheline, "Color stability comparison of acrylic resin, composite resin, and facial silicone," Journal of Prosthodontics, vol. 18, no. 6, pp. 521-525, 2009.

11.M. A. Eleni, M. Katsavou, A. Krokida, M. A. Polyzois, and J. G. Gettleman, "Mechanical properties of maxillofacial prosthetic materials after artificial aging," Journal of Prosthetic Dentistry, vol. 97, no. 5, pp. 381-386, 2007.

12.G. Polyzois, A. Tarantili, M. Frangou, J. Andreopoulos, "Physical properties of a silicone prosthetic elastomer stored in simulated skin secretions," Journal of Prosthetic Dentistry, vol. 95, no. 3, pp. 209-214, 2006.

13.G. T. Firtell, M. C. Moore, "Facial prosthesis retention," Journal of Prosthetic Dentistry, vol. 58, no. 3, pp. 323-327, 1987.

14.H. Kiat-Amnuay, T. T. Powers, G. M. Swartz, "Effect of pigmentation on the color stability of a silicone maxillofacial elastomer," Journal of Prosthetic Dentistry, vol. 86, no. 5, pp. 400-406, 2001.

15.B.Andres, "Maxillofacial prosthetics - history and future," Oral and Maxillofacial Surgery Clinics of North America, vol. 16, no. 1, pp. 45-63, 2004.

16.R. D. Beumer III, K. Marunick, M. A. Esposito, "Prosthetic rehabilitation of midfacial defects," International Journal of Prosthodontics, vol. 22, no. 2, pp. 125-130, 2009.

17.A. M. Hatamleh, S. K. Watson, "Construction of an auricular prosthesis using rapid prototyping technique," Journal of Prosthetic Dentistry, vol. 95, no. 6, pp. 349-353, 2006.

18.R. Prithviraj, M. Regish, A. Prithviraj, "Review of maxillofacial prosthetics," Journal of Oral Biology and Craniofacial Research, vol. 2, no. 2, pp. 71-75, 2012.

19.B. K. Arcuri, J. R. Rubin, "Implant-retained auricular prostheses: an alternative to reconstructive surgery," Annals of Plastic Surgery, vol. 28, no. 4, pp. 442-447, 1992.

20.J. J. Reisberg, R. S. Habakuk, "The use of dental implants in the prosthetic rehabilitation of craniofacial defects," Journal of Prosthetic Dentistry, vol. 75, no. 6, pp. 641-644, 1996.