



Uses of Digital Technologies for Maxillofacial Prosthesis Manufacturing Review article

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استخدام التقنيات الرقمية في تصنيع أطقم الأسنان الوجه والفكين

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Abstract

Digital technologies play a great role in prosthodontics generally and specifically in maxillofacial prosthetics, this revolutionary approach has become an important way for rehabilitation of different modalities in maxillofacial prosthetic field. In this article we will summarize many contents of dental researches, web researches, on-line data bases, discussions of experts and clinicians with the most recent publications and new products releases and evaluate them. Describing the techniques in designing and fabrication for facial prosthesis applying computer aided method and manufacturing (CAD/CAM). As the development of digital dentistry took apart to overcome complexity of prosthesis construction and the limited expertise in specialized centers, maxillofacial defect patients seem to be deprived of appropriate prosthetic rehabilitation. Digitally designed facial prosthesis models show many advantages related to aesthetic, retention, and ease of use and more acceptable by patients.

Keywords: Maxillofacial Dentistry, Digital Dentistry, Facial Prosthesis, CAD CAM



المستخلص

تلعب التقنيات الرقمية دورًا هامًا في مجال طب الأسنان التعويضي، بشكل عام، وفي قسم طب أسنان الوجه والفكين بشكل خاص. وقد أصبح هذا النهج الثوري وسيلة مهمة لإعادة تأهيل مختلف الحالات في مجال طب الأسنان التعويضي. سنلخص في هذه المقالة العديد من محتويات أبحاث طب الأسنان، والبحوث على الإنترنت، وقواعد البيانات الإلكترونية، ومناقشات الخبراء والأطباء مع أحدث المنشورات والمنتجات الجديدة، ونقيّمها باستخدام تقنيات تصميم وتصنيع أطقم الأسنان للوجه والفكين (CAD/CAM) ومع تطور طب الأسنان الرقمي، الذي ساهم في التغلب على صعوبات بناء أطقم الأسنان ومحدودية الخبرة في المراكز المتخصصة، حيث أن مرضى عيوب الوجه والفكين يحتاجون إلى إعادة تأهيل أطقم الأسنان بشكل مناسب. لقد اظهرت نماذج أطقم الأسنان الوجه والفكين المصممة رقميًا العديد من المزايا المتعلقة بالجمال، والثبات، وسهولة الاستخدام، كما أنها أكثر قبولًا لدى المرضى.

الكلمات المفتاحية: طب اسنان الوجه والفكين، طب الأسنان الرقمي، أطقم الأسنان التعويضية، تقنية الحاسوب (CAD/CAM)



Introduction

Repairing and reforming of maxillofacial prosthesis is aim to rehabilitate and regain aesthetic, speech and function to people having maxillofacial defects either by fixed or removable appliances. Though there is many variations in the range of maxillofacial prosthetic according to the defect size and location, it's still categorized as maxillofacial (maxillary and mandibular) prosthesis, while for facial prosthetic rehabilitation that includes (auricular, nasal, facial, ocular, and orbital prostheses as well as craniofacial implant production)¹⁻³. The traditional process for repairing maxillofacial prosthesis including taking an impression for the defect site, then proceeding to stone model and wax pattern to have the permanent final shape made of either acrylic or metal, with all these conventional work steps there is a considerable participation by human and material consumption and this showed a chance for errors, inexactness prosthesis, beside of time consuming, and additional cost⁴⁻⁶. The revolutionary effect of digital technologies in general and for maxillofacial prosthesis in specific has encouraged us to study and evaluate this fundamental path concerning facial prosthesis court^{4, 7}. Now a days in many developing countries the need for specialized centers which should be with unlimited expertise is essential to overcome the complications of maxillofacial prosthesis making and ensure that patient should have a proper prosthesis rehabilitation^{8, 9}. Accordingly involved human and submitting to the digitalized fabricating techniques which will facilitate and develop productivity of facial prosthesis^{8, 10, 11}. This article will display the role of digital system with participation of maxillofacial prosthesis to produce more satisfied future model by employing variable digital technologies.



Maxillofacial Prosthetics

Maxillofacial prosthesis is that department of prosthetics that attentive about replacement and rebuilding of craniofacial body with prosthetic appliance that considered as one of the confronts in the dental area which should deal with many deficiencies in head and neck parts whether congenital or acquired¹². The etiology of these defects is numerous according to its location and how it is behave in such area that may fellow a cancer, trauma, infection or burn causes and treatment will be according to treatment stage either repairing or curative devices such as surgical devices and radiological devices^{1, 13}. These treatment appliances can be divided into two main divisions; facial prosthesis which include any extra oral deficiency in the head and neck regions that contain orbital, nasal, ocular, and facial skin defects. The other group contains appliances that rehabilitate all intra oral defects including maxilla, mandible, and related soft tissue structures like tongue, soft palate and floor of mouth disorderes^{14, 15} Fig (1).

Mandibular defects can be reestablishing functionally and aesthetically by removable and/or fixed prosthetic appliances to fix the deviation in opening and closing, and related alteration in occlusion seen in the affected side. Sometimes such defects may involve tongue defects like glossectomy which apparently affect speech and swallowing^{1, 16}. Maxillary disorder can also be treated with such obturator prosthetic devices for either small and large defects and may include even palatal lift prosthesis in cases of soft palate defects^{16, 17}. For rehabilitation of facial defects include using of silicon material to restore them and even may include use of magnates or facial implants for more retention means; this covers all orbital defects with



eyelashes, some treatment options use eye glasses for fixation.^{18,19} nasal prosthesis are used to treat partial or total nasal defects and sometimes may even include rehabilitation of corresponding cheek and upper lip soft tissue disorders and this reflect the fact that nose is important as it locate in the center of face^{20,21}.

Auricular defect can be repaired by ocular appliance to give excellent aesthetic results^{10, 21}.

All these types of treatment and repair of maxillofacial prosthetics have been developed all over time, they registered an advance approach in such therapy procedures concerning many newly progressive techniques with less time consuming, highly specialized laboratory and clinical skills, less no. of patient clinical attending, and more experience for individual training²².

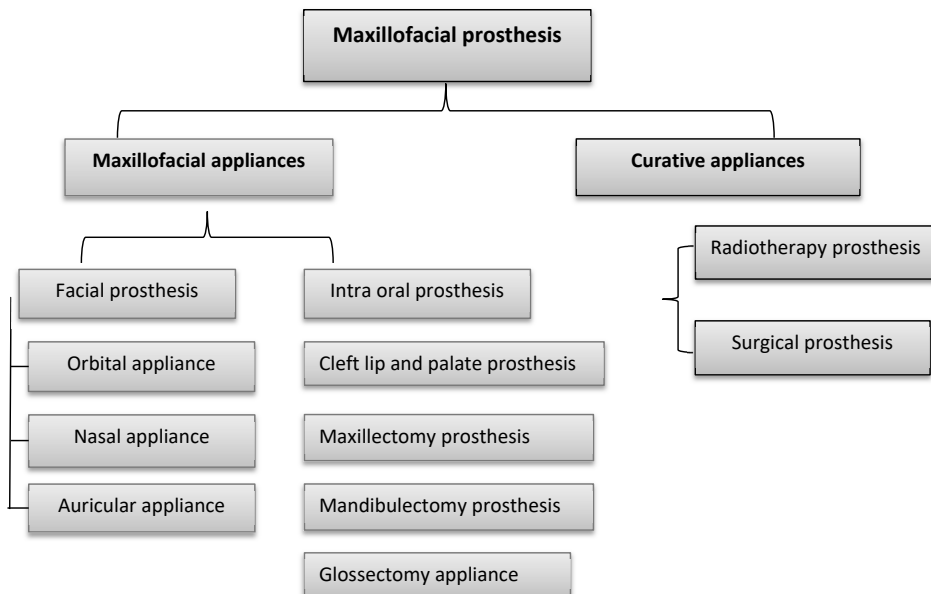


Fig.1 Descriptive chart representing maxillofacial prosthesis range.



CAD CAM Technology for Prosthodontics

The rising of CAD CAM mechanisms has developed in prosthodontics and more chiefly in maxillofacial apparatus. Digital prosthetic reforming is becoming an important oncoming for maxillofacial prosthetic branch. Most recent maxillofacial studies converging on using the newly advanced technologies for making and designing these prosthetic appliances^{23, 24}. In digital maxillofacial prosthesis there are three important procedures to be considered; digitalization (visualization), designing and modeling, and making (processing). All these steps include using many forms of computer aids like intraoral scanner, optical scan system, computed tomography (CT), and magnetic resonance images (MRI)^{1, 25}.

The advantage of using such digitalizing systems is to get a clear photograph so the distortion that may occurs with the conventional impression techniques can be eliminated that data can be collected without need to touch the dental and facial tissues and consequently having successful maxillofacial models with tissue adaptation and good contour.²⁶ according to the type of data cons-questing, CT or MRI photos, and any other digital imaging modeling process will develop, and these data group will be an easily information exchange tool between employers. Standard transformation language (STL) data can be saved according to the American Standard Code for Information Interchange (ASCII) and binary.¹ designing process can use many special software programs for various maxillofacial prosthetic restorations which contain an inclusive tool to erode prosthesis anatomical details and distortions of virtual clay model into any form desired^{26, 27}. The final make-up is constantly available for user update, and can be documented for evaluation and recheck defect model and fitness before manufacturing.



Rapid prototyping techniques have been used in digitized maxillofacial prosthetic production. The unique characteristic of RP is that, models and/or prostheses are produced by adding material from the main source layer by layer to form a 3D model in which all the layers are bound together.^{28, 29} physicians through this technique can get information about fine inner details of difficult structures and undercut areas so this will efficiently employ the production on facial prosthesis with practical steps²⁹.

Matrix using has takeoff the conventional process and makes prosthesis in shorter time and phases, this mold can be used for numerous prosthetic duplication. This long-term mold allow multiple pouring time³⁰.

Implication of Internet Multimedia

It's an application developed in relation to time importance, provide resolution to health-related problems using collective path. To achieve comprehensible communication there should be joining of high quality patient data shared over internet between many institutions at many places over world. In medical implication there is definite need for secure data and information partnership to explore different aspect of the case in real time manner, and that's sometimes inflexible due to different time zone^{7, 31}.

Real time high quality digital data submission is an important characteristic in maxillofacial prosthetic repair, and with all digital aided equipment still the voice communication is an essential achievement as source of references³¹.

Sharing patient's data need a secure database to preserve patient's details and information within working organized schedule; this include using of both video/audio internet based tool consist of sharing screens,



photos and files of any size. The other tool is concurrent/ asynchronous technique which is more advanced one; it requires the practitioners working on common tasks to remotely share computer display workspaces simultaneously, without leaving their workplaces^{32, 33}.

Future Sample Cooperation How will be?

Maxillofacial prosthesis cooperation effectiveness in many developing countries has been extended recently, sample of upcoming include pattern of effective network in perseverance sharing of data. This proposed model will simplify collaborative work on maxillofacial prosthetic different situations through real time high fineness digital information delivery and bring such data for sharing work table and enable navigation of its content³⁴.

The main goal of developing such future sample is to facilitate collaboration between different dental and maxillofacial clinic and centers to provide the required data concerning patients with maxillofacial defects by using various digital technologies; CT, digital photography, and 3D photogrammetry equipment to share information through effective network^{34, 35}. Prosthesis then can be designed and fabricated from 3D modeling and 3D RP technology, it would be possible to give some guidance and instructions during prosthetic insertion with many consultations³⁶.

Conclusion

Digital tools and applications are now widespread in routine dental care. Therefore, this trend towards digitization and outstanding developments must be considered in dental curricula generally and maxillofacial rehabilitation in specific way. In order to provide the new generation of



dentists for their daily work-life. There is a need to establish generally accepted digital standards of education—at least among the different dental universities within individual countries. Digitalization present the prospect to revolutionize the entire field of dental education which will arise that motivation and provide a stimulating, enjoyable, and meaningful educational experiment with proper outlet 24 h a day.



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