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Digitization in Prosthodontics: A Revolutionary Change

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ABSTRACT

Technology is changing on daily basis, and digital dentistry is no exception. In the field of Prosthodontics, there is an imminent probability of using digital technology in subsequent years. Contemporary Prosthodontics is encountering a drastic transformation bypassing traditional clinical and laboratory procedures. The scope of digitization in prosthodontics is endless, not only in the clinical procedures but also in various lab procedures like digital radiography, CAD/CAM, digital shade selection, stereolithography, virtual articulators, digital face bows, dental software such as digital shade selection, smile designing, etc. In this article, various facets of prosthodontics are discussed, where digitization has altered the traditional procedures in terms of fabrication of prosthesis, diagnosis treatment planning and research and development.

Key words: *Digital prosthodontics, CAD/CAM, Virtual dentistry, Virtual articulators*

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INTRODUCTION

Development in any field is incomplete without technology. Technology has been continuously evolving and contributing to the change in society and making human life less complicated by saving time, effort, cost and also improving the quality. Digitization is the integration of equipment and devices which are computer-based to perform dental procedures rather than using traditional methods. The emergence of digital technologies has contributed a lot to dentistry. It secures that the patient shall receive the best treatment with the advantage of reduced chair-side time, patient comfort, better quality assurance, and minimized error potential [1].

The field of prosthodontics is experiencing a far-reaching transformation circumventing traditional clinical and laboratory procedures. A dental prosthesis can be delivered in a few hours when compared to the conventional method. The use of digital impression has eliminated. Predicaments such as choice of right impression material, its influential effect on elasticity, accuracy, dimensional stability, compatibility, and pouring casts with stone.

A virtual three-dimensional (3D) visualization is enabled for the registration of the maxillo-mandibular relationship which is not attainable when performed intraorally. A wide assembly of prosthodontic applications are present today and research is being carried out for more, some of them are as follows:

1. Digitalized Radiography
2. Computer-aided Designing /Computer Aided Manufacturing (CAD/CAM)
3. Shade selection
4. Digital smile designing
5. Virtual articulators and Digital facebow
6. Digital impressions
7. Dental material testing
8. Occlusal and TMJ analysis and diagnosis

DIGITALIZED RADIOGRAPHY

Digitalized radiography includes radio-visiography, orthopantomogram, cephalometrics, and cone beam computed tomography [2]. Radiography is essential for various treatment planning's such as in implants, abutment selection, etc. In implantology radiographs are used to evaluate bone quality, density, determining the number, size, and position of implants. A variety of advanced imaging modalities have been

recommended to assist the dentist in assessing potential sites for implants. Panoramic imaging is widely used, it is one of the earliest and non-invasive techniques for imaging. Through digital radiography, these images can be shared and stored whenever needed and also it reduces the patient's exposure to radiations.

Computer Aided Designing / Computer Aided Manufacturing

Computer-aided design (CAD) and computer-aided manufacturing (CAM) has become a vital part in of prosthodontics and is currently in use since 35 years. The CAD/CAM technology can be applied to fabricate inlays, onlays, fabrication of provisional restorations, veneers, crowns, fixed partial dentures, implant abutments, maxillofacial prosthesis, and full-mouth reconstructions [3]. It can be used both in clinics as well as in dental labs.

Every type of CAD/CAM system consists of three basic components:

1. Digitalization tool or scanner – Which converts the geometry into the digital data
2. Computer software -Processes this data
3. Production technology - Converts the data set into the desired product.

CAD-CAM prosthodontics use additive or subtractive technology for the fabrication of dental restorations. The subtractive technology has explored its avenues in the fabrication of complete dentures, post and cores, and cast metal and ceramic restorations [4]. One of the major constraints of the subtractive method is wastage of more material. To, overcome this limitation additive technology, 3D printing of polymers, and metal laser sintering are validated with obvious advantages.

DIGITAL SHADE SELECTION

The shade selection is a complicated procedure as it is based on the clinician's colour perception, experience, light conditions, tooth background, and the type of shade guide used [5], and due to this visual shade matching becomes a complex procedure where chances of errors are more. These days the traditional method of shade selection is being replaced by digital shade matching with shade selection devices such as colorimeters, spectrophotometers, and digital imaging devices which automatically match the shade.

When compared to visual shade selection, the digital shade selection is more convenient and provides a more accurate shade with realistic effect. It makes communication with the lab easy and reduces operator variability. Digital shade guides such as Vita easy shade/Shade scan and Clear match system (shade matching) are being used for easy shade matching and transfer to the laboratory [6]. Digital cameras and imaging systems are recent automatic shade selection devices that are based on the RGB color model camera that obtains red, green, and blue data is used to produce the color image.

Digital Smile Designing

Digital smile designing is a virtual mode that can assist in improving and predicting the aesthetic outcome by providing minute details about the patient (in extraoral and intraoral view) through the art of capturing images and videography [8]. It is a digital tool that can design and modify the smile of patients and help them to visualize the final outcome beforehand by creating a digital mock-up before the treatment actually starts. Its role in the planning of fixed partial dentures and implant esthetics including emergence profile has made it a promising tool for future dentists.

Advantages: It leads to the active participation of the patient for customization of their smile design which results in an esthetically driven, humanistic, and confident smile as expected by the patient [9]. Pre and post-treatment changes can also be assessed through the digital mode.

Limitations: 1. any insufficiency in documentation, may distort the reference image and may result in an incorrect diagnosis and planning.

2. Expensive as it is based upon complete digital workflow.
3. Training and handling for certain software are required which further increases time and cost.

VIRTUAL ARTICULATORS AND DIGITAL FACEBOW

The conventional articulators are being replaced and/or supplemented with computer-aided design/computer-aided manufacturing (CAD/CAM) systems. Using a virtual procedure, the maxillary digital cast is transferred to a virtual articulator using reverse engineering programs.[12] Digital workflow allows the dentist and the dental lab technician to work in a fully digital environment, and eliminates the need for mounting a stone cast on a mechanical articulator.[13] Digital approach provides a more quantifiable, repeatable, and reliable method of orienting maxillary arch from the patient directly to a virtual articulator [10].

Virtual interocclusal records are made and transferred to the virtual articulator .The basic advantage of virtual interocclusal records is that it generates a universal virtual facebow, which works with any type of virtual articulator [1]. This procedure results in creating a dental digital database so patient information

can be transferred to any machining or sintering center in the world, resulting in greater flexibility and autonomy. This technique generates a digital copy of the patient's face that is available throughout the diagnostic, planning, and treatment phases [11-13].

DIGITAL IMPRESSIONS

Traditional impression techniques have a variety of drawbacks, to overcome this there are various systems available for making digital impressions such as cerec systems, iTero system, True definition/mobile true definition, E4D denist system, and Lava Tm chairside scanner [14-16]. They are different from each other in terms of imaging principle, capture speed, light source, whether they need powder coating spray or not, scanning distance, hardware, and output file format. Digital impressions are less time-consuming, more accurate, and create less mess than the conventional technique [17-18].

Advantages

1. Better precision, consistency, and accuracy of the impression.
2. Unacceptable/ Underextended areas can be scanned again whereas in conventional impressions, the entire impression needs to be repeated.
3. Better visualization from all perspectives.
4. Restoration fit is more accurate when made from digital impressions.

DENTAL MATERIALS TESTING

The physical and the chemical properties of the dental materials can be tested digitally. Fine element analysis (FEA) technology has opened doors for the research field, and the quality of research has been enhanced. It is less consuming as many cycles can be repeated in the computerized software and the results can be easily obtained. Properties like stress transfer, Implant loading, Mechanical properties can be estimated using the FEA technology.

OCCLUSAL /TMJ ANALYSIS AND DIAGNOSIS

T Scan or Matscan allows the examination of the slightest occlusal interferences while studying the occlusal contacts and force generated by the teeth [19-20]. Digital occlusion analyses through T-scan and joint vibration analysis via jaw motion analyzer are giving a ray of hope in treating temporomandibular joint disorders with simplicity and predictability. Scanners record the force and bite of every tooth in contact, and then the software makes a simulation of the patient's occlusion during various functional and parafunctional movements.

T-scan system can accurately identify the location of premature occlusal contacts which are difficult to visualize by direct clinical observation, or with ink ribbon markings. It also enables the clinician to visualize the occlusal contacts during continuous mandibular movement and also provides functional information about occlusions such as occlusion time and Disclusion time [21]. For assessment of nocturnal bruxism, Bite strip which is an electromyographic device could be of great use. This device records electrical activity for up to 6 hours.

CONCLUSION

With the development in the field of Prosthodontics, Dental professionals must stay updated with the newfound technological advancement all around the world. A prosthodontist should judicially incorporate digital technology in their practice to meet the present-day needs of the patients and improve their practice with digital workflow. Digitalization not only decreases the chair side time, but it also provides advantages of patient compatibility, reduction in time , ease of preparation, reduction in errors, and better esthetics. Digitalization also helps in educating and motivating the patient for instance in smile designing software the result comes beforehand which motives the patient's, builds trust and saves time for further treatment. The judicious use of digitalization can propel the quality and efficiency of prosthodontic services to the next level.

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