OPEN ACCESS
Saudi Journal of Oral and Dental Research
Abbreviated Key Title: Saudi J Oral Dent Res
ISSN 2518-1300 (Print) |ISSN 2518-1297 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: http://scholarsmepub.com/sjodr/

Review Article

Recent Advances in Prosthodontic Management of Maxillary Defects: A Review

Dr. Hari Priyanka Kuchipudi[1*], Dr.Y.Sravanthi[2], Dr. Krishna vallabhaneni S.S[3], Dr. T. Krishna Mohan[4]
[1]Post graduate trainee, Department of prosthodontics, crown and bridge including implantology, Sibar Institute of Dental Sciences, Guntur, Andhra Pradesh India
[2]Reader, Department of prosthodontics, crown and bridge including implantology, Lenora Institute of Dental Sciences, Rajanagaram, Rajahmundry, Andhra Pradesh India
[3]Reader, Department of pedodontics and preventive dentistry, Sibar institute of dental sciences, Guntur, Andhra Pradesh India
[4]Professor, Department of prosthodontics, crown and bridge including implantology, Sibar institute of dental sciences, Guntur, Andhra Pradesh India

***Corresponding author:** Dr. Hari Priyanka Kuchipudi
| **Received:** 14.05.2019 | **Accepted:** 25.05.2019 | **Published:** 30.05.2019
DOI:10.21276/sjodr.2019.4.5.11

Abstract

Maxillary reconstruction is still an evolving art when compared to the reconstruction of the mandible. The defects of maxilla apart from affecting the functions of the speech, swallowing and mastication also cause cosmetic disfigurement. Rehabilitation of the form and function in patients with maxillary defects is either by using obturator prosthesis or by a surgical reconstruction. Literature is abundant with a variety of reconstructive methods. The classification systems are also varied, with no universal acceptance of any one of them. The oncologic safety of these procedures is still debated, and conclusive evidence in this regard has not emerged yet. Management of the orbit is also not yet addressed properly. Tissue engineering, that has been hyped to be one of the possible solutions for this vexing reconstructive problem, has not come out with reliable and reproducible results so far. So, this article reviews the various recent advances in maxillofacial prostheses.

Key words: Maxillofacial prostheses, maxillofacial prosthodontist, recent advances.

INTRODUCTION

One of the first writings on maxillofacial prosthesis was by Sir Ambrose Pare in 1530 AD, who was often referred to as the "father of modern surgery." Maxillary obturator using sponge was one of the earliest contributions of Pare. A dried sponge was attached to the upper surface of obturator which absorbed moisture from the secretions and expanded intra orally to retain the prosthesis [1]. His other contributions include artificial nose, eyes, and ears. He advocated the use of prosthetic nose made of silver which was attached to the face by means of strings and the junction of the attachment masked by a mustache [2]. Sir Pierre Fauchard, commonly known as the "father of modern dentistry" also made contributions to maxillofacial prosthesis. He along with a French surgeon and a silversmith fabricated an extensive facial prosthesis replacing the entire lower half of the face. This was worn by a French military man who later came to be known as "gunner with the silver mask [3].

Effect of maxillary defects

The maxillary defects may lead to anatomical and functional deformity of the maxillofacial region. The defect will produce concern regarding facial deformity. As far as functions are concerned, it can produce difficulty in speech, mastication, and deglutition. Loss of partition between oral and nasal cavity will lead to passage of fluid into nasal cavity.

OBJECTIVES

Rehabilitation of maxillectomy patient should fulfill the following objectives

- To restore the function: Speech, respiration, chewing, and deglutition.
- To restore the form: Facial appearance.
- To provide support to the soft tissue to restore the mid‐facial contour and an acceptable aesthetic results.
- To provide support for the orbital contents to prevent ophthalmic complications such as enophthalmus and diplopia.

The surgeon and prosthodontist relationship

For preoperative treatment planning, consultation with the surgeon is often helpful. The

detailed plan for rehabilitation of the patient should be prepared. The requirement of any temporary and/or permanent prosthesis should be evaluated preoperatively. The prosthodontist will help the surgeon by advising about the presence of dental diseases and if present, the nature of the same. The prosthodontist will prepare surgical stents and immediate prosthesis, which will aid in recovery of the patient. During joint consultation, the prosthodontist and surgeon should discuss about the tentative line of resection and type of prosthesis to be used. When insertion of stent or prosthesis has been planned at the time of surgery, the trained prosthodontist should be present at the time of operation. Intraoperatively, the maxillofacial prosthodontist may modify the prefabricated prosthesis using cold cure acrylic resin and other materials. Postoperatively, the surgeon will evaluate the healing of surgical wound and depending on that will advise for the time for fabrication of the final prosthesis. During postoperative healing, the wound should not be disturbed which may affect the healing adversely. On the other hand, fabrication of some stabilizing prosthesis may help in rapid healing [4].

Treatment options for maxillary defects

The defect involving maxilla can be rehabilitated either by surgical correction with plastic surgery or by obturator prosthesis. The treatment with plastic surgery will provide better results as far as esthetics and functions are concerned. However in many cases, plastic surgery may be contraindicated because of advanced age of the patient, poor general health, very large defect, and poor blood supply because of radiation therapy. In such cases, a prosthetist may be called upon to treat the patient. The obturator prosthesis can rehabilitate the defect and can improve patient's quality of life. However by no means should maxillofacial prosthetic repair be considered a substitute for plastic repair, but in certain circumstances, it may be an alternative [5].

Changing era in maxillofacial prosthetics

The field of maxillofacial prosthetics is embracing the rapid explosion of technology. The use of ossoeointegrated implants has broadened the treatment options. New technologies offer standardized quality, excellent precision of fit and outstanding biocompatibility, combined with adequate mechanical strength and provision for esthetic design. Success of implants is based on precise preoperative planning of the implant placement and the restoration. Modern three-dimensional (3D) imaging techniques such as digital volume tomography allow the acquisition of radiologic data with very low levels of radiation and excellent image accuracy and allow the processing of these data with various types of software application. It is possible to predetermine the precise 3-D position of the planned implant before the actual insertion of implant and thus enhance the placement process. Treatment planned in this way is fast, minimally invasive and predictable. This increases the quality of surgical procedure and restoration [6]. The advent and increasing availability of cone beam computerized tomography (CBCT) and 3-D digital imaging machines makes it easier, timely and less costly to obtain images [7] C.T. images are extremely useful as a visualization and diagnostic tool. The use of CT also allows for the discovery of other lesions of head and neck not visible by older imaging technique. Magnetic Resonance Imaging (MRI) is another technology, which is more sensitive than CT; showing the difference between soft tissue types and is a useful tool for detecting the early stages of abnormalities in soft tissues.

The introduction of laser technology, 3-D computer aided designing (3-D-CAD) and computer aided manufacturing (CAM) also known as rapid prototyping (RP) or free form fabrication has revolutionalized the field of maxillofacial technology. CAD /CAM technologies are capable of alleviating most of the limitations of conventional techniques. With rapid prototyping, a life like prosthesis can be fabricated. CAD/CAM technology is changing the restorative quality and concepts of the future. Hopefully the cost for using these technologies in maxillofacial prostheses will drop with time for wider utilization [8].

Biological improvements and the regenerative possibilities for regaining lost bone have shown continued advancement in the use of growth factor and bone proteins including recombinant bone morphogenetic protein and helping the clinician's ability to provide bone for accurate implant placement. Color matching of facial prosthetic elastomers to skin color with portable spectrophotometer and computerized color formulation has been developed and has achieved clinical success. Peek framework light weight prosthesis is into trends now [9].

Tissue engineering has been considered as a possible solution to replace complex reconstructive methods. But, it has been hampered by the lack of adequate vascularisation of the engineered constructs and the lack of clinically usable methods of engineering the constructs. Good manufacturing practices in cell culture and seeding have been available and have been reported [10] to be used successfully in reconstructing segmental mandibular and maxillary defects. The autologous cells are handled and prepared without animal-derived material in good manufacturing practice (GMP) standard clean rooms; the cells can be considered safe for clinical cell therapy applications [11]. For the first time described a novel method of maxillary reconstruction using tissue engineering methods. In a case of maxillectomy for a keratocyst, they harvested abdominal and adipose tissue stem cells. These cells were then isolated and expanded under GMP facilities without contamination. After 17 days, a titanium cage was inserted, filling it with mixture of auto ASCs, beta-tricalcium phosphate and bone

morphogenetic protein-into the rectus abdominis flap area. After 8 months of follow-up, the flap had developed mature bone structures and vasculature. This was then transplanted into the defect. After the flap was settled, dental implants were successfully placed into the reconstruction. This method combined the use of the tissue engineering methods and utilized the microsurgical carrier for revascularising the construct. The computer-aided design for prefabricating the tray, which at present has been changed to biodegradable materials. The anterolateral thigh flap with the vastus lateralis is the preferred carrier for the construct now.

DISCUSSION

The maxillofacial prosthetic treatment is not a substitute for plastic and reconstructive surgery, in certain circumstances it may be an alternative. Certain patients may simply not be good candidates for plastic surgery because of their advanced age, poor health, very large deformity, or poor blood supply to irradiated tissue. Moreover, maxillofacial prosthetic treatment is indicated when anatomical parts of the head and neck are not replaceable by living tissue, when recurrence of malignancy is likely, when radiotherapy is being administered, or when fragments of facial bones are severely displaced in a fracture. A temporary prosthesis may cover a defect when plastic surgery repair requires many steps, and speech appliances may be used when surgery is considered no advantageous for the closure of a cleft palate [12]. Surgically reconstructed sites also require maxillofacial prosthetic treatment with or without implants. As maxillofacial prosthetic training and materials continue to improve, and as implants become more and more important to facial rehabilitation, the maxillofacial prosthodontist and maxillofacial prosthetist become ever more important. Moreover, their contribution is often of the longest duration. During the 2–4 years, they may be working with a patient, they are the ones who often develop the closest relationships with the patient, and become even more important to the medical center team [13].

FUTURE VISION

If the bridge between the existing chasm between oncology and rehabilitation has to be crossed several important challenges remains to be solved. Those challenges include 1) a paucity of outcome evaluation metrics 2) underdevelopment of the evidence base for cancer rehabilitation 3) the need for workforce development and 4) the absence of a health policy framework for cancer rehabilitation to support optimal service delivery, access to care and reimbursement [9]. Outcome is a major factor dictating treatment decisions and funding allocation.

Quality of life outcome is equally important as survival rates. Those conducting research must ensure that evidence based research has its application to evidence based clinical practices. The reluctance to accept new treatment in clinical practice is a result of lack of adequate evidence. There is a need for transformation of educational programs. Core curriculum or competencies for cancer rehabilitation needs to be revised [10]. The technological advancement as well as public demand for professionals accountability has increased the need for continuing and accessible education and specialized training for the professionals working with head and neck cancer patients.

Interesting challenges are provided by robotics in the development of active prosthesis [11] such as blinking and moving eye. Exciting developments in tissue engineering is likely to change the methods of reconstruction of tissue defects in the future [14]. Tissue engineering involves regeneration of new tissue with biologic mediators or scaffold. Success of tissue engineering depends on the effective participation of three components-scaffolds, signaling molecules and cells. Newer Scaffold materials with improved mechanical properties to provide tissue morphology and enhanced chemical properties to serve, as a bio-molecule carrier needs to be developed. Much research is being carried out in the field of muscular and neural tissue regeneration, which may have an impact in orofacial reconstruction in the future [15].

Developing patient centered rehabilitation models, proposing evidence based guidelines through co-ordinated efforts of interdisciplinary teams should be on the agenda. Health policies to improve rehabilitation outcomes during and post-surgical cancer treatment will be beneficial in rendering quality services to the cancer patient. Restoration with prosthesis is less expensive than plastic and reconstructive surgery. Innovations in digital technology can be time saving and more precise but presently at significant cost for maxillofacial prosthesis. The investment in this technology should be based on subjective and objective assessment in terms of quantity and quality of outcome [16]. Algorithm for defects and reconstruction can be found elsewhere in the published literature [17, 18].

CONCLUSION

The role of a maxillofacial prosthodontist in the treatment of facial defects cannot be underestimated. A multidisciplinary approach is required during the rehabilitation procedure to bring out effective results. Maxillofacial prostheses limit the patient's disability and improve function. These prostheses are inevitable in restoring the general and psychological health of the patients.

REFERENCES

1. Parr, G. R., & Gardner, L. K. (2003). The evolution of the obturator framework design. *The Journal of prosthetic dentistry*, *89*(6), 608-610.
2. Bulbulian, A. H. (1965). Maxillofacial prosthetics: Evolution and practical application in-patient

rehabilitation. *The Journal of prosthetic dentistry*, *15*(3), 554-569.
3. Platt, J. H. (1947). The history and principles of obturator design. *J Speech Disord*, *12*, 111-23.
4. Chalian, V. A., Drane, J. B., & Standish, S. M. (1972). *Maxillofacial prosthetics: multidisciplinary practice*. Williams & Wilkins Company.
5. O'Fearraigh, P. (2010). Review of methods used in the reconstruction and rehabilitation of the maxillofacial region. *Journal of the Irish Dental Association*.
6. Dingman, C., Hegedus, P. D., Likes, C., McDowell, P., McCarthy, E., & Zwilling, C. (2008). A coordinated, multidisciplinary approach to caring for the patient with head and neck cancer. *The journal of supportive oncology*, *6*(3), 125-131.
7. Jacob, R. F. (2000). Clinical management of the edentulous maxillectomy patient. *Clinical maxillofacial prosthetics. Chicago: Quintessence*, 85-7.
8. Marquardt, P., Witkowski, S., & Strub, J. (2007). Three-dimensional navigation in implant dentistry. *European Journal of Esthetic Dentistry*, *2*(1).
9. Hubálková, H., Holakovský, J., Brázda, F., Diblik, P., & Mazanek, J. (2010). Team approach in treatment of extensive maxillofacial defects–Five case report serie. *Prague Med Rep*, *111*(2), 148-57.
10. Sándor, G. K., Tuovinen, V. J., Wolff, J., Patrikoski, M., Jokinen, J., Nieminen, E., & Miettinen, S. (2013). Adipose stem cell tissue–engineered construct used to treat large anterior mandibular defect: a case report and review of the clinical application of good manufacturing practice–level adipose stem cells for bone regeneration. *Journal of Oral and Maxillofacial Surgery*, *71*(5), 938-950.
11. Mesimäki, K., Lindroos, B., Törnwall, J., Mauno, J., Lindqvist, C., Kontio, R., & Suuronen, R. (2009). Novel maxillary reconstruction with ectopic bone formation by GMP adipose stem cells. *International journal of oral and maxillofacial surgery*, *38*(3), 201-209.
12. Kuriakose, M. A., Sharma, M., & Iyer, S. (2007). Recent advances and controversies in head and neck reconstructive surgery. *Indian Journal of Plastic Surgery*, *40*(12), 3.
13. Lemon, J. C., Kiat-amnuay, S., Gettleman, L., Martin, J. W., & Chambers, M. S. (2005). Facial prosthetic rehabilitation: preprosthetic surgical techniques and biomaterials. *Current opinion in otolaryngology & Head and Neck Surgery*, *13*(4), 255-262.
14. Wallace, C. G., & Wei, F. C. (2008). The current status, evolution and future of facial reconstruction. *Chang Gung Med J*, *31*(5), 441-7.
15. Wolfaardt, J., Sugar, A., & Wilkes, G. (2003). Advanced technology and the future of facial prosthetics in head and neck reconstruction. *International journal of oral and maxillofacial surgery*, *32*(2), 121-123.
16. Khan, Z., & Farman, A. G. (2006). The prosthodontist's role in head and neck cancer and Introduction-Oncologic dentistry. *The Journal of Indian Prosthodontic Society*, *6*(1), 4.
17. Ahila, S. C., & Jagdish, S. K. (2018). Adjuvant therapy for intra oral surgical oncological defect with ancillary prosthesis: A literature review. *Journal of cancer research and therapeutics*, *14*(2), 255.
18. Parr, G. R., & Gardner, L. K. (2003). The evolution of the obturator framework design. *The Journal of prosthetic dentistry*, *89*(6), 608-610.