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Digital versus conventional impressions in dentistry- An overview

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Abstract

It is essential to take an impression of the oral cavity that replicates the surrounding hard dental and soft tissues accurately. Impressions made with the aid of polyether and vinyl polysiloxane impression materials are frequently used in contemporary prosthetic dentistry. Digital impressions save clinical time by omitting some of the steps of traditional impression techniques. Computer-aided design and manufacturing, or CAD/CAM technology has advanced quickly and become very well-liked.

Keywords

Conventional, dental, CAD / CAM, digital, impression,

Introduction

The accuracy of the dental impressions is crucial to a successful dental restoration. An impression is a negative copy or imprint of an oral structure. For a very long time in dentistry, taking impressions has been a crucial step in the creation of fixed prosthetic restorations like crowns, bridges, inlays, onlays, and implants as well as removable dentures.[1] Various impression techniques have been followed to generate a definitive cast that ensures accurate clinical fit of prosthesis. The accuracy of the impression greatly affects the final prosthesis' quality. The most popular method for recreating the intraoral anatomy and sending this data to the dental lab for the creation of indirect dental restorations is still conventional impression (CI) making with elastic impression materials. The demand for fixed prostheses is rising, and prosthodontics is now placing a significant emphasis on the production of fixed partial dentures (FPD) using intraoral digital impression (DI) techniques. [2]

To create a model that is as accurate as possible, it is crucial to choose an appropriate impression technique and the right materials. To produce duplications as accurately as possible, various impression techniques have been developed. The tools and methods used to create an impression both affect how accurate it will be. Each method has benefits and disadvantages of its own.[1]

Development of dental impression method

The first impression material, known as Agar, was created in 1937. Agar is a reversible hydrocolloid with low precision and a very difficult handling method. After that, alginate was created. The polysulfides, also known as mercaptans, were created in 1950 to address a variety of hydrocolloid issues. The polyether, the first elastomeric substance, was created in 1965. The silicones were then produced using addition and condensation techniques. Digital impression systems first appeared at the start of the 1980s. In 1984, Duret invented and

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received a patent for CAD/CAM technology. He also revealed the four-hour fabrication of a crown. CEREC1, the first classical impression system that was profit-driven, was created in 1985 by Mormann and Brandestini. Using commercially available blocks of porcelain material, CEREC1 used a 3-dimensional (3D) computerised scanner and a cutting tool to create dental prostheses in a single appointment. A tool called CEREC1 can create porcelain inlays and onlays. In fact, Sirona Systems currently has Mormann under licence. In 1994, 2000, and 2003, respectively, CEREC 2, CEREC 3, and CEREC 3D entered production. [3]

CONVENTIONAL IMPRESSION TECHNIQUE

The first step in a traditional impression is choosing the right tray for the subject's two arches. Alginate or polyether impression materials are typically used to create the standard impressions of the mandibular and maxillary arches. The drawbacks of traditional dental impression technique include the inability of the doctor to apply sufficient pressure during moulding and patient movement. Additionally, they don't provide the patients with a lot of comfort, and because mistakes can happen, they may need to be repeated several times, which adds to the difficulty for both the patient and the doctor. The impression material can occasionally cause an allergic reaction in patients, and swallowing the impression material due to improper handling also poses a risk.

Impression materials can be-Non rubber based (Alginate), and rubber based (elastomeric) one. Impression can be one step or two step procedure. After impression it will be poured with dental stone or plaster to fabricate the prosthesis.

The full denture impression only captures soft tissue. The partial denture impression must accurately capture both a hard, unyielding substance and a relatively soft, yielding tissue (the oral mucosa) (the remaining teeth). An impression technique with one stage that captures the soft and hard tissues at rest. [4] Perforated trays are used to take impressions for dental prosthetics, either partial or fixed.

Type of Impression Techniques

Fixed partial denture (FPD) impressions can be made using a variety of methods, including I. Putty-wash impression, II. Dual-phase impression, III. Mono-phase impression, IV. Hydrocolloid laminate technique, V. Copper-band impression technique, and VI. Impression using vacuum-adapted splints.[1]

Alginate impression: To ensure good mechanical retention, impressions are typically made using a perforated impression tray. As directed by the manufacturer, combine the powder and water in a bowl.

Elastomeric impression: It is made with both putty and light body materials.

i)One-step technique: The heavy body PVS or putty is put on the impression tray after the adhesive has been applied and has had time to dry. Next, the light body material is placed around the dental elements used in the preparation, making sure there are no air bubbles. The tray containing the more viscous substance is then put into the patient's mouth to harden.[1]

***ii)Two-step technique*:** With the aid of putty or heavy body material, a preliminary impression is created. The undercuts are also removed after the material has dried and impression taken from the oral cavity. The dentist makes sure the impression tray can be passively fitted over the arch where it was taken.[1]

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The conventional impressions-advantages and disadvantages

Even though it is frequently held, the conventional impression has a number of shortcomings. There is still no perfect impression material in the market for specialists, despite improvements in the quality of impression materials that haven't addressed the drawbacks. Examining the impression outside of the mouth cavity revealed issues like fractures, bubbles, or improperly delineated preparation margins; overall, there are a number of potential issues with taking traditional dental impressions.[3]

Due to drawback of conventional impression, digital impression is gaining importance nowadays.

DIGITAL IMPRESSION

Dentistry has advanced to new heights with the introduction of computers and the corresponding advancements with significant improvements in impression production, particularly with regard to digital impressions. The idea of intraoral digital impressions was introduced in the early 1980s as a result of the application of computer-aided design and computer-aided manufacturing (CAD/CAM) techniques in the field of prosthodontics. It has received extensive attention from dentists and has been applied to the fabrication of dental prostheses in a number of instances. The mode of prosthodontics is anticipated to completely digitise thanks to this new digital impression technique.[6]

With the aid of computerised impressions, dentists can create lifelike, artificial recreations of the soft and hard tissues in the jaw using lasers and other optical scanning technologies. [3]

Dental offices use intraoral scanners (IOS) to take digital impressions of patients' direct optical impressions. They project a light source (laser or more recently structured light) onto the object to be scanned, in this case the dental arches, including ready teeth and implant scanbodies, similarly to other three-dimensional (3D) scanners (i.e. cylinders screwed on the implants, used for transferring the 3D implant position). The scanning software processes the images of the dentogingival tissues (as well as the implant scanbodies) taken by imaging sensors, producing point clouds. The same software then triangulates these point clouds to produce a 3D surface model (mesh). The optical impression produces 3D surface models of the dentogingival tissues as a "virtual" replacement for conventional plaster models. Following the transmission of the impression data to software, restorations can be made without the need for a stone model.[3,7]

The output and accuracy of computerised impressions can be affected by a number of variables; further research into imaging technologies, scanning methods, and screening techniques is needed to increase the accuracy and specificity of implant scan body visual acquisition. Many commercial brands created ISBs with various geometries and designs as digital technology enabled implant dentistry.

The ISBs is divided into three sections: the base region, which corresponds to the bottom, the body region, which corresponds to the middle, and the scan region (correlating to the most proximal region of the body that links to the implants).[3]

Based on current developments in the field of digital dentistry, using computer-aided design (CAD) and computer-aided manufacturing can result in outcomes that are more effective and favourable (CAM). Based on the purpose and nature of the targeted tissue, numerous technologies and treatment modalities have been suggested.[3,5]

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There are three main components that make up CAD/CAM systems: (1) a data acquisition unit that gathers information about the area of the preparation teeth and surrounding structures and then converts it to virtual impressions (at this point, an optical impression is created either directly or indirectly) (2) software for designing virtual restorations anchored in virtual impressions and setting up all the milling parameters; and (3) a computerised milling device for producing the restoration with solid blocks of the chosen restoration. The main digital impression systems that are offered on the market are TRIOS, iTero, Lava C.O.S. system, CEREC, and Lava C.O.S. system. They differ from one another in a number of ways, including working principle, light source, whether powder coat spraying is necessary, operational procedure, and output file format.[1]

The three essential components of CAD/CAM are (1) a digital scanner that scans and converts tooth geometry into computer-readable data, (2) a software that takes the data and converts it into a 3D model, and (3) a manufacturing technology that uses CAM to turn the data set into the desired product. The optical surface scanning technology used by the intraoral scanning devices is extremely advanced and functions similarly to a camera.[8]

Digital impression machines and technology (Table 1)

There are primarily eight systems available from six different companies, with three fundamental systems currently being used to create digital impressions: The CADENT ITERO systems, the CEREC AC by Sirona systems, and the Lava chair side oral scanner by 3M.[3]

Table 1: The evaluation of three scanner systems. [3]

Features	**3 M LAVA C.O.S**	**S. CEREC AC**	**CADENT ITERO**
Visual Technique	Wave front sampling techniques (3D in motion)	LED/Laser collection	Parellel confocal/telecentric
Focal Depth	Extent from 5 mm to 15 mm	Extent from 5 mm to 15 mm	13.5 mm 1:1 exact focus
Powder Required	yes	Yes/opti spray	no
Models	Added ingredient/SLA in blue resin. One solid model and one working model	Added ingredient/SLA; not tissue	Milled/Polyurethane. Soft tissue profile,Removable dies
Indications	Upto 4UB, and singles	all	all
Export for Digital Interface	LAVA	CEREC Connect	Major CAD front end systems-Dental wings, CEREC In-Lab, 3 Shape, Standard STL binary file.
Articulator	Articulated; Centric	Hinge-Only	All directions, attachment

	and lateral excursions		system to whip mix full articulator for complex cases

Digital impression making

In digital impression techniques, the method for recording the impression is quite simple. The following steps must be followed-

Make sure the system's software is current and that the camera is ready for scanning before anything else.

•A gingival cord must be used to retract the tissue after the prepared tooth has been dehydrated, and separated. Retraction is required when taking digital impressions because if the profile margin is not visible, the scanner might not be able to read it. The tooth is lightly coated with titanium dioxide after it has dried to provide contrasting points for scanning, speed up recording, and enhance 3D picture recording.

• It is possible to scan the images using a scanner, which is equivalent to an intraoral camera. The prepared tooth is scanned from different angles, and the neighbouring teeth are created in software. The patient is then told to close their mouth completely so that the occlusion is captured on camera.

• The image data and patient information for the prosthesis are transferred to the appropriate laboratory or office milling machine.[3]

Digital Impressions–Advantages and Disadvantages [3]

By enabling practitioners to email a digital imprint to the labs rather than sending a traditional impression or stone replica through regular mail, classical optical imprints increase productivity, creativity, and accuracy. Additionally, identical dental restorations could be created from computerised impressions, reducing the number of office visits and accelerating patient care. (Table 1)

DISCUSSION

The practitioner is thrust into a digital universe that is growing ever more imposing as a result of the recent digital revolution. In actuality, the impression serves as the primary informational conduit between the practitioner and the prosthesis laboratory. Impressions, whether conventional or digital, must adhere to a number of rules and specifications. [6] Eliminating the tray selection process, reducing the chance of distortion and material consumption during the pouring, disinfecting, and shipping of impressions to the dental laboratory, and improving patient comfort and acceptance are additional benefits. These impressions can be transmitted and stored digitally so that they can later be retrieved without being altered. Ceramic restorations no longer require casting, waxing, investing, or firing thanks to digital impressions.[2]

The development and adoption of CAD/CAM technology is intended to address three key issues in dentistry: ensuring adequate durability of restorations, particularly in the distal area; producing restorations that look more natural; and facilitating and streamlining the process of making these restorations, which would also improve their accuracy.[9]

The creation of intraoral scanners aims to overcome some of the drawbacks of traditional techniques, including volumetric changes in impression materials, plaster expansion during

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the casting of working models, and potential production-related mistakes in the creation of prosthetic restorations. Digital impressions do away with some of the steps involved in conventional impression techniques (CIT), including choosing a tray, applying adhesive, cleaning it, and transporting it to the dental lab. When taking a traditional impression, this reduces patient discomfort and cuts down on clinical time.[9]

Internal fit, marginal fit, or both internal and marginal fit were used to compare the accuracy of digital and conventional impressions. [2] In the literature, it has been widely discussed that the ideal marginal fit required for the clinical success of full crowns is 120 m or less, while in CAD/CAM or copy-milling systems, the marginal opening has been reported to range between 60 m and 300 m.

Digital impressions are superior to conventional impressions, without any statistically significant difference, according to Chandran et al's systematic review of digital and conventional impressions.[2] In the case of an All-on-Four implant-supported hybrid prosthesis, Afram et al. compared two impression techniques: digital and conventional, in order to reach a clinical conclusion regarding the accuracy of adaptation of the prosthetic reconstructions. They came to the conclusion that digital impressions are more accurate and trustworthy than traditional impressions.[6] The development strategy of CAD/CAM techniques included automating the production process.[10]

Digital impressions produced a more time-efficient technique than traditional impressions. According to Yuzbasioglu et al. The digital impression technique was preferred by patients over traditional methods.[10] In comparison to the traditional impression technique, the digital impression technique has shown to be more effective in terms of the amount of clinical time needed for its application.[9] According to a systematic review and meta analysis by Chochlidakis et al, the digital impression technique offered fixed restorations a better marginal and internal fit than conventional methods did.[11]

In comparison to the traditional impression technique, the digital impression technique has shown to be more effective in terms of the amount of clinical time needed for its application. Digital impressions allow you to make corrections to a specific area without having to start over. This reduces the length of the clinical period. Despite the fact that intraoral scanning systems have many advantages, few dentists have implemented them in their offices. This is primarily because buying an intraoral scanner and software requires a large initial investment. The type of material used, the type of tray chosen, and the technique used can all affect an impression's accuracy and dimensional stability. Intra Oral Scanners (IOS) have a number of advantages over conventional imprinting methods, including improved treatment and technician conveniences, reduced appointment frequency, and increased practise capacity for the operator.

Conclusion

The clinician must have a thorough understanding of both techniques in order to make the best technique-based decision. Digital impressions were more accurate than traditional impressions without showing any statistically significant differences.

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