
COMPARISON OF DIGITAL AND CONVENTIONAL IMPRESSION TECHNIQUE IN ASPECT OF PROCEDURE, TIME AND SATISFACTION

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Abstract: Dental impression in dentistry is used for many purposes. One of these is to make a model that allows the study of fine details outside the oral cavity, which is sometimes impossible to achieve by direct prosthetic field inspection. This study aimed to review the literature on the comparison of conventional and digital impression techniques in aspect of procedure, time and satisfaction. The development strategy of CAD/CAM techniques included automating the production process and optimizing the quality of restorations by using new biocompatible materials, especially high performance ceramics, such as zirconia and lithium disilicate. Several reports have demonstrated the potential for accurate and precise restorations using CAD/CAM technology. There is some variability in conventional impressions and the resulting master casts, depending on the technique and material used by the operator. The accuracy of master casts has been the subject of numerous research projects, and is dependent on numerous items, including the water/ powder ratio, vacuum versus hand mixing, and the type of dental stone and its compatibility with impression materials. The advantages of the intra-oral scanning technique are: better patient acceptance, reduction of distortion in impression materials, visualization of three-dimensional preparation, reduction of clinical time. A lack of clinical studies addressing patient outcomes regarding digital prosthodontic treatments was observed among the included articles. However, current evidence suggests that patients are more likely to prefer the digital workflow than the conventional techniques.

Keywords: impression, digital, conventional, technique

1. INTRODUCTION

According to Glossary of Prosthodontic Terms, the impression is “a negative likeness or copy in reverse of the surface of an object; an imprint of the teeth and adjacent structures for use in dentistry. [1]

Taking impression is a very important step in the production of fixed prosthetic restorations such as crowns, bridges, inlays, onlays, and implants as well as removable dentures for a long time in dentistry. [2,3]

In dentistry, impression was taken with conventional methods for many years and nowadays elastomeric impression materials especially polyvinyl siloxane and polyether are used very reliably in terms of impression accuracy. [3-5]

The accuracy of the impression depends on the materials themselves [6,7], impression tray types [8], and impression techniques. [9]

Each step in the process introduces potential human and/or material error. [10,11]

The first impression material was developed in 1937 denominated Agar, which is a reversible hydrocolloid with low precision and very complex handling technique. After that, alginate was created, which is an irreversible hydrocolloid, which had a disadvantage as a low dimensional stability. In 1950, the polysulfides or mercaptans were developed to solve some hydrocolloid problems. However, these substances had an unpleasant taste and odor that were not well accepted by patients. [12]

In 1965, the polyether was developed, being the first elastomeric material developed specifically for dentistry. This material presented excellent characteristics such as: relatively fast chair time, excellent fluidity and detail reproduction, hydrophilic and high modulus of elasticity. [13]

Then, the silicones were created by addition and condensation, the addition silicones exhibit a high modulus of elasticity, excellent tear strength, high stability, allowing the mold not to be melted. Regardless of the accuracy of impression materials, other factors can cause distortions in the models, such as: the impression technique, temperature variations that the molds undergo during transfer from the dental office to the laboratory. [14]

At the beginning of the 1980s, digital impression systems occurred as Werner Mörmann began to think about what could be done to develop one session treatment. He shared this idea with his electronic engineer friend, Marco Brandestini. In this way, it has been started to develop digital impression instruments with optical reading systems. [15]

Digital and conventional impression methods have some advantages and disadvantages compared to each other. [16]

In conventional impression method, having a greater number of steps increases the possibility of making extra mistakes. [17]

Standardization of the milling stage in the digital impression method and less step numbers reduce the possibility of mistakes and improves adaptability. [18]

Digital methods are more preferable in terms of time and preference of clinicians. [19]

In the digital impression method, the possibility of a problem because of inadequacy of impression details is less than conventional method. Even if there are fewer scanned places in the digital impression, only the missing areas can be scanned without making re-impression. Intraoral camera has less effect on the gag reflex than the impression tray. It is easier to store digital impression. [20]

The difficulty of scanning the distal part in the digital impression and requirement of titanium oxide powder spray for contrast (such as CEREC Bluecam systems) are some disadvantages of the digital system. [20,21]

In addition, the other disadvantages of the digital impression method are cost and requirement of extra education for using.

The introduction of computer-aided design/computer aided manufacturing (CAD/CAM) technology in dentistry has resulted in more accurate manufacturing of prosthetic frameworks, and greater accuracy of dental restorations, and the technology has improved since the 1980s. [22]

The development strategy of CAD/CAM techniques included automating the production process and optimizing the quality of restorations by using new biocompatible materials, especially high performance ceramics, such as zirconia and lithium disilicate. [23]

Several reports have demonstrated the potential for accurate and precise restorations using CAD/CAM technology. [24]

There is some variability in impressions and the resulting master casts, depending on the technique and material used by the operator. [25]

The accuracy of master casts has been the subject of numerous research projects, and is dependent on numerous items, including the water/powder ratio, vacuum versus hand mixing, and the type of dental stone and its compatibility with impression materials. [26]

This study aimed to review the literature on the accuracy of conventional and digital methods of dental impression, as well as present the various three - dimensional digital impression systems.

2. CONVENTIONAL IMPRESSIONS

First step in conventional impression is selection of proper tray for both arches of the subject, and applied the adhesive. The conventional impressions of mandibular and maxillary arches are made by polyether impression material with stock trays using the monophasic impression technique. The interocclusal relationship is recorded with a polysiloxane bite registration material.

The negative effects of conventional dental impression technique are: inadequate pressure during molding, patient movement during molding, and doctor ability. In addition, they are not very comfortable to the patients, and because of possible errors it can be repeated several times, that is additional difficulty for the patient and the doctor.

Sometimes the patients may experience an allergic reaction to the impression material, and there is a risk of swallowing of the impression material as a result of improper handling as well.

3. DIGITAL IMPRESSIONS

Digital impression and scanning systems were introduced in dentistry in the mid 1980s. It was predicted that most of the dentists in the U.S. and Europe would be using digital scanners for taking impressions within the next decade. [27]

Digital impressions offer speed, efficiency, ability of storing captured information indefinitely and transferring digital images between the dental office and the laboratory. [28]

The advantages of the digital impressions and scanning systems are improving patient acceptance, reducing the distortion of impression materials, 3D pre-visualization of tooth preparations, and potential cost- and time-effectiveness. Digital impression offers increased patient's comfort for several reasons: small size of intraoral scanner eliminates the inconvenience of holding a voluminous tray, eliminating the allergic reaction to impression material and it's swallowing and eliminating of vomiting at sensitive patients. [29]

Several studies on the accuracy of intraoral scanners and digital impressions have been published, testing single-unit restorations, [30] several teeth in a row, [31] quadrants, [32] and full arch scans. [33]

A recent report by Lee & Gallucci compared the operator's preference of digital versus conventional implant impression techniques. In this in vitro study, inexperienced students made impressions on a customized model instead of live patients. The overall perception of the inexperienced students was that they preferred the digital impression technique. Until now there have been no clinical studies comparing the digital and conventional impression techniques. [34]

The advantages of the intra-oral scanning technique are: better patient acceptance, reduction of distortion in impression materials, visualization of three-dimensional preparation, reduction of clinical time. [35]

The digital impressions are performed with the chairside dental CAD-CAM system. The digital impression electronic data constituents of the virtual models for both arches and bite registration are recorded. All digital scanning procedures are carried out according to the manufacturer's guidelines and performed by the same operator (EY).

The effectiveness and clinical outcomes of the digital impression technique are evaluated by measuring the total treatment time, including the individual steps:

- A) Entering patient information (including name, last name, date of birth)
- B) Laboratory prescription (including shade of restoration, material choice of restoration, form of restoration)
- C) Upper/lower scan
- D) Bite scan.

The advantages of digital impression technique are: better patient acceptance, reduction of distortion in impression materials, visualization of three-dimensional preparation, reduction of clinical time.

4. DISCUSSION AND CONCLUSION

In the conventional impression method, preparation time included selecting impression tray, mixing of the impression material. Taking impression time started from the placement of the impression tray to mouth and ended when the impression item set. At the end, the tray is removed from the mouth. The total taking impression time was the total duration of these. In the digital impression method, preparation time included entering the patient's information into system, the stages of describing how the intraoral scanner should be held during the scanning. The digital impression time included the time from the beginning of the intraoral scanning to the end of the scanning. Total taking impression time was the total duration of these.

Although studies of Lee and Gallucci and Zitzmann et al. are the implant-based study, the results of this study are similar with them. The total digital impression time is shorter than conventional impression method. [36,37]

Joda and Bragger assessed subjective patient satisfaction concerning convenience, speed, and general preference and showed a greater overall preference for the digital protocol than for the conventional workflow. [38]

Likewise, Schepke et al. reported an overall preference for the complete-arch digital impression technique than for the conventional technique. However, the authors are unaware of a systematic review that provides the patient's perception of implant impression with both digital and conventional methods. Therefore, the purpose of this systematic review was to compare patient outcomes and procedure length for digital impression versus conventional impression techniques. [39]

The results of the present review showed that patients seem to prefer the digital impression technique rather than the conventional ones. [40]

This may be because today's patients expect less invasive and more comfortable treatment. [41]

Moreover, in the conventional technique, an unacceptable impression requires the entire impression to be remade. However, if the digital technique is used, only the missing and unacceptable areas will need to be rescanned. Hence, the technique reduces the procedure working time while increasing patient comfort

With respect to time efficiency, a marked variation was noted in the procedure working time between conventional and digital impressions techniques. Benic et al. and Wismeijer et al. reported less total working time for the conventional technique. [42,43]

Joda and Brager, Gjevsold et al., and Schepke et al. reported less total working time for the digital technique. Most of the included studies used the following protocol: complete arch polyether impression of the prepared teeth, an alginate impression of the opposing jaw, and an occlusal record with composite resin or wax. [38-40]

The fact that Benic et al. observed less time for the conventional impression may be explained by their conventional closed-mouth impression technique, which allowed the impression of both jaws and the occlusal registration in a single step. Hence, the conventional impression resulted in better time effectiveness than the digital technique. [43]

Likewise, Wismeijer et al. also observed less procedure working time for the conventional technique. With regard to this, the authors claim that the decrease in procedure working time is related to the difficulty in scanning proximal surfaces because of the position of the scan body, which may hamper the scanner assessment. [42]

Based on the findings of this systematic review, it was concluded that the digital impression technique was more efficient than the conventional impression technique. The overall treatment time for the conventional impression technique was longer than that for the digital impression technique. When compared with the conventional impression technique, the digital impression technique was accepted as the preferred and effective technique. The treatment comfort of the digital impression technique was higher than that of the conventional impression technique when it was performed by an experienced doctor. Usually patients prefer the digital impression over the conventional impression technique.

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