Digital applications in prosthodontics: A review

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Abstract
The field of science and technology is ever changing and the scientific knowledge of prosthodontics is no exception. As a result of continual advancements in technology, new methods of production and state of art may be expected. Digital dentistry is more over an embodiment of equipments and devices which are computer based to perform dental procedures in place of conventional methods. The article reviews these various aspects of prosthodontics where digitilization has modified the conventional procedures.

Keywords: CAD/CAM, Digital scanning, Digitalization.

Introduction
Although conventional techniques in dental care have worked valuably for decades, for a simpler, faster, more accurate and more efficient workflow, there is a large possibilities in digital applications in the field of prosthodontics. The modern dental practice has countless options for preserving oral health and provides next to natural aesthetics with an increased approach, minimized treatment time, decreased error potential and better quality assurance. These reasons explain present day dentistry being called the Golden Age of Dentistry.

Wide array of digital applications are available and many more are being explored, some of them areas follows

1. Digital radiography
2. Intraoral imaging / Optical impression
3. Computer-aided design/computer-aided manufacturing (CAD/CAM)
4. Shade matching
5. Digital smile designing
6. Virtual articulators and digital facebows
7. Laser
8. Occlusion and temporomandibular joint (TMJ) analysis and diagnosis
9. Photography – extraoral and intraoral

Digital Radiography
The first digital radiography system came in 1987 called radiovisiography (RVG), launched by Dr. Francis Mouyen. A physicist and engineer Paul Suni created the charge-coupled device (CCD) image sensor technology that made the credit for providing to radiovisiography fantasies or medical and dental application goes to Dr. Francis Mouyen.[1]

A good treatment begins with the good diagnosis, and the dental X ray has been an important diagnostic tool from the beginning RVG is a combination of charged couple device and image sensor technology.

The advantages are as follows:

1. Lesser radiation (when following the ALARA principle)
2. Lesser time acquisition
3. Ease of storage and organization
4. Better image quality for easier reading and diagnosis, comparison, and subsequent viewing.

Cone-beam computed tomography
In 1972, G.N. Hounsfield made known computerized transverse axial scanning which led to introduction of computed tomography (CT) for all dental applications.

Indications in prosthodontics
1. Procedures pertaining to implant rehabilitation procedures.
2. Temporomandibular joint imaging
3. Maxillofacial prosthodontics –especially remodelling of extra oral defects.
4. Craniofacial and airway analysis - volumetric analysis & accurate visualization of the airway

Implant prosthodontics
Anatomic structures are easily viewed it permit exact measurement of distance, area, and volume[2].treatment planning for sinus lift and ridge augmentation, implant placement with or without a surgical guide.

Temporomandibular joint imaging
It facilitates easy measurement of the roof of the glenoid fossa along with its condylar head three dimensionally with greater visibility due to its precision.[3]

Maxillofacial prosthodontics
Three-dimensional virtual models of the patients face, bony structures and dentition can augment treatment planning of such individuals especially in the field of maxillofacial prosthodontics. The shape of the graft can be virtually planned and can also be positioned in the defect area creating a virtual reconstruction placement (if required) onto the graft can also be planned. Obturators can be milled using CAD/CAM units for cleft closures.[4]

Craniofacial and airway analysis
CBCT offers a three-dimensional presentation of the airway and its surrounding structures which makes volumetric analysis and accurate visualization of the airway possible.[5]

Optical Impression
Many oral scanners systems are available in the market today such as ED4, I Tero, Lava chair side oral scanners, CEREC AS, etc. These systems offer the dentist by allowing the design and milling in the office itself whereas after systems captures impressions which can be transferred to laboratory for fabrication. It is common for all systems can produce models distally thus producing prosthesis.[6,7]
The benefits of digital impression are as follows:
1. It improves precision, consistency and accuracy of the impression.
2. Visualization of preparation in all perspective to design the prosthesis.
3. Instant display and feedback for corrective procedures if necessary.

Computer Aided Design / Computer Aided Manufacturing
All CAD/CAM systems are composed of three computer-linked functional components although the difference exists between them with respect to data acquisition, restoration and design production.[8]

Initially CAD was based on "subtractive method," where as recent process involves ''additive manufacturing'' method such as rapid prototyping and selective laser sintering technologies or a combination of additive and subtractive.[9,10] (3M ESPE Lava Chairside, Oral Scanner C.O.S., CEREC AC, E4D Dentist, iTero).

The available advanced CAD/CAM systems can be divided into the following three groups based on their production methods.[11]

In office system
The prepared tooth is digitally scanned, restored chairside and insertion is done within one appointment.

In laboratory system
Physical impressions are made and scanned using CAD-CAM.

Centralized production
Captures digital impressions and data is send to the lab via internet.

Shade Matching
Visual shade matching is now being overrun with automatic shade selection devices such as colorimeters, spectrophotometers, and digital imaging devices. They produce more accurate shade with a near life effect, reduced operator variability and easy communication with the laboratory personnels.[12] (colorimeter, spectrophotometer, VITA easy shade compact).

Digital cameras and imaging systems are recent automatic shade selection devices. These are based on the RGB color model camera obtains red, green, and blue data that are used to produce the color image.

Digital Smile Designing
DSD is a multi used tool that can assist dentist in improving and understanding the aesthetic concerns and predictable acceptance by providing detailed examination of patients extraoral and intraoral through state of the art videography and technologically.

Advantages
Superiority of DSD protocol with respect to esthetics and diagnosis, communication, feedback patient management and education make it a viable alternative to conventional protocols.

Virtual Articulators and Digital Facebows
Now a days virtual facebows has substituted conventional facebow for relating the cast to an articulator[13] with more accuracy thus minimizing possible errors for effective treatment planning and execution.

Conventional methods are being replaced with virtual articulators with respect to simulation to jaw motion analyzer to design error free prosthesis.

Lasers
The laser is an acronym, which stands for "light amplification by stimulated emission of radiation.[14]."

Advantages
Patients will not have pain, it produces bloodless clean surgical field, best for apprehensive patients, can be done under minimal or no need of anesthesia, Patients will have minimal postoperative symptoms, Improves healing of the surgical wound and minimizes the risk of infection.

The applications of lasers in prosthodontics
Removable prosthodontics
Vestibuloplasty, Frenectomy, contouring of irregular ridge anatomy, removal of tori, etc.

Fixed prosthodontics
Crown lengthening procedures, soft tissue managements around abutments, tooth

Example
Er: YAG, CO2 laser, argon laser. Nd: YAG, diode preparation for veeners and full coverage crowns and bridges, removal of carious lesion and faulty composite restorations before placement of final restorations.

Implantology
Second stage uncovering and peri-implantitis.

Maxillofacial prosthetics
Extra oral defects.

Occlusion and Temporomandibular Joint Analysis and Diagnosis

Digital occlusion analyses through T-scan and joint vibration analysis via jaw motion analyzer and widen the new horizons in treating temporo mandibular joint disorders with simplicity and predictability.[15]

Jaw tracking devices (K6 Diagnostics) it is helpful in studying jaw movements and hence occlusion which may be a micro-trauma for temporomandibular disorder.[16]

BITE STRIPTM is an electromyographic device which can be helpful in record muscle activity for 6 hrs and it helps in assessing the nocturnal bruxism.[17]

Practice and Patient Record Management – Including Digital Patient Education

Practice and patient record management

Use of computer in each operatory and throughout the practice is prime requisite of practicing dentistry.[18,19]

Digital patient education

Digital dentistry is confronted with difficulties for dentist and technicians including patients majorly with high capital investments, lack of adequate knowledge about the usage.[19]

Importance and advantages of digital dentistry

Cost and time effective, predictable outcome, has better results when compared to earlier methods.

Challenges in dentistry

Digital dentistry brings many challenges for dentist and dental technicians as well as society.

As dentist's precision on the intraoral scanning technique improved, they also gain a better understanding of the complete process of digital dentistry and helps too close the gap between dentists and technicians.

Cost is a major limitations of most areas of digital dentistry because of higher capital investment generally needed to adapt new technology.

Maintaining a balance between simplicity, speed, and reliability

For ease of using digital applications manufacturing companies should come forward with simpler and easier workflow characteristics to help dental professionals along with cost factor on regular basis.

Conclusion

Digitalization is one of the most important parts of modern dentistry.mIf digitalization is implemented in clinical dentistry with proper knowledge, then it can increase the joy of practicing dentistry and better care for patients.

To achieve a fully digitalized workflow in dental care, prosthodontist should start using the digital techniques to the same large extent as the technicians. They should keep knowledge of all ongoing advancement in dentistry and use judicially in their practice to meet today's patient's needs and improve their own workflow.

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Conflict of Interest

None.

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