Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies ***NLM ID:*** *101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Index Copernicus value = 85.10

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Review Article

Role of Stereolithography in Orthognathic Surgery

Dr. Faisal Mohiuddin Ansari[1], Dr.Sankara Rao Sanaka[2], Dr. Rahul Anand[3], Dr. Rahul VC Tiwari[4], Dr. Sunil Kumar Gulia[5], Dr. Heena Tiwari[6]

1. MDS, Department of Orthodontics and Dentofacial Orthopedic, Assistant Professor , Govt Dental College and Hospital, Afzal gunj , Hyderabad
2. MDS, Consultant Oral and Maxillofacial Surgeon, Vijaya Santhoshi Dental Clinic, Kakinada, Andhra Pradesh
3. Senior Lecturer, Dept of OMFS, Shri. Yashwantrao Chavan Memorial Medical & Rural Development Foundation's Dental College & Hospital, MIDC, Ahmednagar, Maharashtra.
4. OMFS, FOGS, PhD Scholar, Dept of OMFS, Narsinbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar, Gujarat.
5. Senior Lecturer, Oral and maxillofacial Surgery, SGT University, Gurugram, Badli, Jhajjar, Haryana
6. BDS, PGDHHM, Ex-Government Dental Surgeon, Kondagaon, Chhattisgarh, India.

***ABSTRACT*:**
Advancements in the digital imaging systems combined with the availability to register the CBCT data along with the digital models had made possible in the fabrication of orthognathic surgery,customized brackets, CAD/CAM designed splints and indirect bonding systems. Thereby, stereolithography is used in a wide range of dentistry which thus helps in creating the asymmetries, coating, fabricating and land marking the synthetic mandible. The present review article describes about stereo lithography and also its application in various fields of orthognathic surgery.
Key words: Orthognathic Surgery, Stereolithographic models, 3-d models.

Received: 02/06/2020 **Modified:** 20/07/2020 **Accepted:** 24/07/2020

Corresponding Author: Dr Faisal Mohiuddin Ansari, MDS, Department of Orthodontics and Dentofacial Orthopedic, Assistant Professor , Govt Dental College and Hospital, Afzal gunj , Hyderabad

This article may be cited as: Ansari FM, Sanaka SR, Anand R, Tiwari RVC, Gulia SK, Tiwari H. Role of Stereolithography in Orthognathic Surgery J Adv Med Dent Scie Res 2020;8(9):57-59.

INTRODUCTION:

With the advancements in digital technology as well as in the imaging over the last 25 years have permitted the implementation of three-dimensional (3D) modeling protocols in dentistry. Use of stereolithographic models has gradually replaced the traditional milled models and the x-rays in management of the craniofacial anomalies as well as in the implant rehabilitation. Various advantages include more precise,better visualization of complex anatomical structures and also sophisticated pre-surgical planning by a simulated insight of the procedures to be done. The present review aims to provide an essential information about the different applications of stereolithography in the orthognathic fields.The facial soft tissues, cartilage & bone skeleton and dentition are the three important anatomical groups which play a decisive role in planning for the orthodontic therapy as well as orthognathic surgery. Moreover, it is also required to develop a correct recording and also the replication of an accurate position of maxilla-mandible as well as their orientation in relation to the skull. Conventionally, these challenges

in the diagnosis have been approached by the manual or digital tracings based on the cephalometric radiographs, also in the combination with photograph assisted systems. [1]For various complex cases of orthognathic surgery, a careful pre-operative assessment of the interdependence of different tissues is necessary, and thereby, the stereolithographic methods that integrate the digital dental casts are available in order to display the facial skeleton and also the dentition, hence, providing an improved visualization of these structures. [2,3] Three dimensional physical models are quite accurate and also anatomical replicas for analysis,, treatment planning,long-term follow up and documentation; furthermore,these models are also useful for developing as well as for teaching the surgical and orthodontics protocols. Moreover, the different purposes that can be achieved primarily are: giving the patient an idea of the outcome, leading the treatment to a desired result, serving as a communication tool among the Orthodontist, Surgeon and other specialists as well as the patient.

Application of Stereolithography in Orthognathic Surgery

In diagnosis: The stereolithography renders the diagnostic information analogous to caliper measurements with varying agreement limits. It also showed the least mean biases when the virtual models are scanned. The e-models and virtual scanned models showed a strong surface correlation which showed that it could be used interchangeably.[3]

In distraction osteogenesis: Mandibular midline distraction osteogenesis is available as a treatment optionfor the procedures like mandibular transverse arch deficiency. By this technique the surgeon can predict the amount of the transverse expansion that can be gained which was presented by the model study technique. With the use of the three-dimensional stereo lithography model measurements, the mandibular cast is mounted on a semi adjustable articulator. [4] Fabrication of acrylic straps were done which relate the condylar elements of articulator to the right and also the left mandibular dental segments. At the midline, the mandibular cast is sectioned the hemi-mandibular segments are rotated laterally until the desired midline expansion is achieved, in the new position the mandibular model is luted. Thereby, it renders the valuable information to surgeon and also orthodontist about the post expansion relationship of the maxillary as well as the mandibular arch.[5] This also helps for the in vitro planning of new protocols of various processes and surgical techniques for their accuracy for distraction osteogenesis in mandible.[3, 4, 5]

In mini implant placement: Stereolithography can be made as a surgical guidefor accurate placement of mini implant. The surgical guide was easily placed intra orally which was accurate, simple and also led to a rapid placement of the mini implant.[6]

In milling models of orthodontics surgical treatment of dysgnathia: The diagnosis of various craniofacial disharmonies is made by the three-dimensional realization of CT by the models produced by milling machine and also stereolithographic. Three dimensional milling models were used in order to verify the results of operations involving the sagittal splitting of mandible. This manifested remarkable changes in the condylar position and also the anatomy after the sagittal splitting of mandible.[7]

In manufacture of occlusal splints/ oral removable appliance: The manufacture of the occlusal splints by digital process is evaluated.Modern digital technology enables us to manufacture the clinically functional occlusal splints which minimizes the dental technicians time,chair side time and also the cost. [8]Thiswas made by taking an alginate impression of upper and lower jaws of a patient with temporomandibular disorder, owing to cross bite and were of teeth, and then digitalized by table laser scanner. The scanned model was repaired using the 3data expert software, and a splint was designed with viscam rp software. With the help of stereo lithography, a splint was manufactured from a biocompatible liquid photopolymer. The splint was supposed to be worn nightly for six months and the patient adapted well to the splint and found it very comfortable to use. The tension on the patient bite muscle was relieved by the splint. After six months of testing, no sign of tooth wear or significant splint wear was detected.[9]

DISCUSSION:

The stereolithography offers the clinician a 3Dsolid model for the analysis of various maxillofacial anomalies from numerous observation aspects. Spatial realism and the tactile abilities of model afford a multi sensorial approach in regard to surgical procedure or the implant placement,without the surgeon even meeting the patient.[10] This digital system provides a clearer panoramic view by delineating the anatomical site of interest and the surrounding tissues by the combination of selective coloring of some of the structures: thereby it is of great use for the surgical simulation in order to facilitate the anatomic reduction and also diminish the operation invasiveness as well as the time, such as, in instances such as the tumor ablation reconstruction.[11] The stereolithography is also usedin order to determine the location, dimensions and also the form of the osteotomies, grafts, implants, fixation devices etc .[11]

Certain disadvantages of the stereolithography are the high cost of manufacturing thephysical modelas well as the increased radiation exposure from the CT scan. However, this technology has been proven to be an effective adjunct for the diagnosis,planning, and thereby treating the various craniofacial anomalies and can also be used for placing as well as restoring the implants by use of the surgical guides. The general dentists should also possess a fundamental knowledge as a part of their upgrade process and also should be acquainted with the basics about the applications as well as the advantages of the new 3-D modeling technologies used in dentistry, like those of the stereolithography, an exceptional tool for support in designing the surgical treatment and also for implant placement. [12] Since the stereolithography evaluates and becoming more accessible in terms of the cost, it should be comprised of a more common technology among the general dentists for obtaining a better surgical as well as the restorative results and obviously should be in favor of the patients.

CONCLUSION:

With the advancement and availability of 3-dimensional dental model scanning technology provides a new and novel method that can be applied in various fields of dentistry which are relatively easy. These technologies are used for evaluation which are of great use for the treatment as well as it also helps in comparing the pre and post treatment plans. The models can be saved and exported and moreover, it can be converted to fabricate at the same time which is time consuming. Thereby, the advancement in the 3-dimensional technology is a boon and it must be utilized in an appropriate method.

REFERENCES:

1. Sukanya .D. “Application of stereo lithography in orthodontics –a review.” IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), 19(5), 2020, pp. 09-13.
2. Kwon SY, Kim Y, Ahn HW, Kim KB, Chung KR. Computer-aided designing and manufacturing of lingual fixed orthodontic appliance using 2D/3D registration software and rapid prototyping. International journal of dentistry. 2014;2014.
3. Akyalcin S, Dyer DJ, English JD, Sar C. Comparison of 3-dimensional dental models from different sources: diagnostic accuracy and surface registration analysis. American Journal of Orthodontics and Dentofacial Orthopedics. 2013 Dec 1;144(6):831-7.
4. Hourfar J, Kanavakis G, Goellner P, Ludwig B. Fully customized placement of orthodontic miniplates: a novel clinical technique. Head & face medicine. 2014 Dec 1;10(1):14.
5. Ercoli F, Tepedino M, Parziale V, Luzi C. A comparative study of two different clear aligner systems. Progress in orthodontics. 2014 Dec;15(1):1-5.
6. Russett S, Major P, Carey J, Toogood R, Boulanger P. An experimental method for stereolithic mandible fabrication and image preparation. The open biomedical engineering journal. 2007;1:4.
7. Guo, Q.Y., Zhang, S.J., Liu, H., Wang, C.L., Wei, F.L., Lv, T., Wang, N.N. and Liu, D.X., 2011. Three-dimensional evaluation of upper anterior alveolar bone dehiscence after incisor retraction and intrusion in adult patients with bimaxillary protrusion malocclusion. Journal of Zhejiang University SCIENCE B, 12(12), pp.990-997.
8. Salmi M, Tuomi J, Sirkkanen R, Ingman T, Mäkitie A. Rapid tooling method for soft customized removable oral appliances. The open dentistry journal. 2012;6:85.
9. Ren C, Li X, Wang Z, Wang H, Bai Y. Measurement of orthodontic forces exerted on the upper right central incisor with the increase of the distance of tooth movement and thickness of the aligner. Zhonghuakouqiangyixue za zhi= Zhonghuakouqiangyixuezazhi= Chinese journal of stomatology. 2014 Mar;49(3):177-9.
10. Salmi M, Paloheimo KS, Tuomi J, Ingman T, Mäkitie A. A digital process for additive manufacturing of occlusal splints: a clinical pilot study. Journal of the Royal Society Interface. 2013 Jul 6;10(84).
11. Liu H, Liu DX, Wang G, Wang CL, Zhao Z. Accuracy of surgical positioning of orthodontic miniscrews with a computer-aided design and manufacturing template. American Journal of Orthodontics and Dentofacial Orthopedics. 2010 Jun 1;137(6):728-e1.
12. Kim SH, Kang JM, Choi B, Nelson G. Clinical application of a stereolithographic surgical guide for simple positioning of orthodontic mini-implants. World journal of orthodontics. 2008 Dec 1;9(4).