Review

Digital Impression

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Abstract :
The use of different impression materials is in vogue for last few years with a view of capturing more accurate dental impression, which in turn produces more accurate fitting restoration. For achieving this goal, one should have ample knowledge about the different physical and mechanical properties, as well as in different techniques with the most recent advances. In this review, we highlighted the impression material and recent updates on Digital Dentistry with the benefits which can be gained from this system by both Clinician and Dentist.

Key words: Polyvenyl siloxane, CAD-CAM.

Introduction :
Capturing an accurate dental impression is one of the most challenging steps in Dentistry. A meticulous impression is of paramount importance for a proper fit of permanent restoration. Today's Dentistry is exposed to a variety of dental materials. It is easy to take great impression if a Dentist chooses the proper tray, attains controlled bleeding and adequate retraction and proper impression material. Improper impression technique may result in retakes, resulting in extra time and cost, affects the patient's perception of dentist and his /her practice. Use of quality material and proper technique helps to ensure clinical success in one take.

Impression materials:
Different types of materials have been developed for use in Dentistry for last few years. The non-elastic materials include plaster, impression compound and zinc oxide eugenol paste impression material. The elastic ones include alginate, agar and rubber base.[1]

Dentists mainly focus on three main factors while working with rubber base: hydrophilicity, setting time and cost. Other physical and mechanical properties to consider are detail surface reproduction, dimensional stability, ease of removal, gypsum compatibility, elastic recovery, tear resistance, viscosity, complete conversion to a elastic solid, acceptable odor and taste, shelf life and having the capabilities of being poured multiple times while still maintaining accuracy.[2]

Digital impression (CAD-CAM):
With the introduction of digital impression technique computer aided designing and computer aided manufacturing (CAD-CAM), the conventional impression (non digital) is sometimes referred to as physical impression.[3] CAD involves the use of hardware and graphics software to generate design drawings, CAM is a system of automatically producing finished products by using computer controlled production machines.[4]

Process: Typically CAD-CAM restorations are milled from solid blocks of white composite resin or porcelain matching the shade of restored tooth (commercially available as VitaBlocks, in upto 15 shades, 6 sizes, 3 variants. It has been recognized as the most suitable silicate ceramic for the Sirona CAD-CAM System). After the tooth is prepared for the restoration, an image is taken. The image draws the data into a computer and proprietary software is used to create dental restoration which is carved out of a solid block of composite resin or porcelain. The resultant restoration then can be adjusted in the patient's mouth and bonded in place. Milling accuracies are typically accurate to 50 micrometers.[5]

Advantage of Digital Impression:

- It offers the patient, Clinician and laboratory Technologist a technique that are reproducible, accurate and allows for user friendly clinical procedure.
- CAD-CAM systems can digitally scan and create fixed restoration chairside.
- CAD-CAM can also capture chairside digital impression that can be sent to laboratory.
- Chairside CAD-CAM allows Clinician to provide same visit indirect fixed restoration that is accurate and esthetically pleasing.
- Chairside digital impression making allows for the creation of accurate models that can then be used for either traditional or CAD-CAM fabrication of restoration, involving less chairside time.
- In-office CAD-CAM does not require any communication with laboratory.
- CAD-CAM offers accuracy and speed, ability to indefinitely store the information captured without any material constraints.
- Quickly transfers the digital image from dental office to laboratory and vice-versa.
- The CEREC and E4D machines have the chairside milling systems along with capturing accurate digital impressions.
- Digital impression is advantageous for: i) patients who are gaggers and cannot tolerate impression material in mouth for several minutes, or ii) presence of tori or undercut which make removal of a traditional impression difficult or impossible without causing the patient discomfort/ or tearing the margins, iii) no need for infection control and iv) no concern about the compatibility of specific material with specific disinfectants.
- A clinician can choose between in-office technique (CEREC and E4D) or CAD-CAM technique that combines chairside digital impression making and laboratory fabrication of restoration, depending on the factors: chairside time required, use of a laboratory, laboratory communication, standardized quality control, complexity of the case, desirability of one visit treatment, and esthetic demand.
- The scanning can be used to generate models at a manufacturing centre or sent to individual laboratory.[3]
- These restorations contain no metal to block subsequent x-rays. Dentists are able to keep track of potential decay underneath a CAD-CAM restoration, whereas, conventional porcelain fused to metal (PFM) restoration blocks x-ray radiation.[6]

CAD-CAM system:

The E4D can be used for all fixed restoration except bridge and implant. It has two components:

1. Scanning unit: Scanner should be held at a specific distance above the tooth, aided by rubber stop on scanner head. E4D does not offer the opportunity to scan and digitally transfer the image to laboratory.
2. Milling unit.

Figure 1: E4D.

Figure 2: Cerec AC.

Figure 3: CAD-CAM milling machine.

Figure 4: LAVA COS.

Figure 6: Imaging of interocclusal clearance.

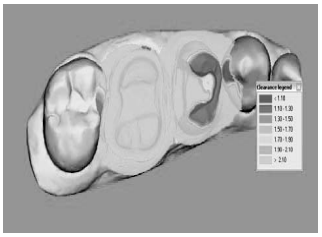

Figure 7: Highlighting of occlusion on preparation and adjacent teeth.

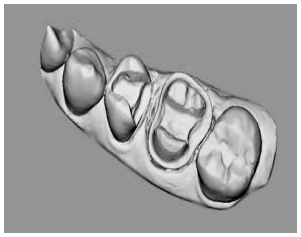

Figure 8: Margin delineation.

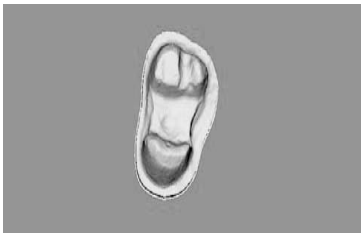

Figure 9: Virtual preparation die

CEREC AC (new):

E4D-

It offers the following facilities:

- In-office fabrication.
- Can send the digital image to laboratory with CEREC CONNECT, where restoration can be milled directly /or a model can be created for traditional fabrication of restoration. For this, laboratory has to have CEREC CONNECT.
- The CEREC MC XL milling centre can be used to create full contour crowns in 6 minutes. All types of indirect restoration can be created.

LAVA COS:

This system is for chairside digital impression making, can produce 2D or 3D images. Images can be transmitted directly to an authorized laboratory where the laboratory Technologist digitally mark the margin and sections the virtual model prior to sending this to manufacturers. In model fabrication center, an acrylic model is created using stereolithography (SLA). These models can be used for conventional laboratory technique or CAD-CAM restoration.

Figure 5: iTero Scanner over the occlusal surface of the preparation.

iTero:

The iTero chairside digital impression scanner utilizes parallel confocal imaging to captures 3D image of tooth surface, contours and gingival structure. The scanner has ability to capture the preparation for crown, bridge, inlay and onlay. After the images have been captured, the digital impression is transmitted to manufacturers' facility and to the selected dental laboratory. Manufacturer mills the model on a milling machine using a resin material. At the same time, the dental laboratory Technician can export the digital impression file to the CAD-CAM system and begin the fabrication of coping or full coverage restoration.[3]

Figure 10: VITABLOCK In-Ceram

Figure 11: Blocks of dental ceramic material used to create dental restorations.

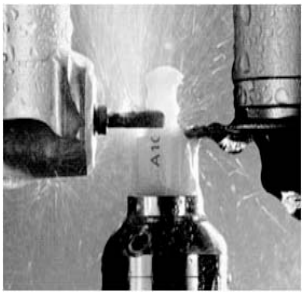

Figure 12: A milling machine located inside the dental office carves a restoration from a block of ceramic material.

Models from CAD-CAM system:

iTero- CAD-CAM resin (poly urethane) is not subjected to voids, shrinkage or expansion of materials or other defects. These models are strong and durable, resistant to abrasion or chipping.

LAVA COS- Creates model using SLA. This system provides a solid model and a working model.

CEREC AC- Also utilizes SLA.

The restoration: The next step is to choose a small block of matching dental ceramic material for milling the crown. After the material is chosen, it will take only minutes to make a fully restored tooth. The computer's digital design is transmitted to a milling machine that carves the crown from the block of ceramic in about five minutes.

After the milling is completed, fitting is checked, any necessary adjustment can be done right then and there. Several finishing tools can be used for refining such as 'wet look' surface gloss. Stain and glaze can be applied and fired in 12 minutes or less. Crown is physically bonded to prepared tooth restoring esthetics and function.[8]

Similarity with the conventional impression technique:

- CAD-CAM scanner requires a dry, visible field for scanning.
- Digital scanners can't see through any fluid or gingival tissue, have no ability to displace tissue close to margin.
- Accurate master die preparation needs capturing the complete restorative margin of the tooth or root surface just apical to margin.
- Absolutely needs a proper tissue management (soft tissue retraction and moisture control).

Advantage over conventional impression:

• Digital scanning takes less time than conventional impression, which increases the efficiency and productivity of dental office.

• The on screen image can be checked for margin visibility, preparation from and interocclusal clearance. Adjustment and isolated scanning is possible.

• Results are instantly visible and can be enlarged.

• Scanning takes 3 to 4 minutes, no material restriction, no risk of error due to distortion.[4]

Fig 13: Milling of model.

Fig 14: Resin model output from the milling machine.

Figure 16: Completed restoration.

Fig 17: Chrome-cobalt disc with bridges and crowns manufactured using WorkNC Dental CAD-CAM.

Software for CAD-CAM:

- CEREC software for manufacturing crowns, veneers, onlays and inlays, using different types of ceramic materials.
- Delcam dental solutions, for the design and manufacture of copings and bridge frameworks, including full crowns, abutments, dental bars, inlays /onlays and implant bridges.
- Renishaw plc.
- WorkNC Dental from Sescoi, CAD-CAM for automatic machining of prosthetic appliances, implants, bridges or dental structure.[7]

Conclusions:

Although the clinical history of Digital Dentistry started at 1980, it is being used in the advanced countries with advantage. The highly expensive CAD-CAM system CEREC AC with MCL Milling machine ranges approximately from 92,000 USD to 190,000 USD, thus limiting the use of it in general dental offices. On the context of Bangladesh, this system can be used centrally to avoid the inconveniences related to take accurate impression. The Clinician and Technologist should have sufficient knowledge and trained to operate and calibrate this system.

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