

# DIGITAL AND CONVENTIONAL IMPRESSION TECHNIQUES OF OBTAINING COMPLETE-ARCH DENTAL IMPRESSION

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## Summary.

Impression making has become an essential procedure in dentistry. Various materials and impression-taking processes have been utilized over time to obtain the desired accuracy for successful treatment. Aim of this study is to investigate the accuracy and trueness of digital full arch dental impressions in comparison to a conventional dental impression procedure in clinical application. This study was conducted in the department of stomatological propaedeutics “Pavel Godoroja” at the State University of Medicine and Pharmacy “Nicolae Testemițanu” and Smiles for Miles Dental Office Modesto, California. The preferences of 20 patients with full dentition were analyzed and compared regarding the use of conventional and digital impression techniques. Patients were requested to complete a comparative questionnaire in regards to their experience with each technique. The results of the comparative questionnaire presented show that 100% of patients preferred the digital impression technique when given the option for either impression.

Through the questionnaire, it was determined that the comfort and satisfaction of patients was greater in the digital impression technique. Digital impression was less invasive and did not require the scanner to be placed in the mouth to the depth of the conventional impression tray. The intraoral scanner did not have any unpleasant odors or trigger gagging reflex.

**Keywords:** *conventional dental impression, digital dental impression, tray, intraoral scanner*

## Introduction

The Digital Revolution has transformed the all industries but especially the dental industry to support new digital devices to increase workflow and a more predictable dental practice [38].

Dental impressions are used to recreate the patient's intraoral cavity for manufacturing prosthesis, restorations or orthodontic appliances in the absence of the patients. The ultimate goal is for the impressions to provide the dentist and the lab technician a high-quality and accurate representation of the patient's oral soft and hard tissues. It directly is influenced by the materials used and technique required to achieve the dimensionally stable and a precise working model. [31]. Impression making has become an essential procedure in dentistry as an additional component to diagnosis procedure. Various materials and impression-taking processes have been utilized over time to obtain the desired accuracy for successful treatment [5].

In the early 1980s, the digital impression systems were introduced to improve accuracy and efficiency into a one session treatment [2,41]. Developmental engineers have worked alongside dentists to enhance the technology for user-friendly precise dental impressions with the use of these intraoral scanners. Progressing the world of dentistry forward to more digital and efficient treatment planning in less time. As well as progressing to eliminate errors that may occur during the conventional impression techniques.

Each stage of the process presents the risk of material error or procedural error. Digital scanning has the potential to solve a number of issues commonly associated with conventional impression processes such as “bubbles” “voids” and material shrinkage. Additionally, models manufactured from plaster have limitations in terms of durability, diagnostic use, storage and transferability [21]. Errors during the impression stage would further be problematic in the manufacturing of prosthesis or treatment that relies on accuracy to produce a final result. Impressions should replicate an accurate occlusal aspect and dimension of the patient's dentition to use in their absence.

Importance of this study is to evaluate the preferences of patient experience and comfort during the impression technique by gathering their responses in a questionnaire following each technique.

**The aim of the paper:** to evaluate the accuracy and trueness of digital full arch dental impressions in comparison to a conventional dental impression procedure in clinical application.

## Materials and methods

This study was conducted in the Department of stomatological propaedeutics “Pavel Godoroja” at the State University of Medicine and Pharmacy “Nico-

lae Testemițanu” and Smiles for Miles Dental Office Modesto, California.

A comprehensive electronic search was performed through PubMed and Google Scholar. The following keywords: “conventional dental impression” “digital dental impression” “tray” “intraoral scanner”.

The preferences of 20 patients with full dentition were analyzed and compared regarding the use of conventional and digital impression techniques. Patients were requested to complete a comparative questionnaire in regards to their experience with each technique. This study was conducted in the department of stomatological propaedeutics “Pavel Godoroja” at the State University of Medicine and Pharmacy “Nicolae Testemițanu” and Smiles for Miles Dental Office Modesto, California. Responses were gathered by patient indication of either conventional or digital impression technique preference.

All participants were informed of their participation in research and the requirements of performing both techniques.

Subjects were required to meet certain criteria for inclusion in the study:

- Have signed informed consent
- Good oral hygiene
- Dentate patients
- No periodontal disease
- No experience with either conventional or digital impressions

Criteria of exclusion:

- Presence of periodontal disease
- Edentulous patients
- Patients under the age of 18
- Poor oral hygiene
- Patients with prosthodontic treatment

All subjects who fulfilled the required criteria were chosen to participate in the study.

To accomplish the goal of this study, patients initially would undergo conventional impression technique and after a period of 5 minutes would be subject to the digital technique.

Initially at the clinical visit, patients had prophylaxis scaling to remove any possible interferences.

An impression of the upper jaw and lower jaw were obtained from each technique.

In the application of the conventional impression technique, a one-stage irreversible hydrocolloid material, Alginate, and standard perforated plastic tray were used. Occlusal registration was obtained with the use of PVS.

After completion of the conventional impression technique, patients were provided with a questionnaire to assess their perception of technique and experience. Patients complete the questionnaire using a numerical rating scale (NRS) with a range between 1 to 5 (where 1 is strongly negative and 5- strongly positive).



Figure 1. a. Mixing bowl and Spatula with vibrating table for mixing alginate material b. PVS material



Figure 2. Perforated plastic stock trays

Questionnaire for Conventional Impression Technique	1 (strongly negative)	2	3 (neutral)	4	5 (strongly positive)
1. How was the taste?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Did it trigger a gag reflex/nausea?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Did you feel difficulty in breathing?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Did you feel discomfort with the size of the tray?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Did you feel any sensitivity?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 3. Questionnaire for Conventional Impression Technique

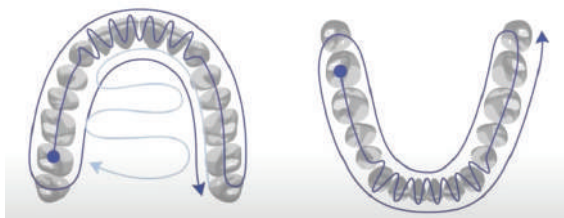
After 5 minutes, a digital impression technique was performed with an intraoral scanner and images directly project on the computer screen with a specialized program to form 3D representation of the scans.



Figure 4. a. Digital Impression Unit b. Intraoral scanner

According to manufacturer sequence, upper jaw was scanned, followed by lower jaw and subsequently with the occlusal registration. Lower jaw sequence begins with the most distal molar starting on the occlusal surface moving mesially in the quadrant then tilting the

scanner lingually pushing the tongue aside while moving the scanner distally until shifting the scanner over to the buccal surface (once reaching back to the distal molar) then going back mesially. Upper jaw sequence begins with the most distal molar of the quadrant going along the occlusal surface moving the scanner mesially, then tilting the scanner buccally as its moving back distally, then shifting over the distal molar to the palatal surface to move mesially and complete the quadrant. Sequence is followed for each quadrant.



**Figure 5.** Schematic of the positioning sequence of intraoral scanner [56]

Occlusal registration was required to complete the scan by asking the patient to perform their natural bite, while introducing the scanner most distally and then moving is mesially to scan 4 teeth in a row so the program may line the arches in occlusion.



**Figure 6.** Schematic of scan area and sequence for bite registration [56]

After completion of the digital impression technique, patients were provided with a questionnaire in regards to their experience. As in the previous questionnaire, responses were collected from a numeric rating scale from 1 to 5 (where 1 is strongly negative and 5- strongly positive).

Questionnaire for Digital Impression Technique	1 (strongly negative)	2	3 (neutral)	4	5 (strongly positive)
1. How was the taste?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Did it trigger a gag reflex/nausea?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Did you feel difficulty in breathing?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Did you feel discomfort with the size of the intraoral scanner?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Did you feel any sensitivity?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Figure 7.** Questionnaire for Digital Impression Technique

After the completion of the both techniques and their respective questionnaires, patients were asked to complete a questionnaire comparing each technique and their preferences for one of the two.

Questionnaire for Patient Preference:	CIT	DIT
1. Which impression technique do you prefer?	<input type="radio"/>	<input type="radio"/>
2. Which technique do you feel more discomfort with?	<input type="radio"/>	<input type="radio"/>
3. Which technique would you prefer in regards to time to complete?	<input type="radio"/>	<input type="radio"/>
4. Which technique do you prefer in regards to taste/smell?	<input type="radio"/>	<input type="radio"/>
5. Which technique do you prefer in regards to impression tray size vs. intraoral scanner?	<input type="radio"/>	<input type="radio"/>
6. Which technique do you prefer in regards to not triggering gag reflex?	<input type="radio"/>	<input type="radio"/>

**Figure 8.** Questionnaire for Patient Preference

A questionnaire was provided to the performing doctor on their experience and the final results of the impression obtained using conventional impression technique versus digital technique.

Questionnaire of Doctor Preference:	CIT	DIT
1. Which impression technique do you prefer?	<input type="radio"/>	<input type="radio"/>
2. Which technique did you feel was technique sensitive?	<input type="radio"/>	<input type="radio"/>
3. Which technique would you prefer for more accurate final results?	<input type="radio"/>	<input type="radio"/>
4. Which technique do you prefer in regards to having to do multiple impressions?	<input type="radio"/>	<input type="radio"/>
5. Which technique did you feel put your patients at more discomfort?	<input type="radio"/>	<input type="radio"/>
6. Which technique took longer to obtain an impression?	<input type="radio"/>	<input type="radio"/>
7. Which technique will you continue to use in your practice?	<input type="radio"/>	<input type="radio"/>

**Figure 9.** Questionnaire for Doctor Preference

## Results

A clinical trial of 20 patients that met the criteria for inclusion was conducted initially with conventional impression technique. Afterwards patients were provided a questionnaire to collect their responses about their experience and preference.

Figure 10 represents the results of the patients' perception of the conventional impression technique and responses to the questions provided. A majority of patients marked they had a "strongly negative" response to the taste of the conventional material.

A high response to the trigger of a gag reflex from the conventional material technique. Patients responded that they felt a positive or strongly positive "discomfort with the size of the tray" as well as difficulty breathing. A majority of patients indicated a "neutral" response toward if "any sensitivity" was felt during the conventional impression process.

Afterwards, patients would experience the digital impression technique and followed by a specific questionnaire for digital impression.

The results of the patients' perception of the digital impression technique are represented in Figure 13. A majority of patients indicated "strongly negative" response to the questions asking in regards to feeling



### Questionnaire for Conventional Impression Technique

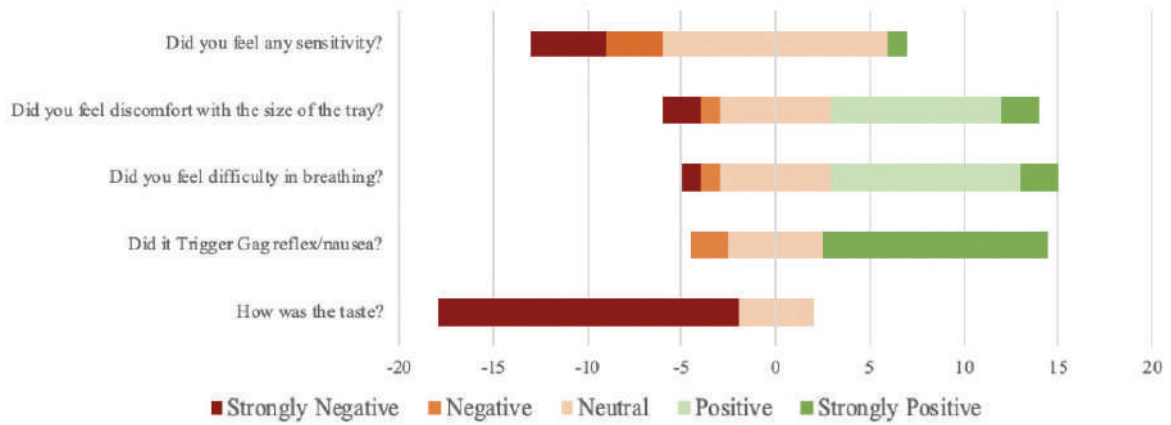


Figure 10. Assessment of the Results of the Questionnaire for Conventional Impression Technique



Figure 11. Sequence of upper and lower arch scanning

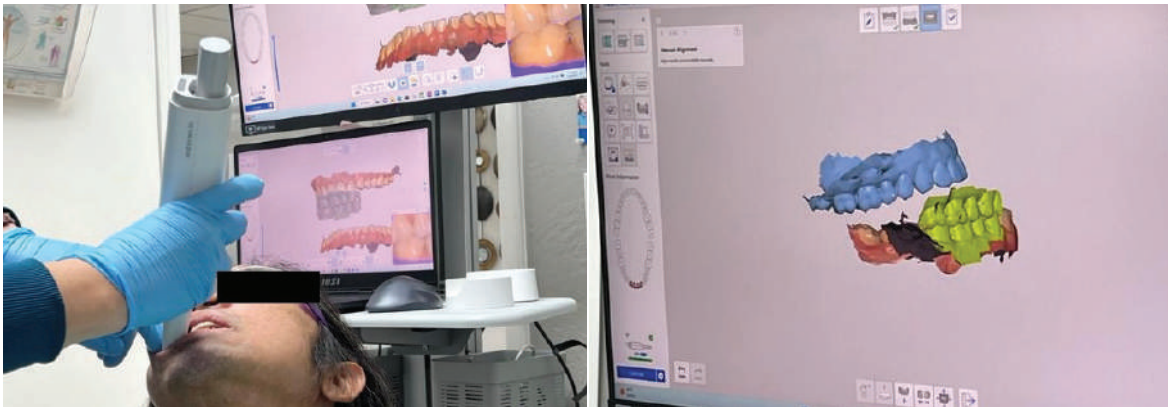


Figure 12. a. Bite registration scanning b. Arch alignment for bite registration on digital program

### Questionnaire for Digital Impression Technique

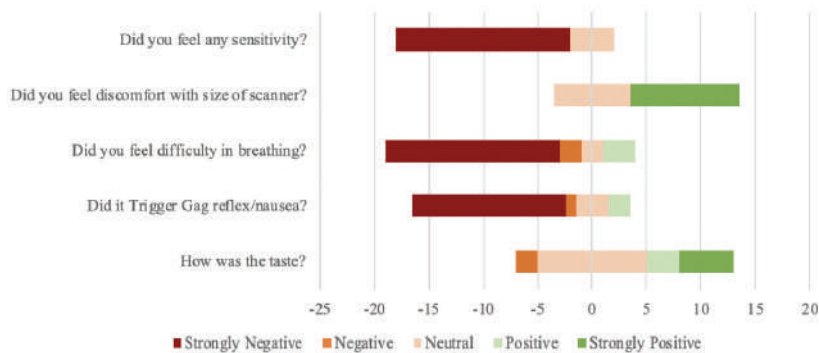


Figure 13. Representation of results of Questionnaire for Digital Impression Technique

“sensitivity” “difficulty in breathing” and “trigger of gag reflex/nausea”. There was a “strongly positive” result for patients indicated discomfort to the size of the intraoral scanner. A majority of patients indicated a neutral response to the question about “how was the taste” during the digital impression technique. The results of the “trigger gag reflex” for the digital impression technique resulted in a majority of patients having a “strongly negative” response to the trigger of a gag reflex; stating that many did not experience any reflex that would trigger a gag.

Following the responses of digital impression, patients were provided a comparative questionnaire of their preference.

Comparative Questionnaire for Patient:	CIT	DIT
Which technique do you prefer in regards to not triggering gag reflex?	5%	95%
Which technique do you prefer in regards to tray size vs. intraoral scanner?	50%	50%
Which technique do you prefer in regards to taste/smell?	5%	95%
Which technique would you prefer in regards to time to complete?	25%	75%
Which technique do you feel more discomfort with?	80%	20%
Which impression technique do you prefer?	0%	100%

Patient experience and preferences for both impression techniques are presented in Figure 14. The results of the comparative questionnaire presented in table 4, show that 100% of patients preferred the digital impression technique when given the option for either impression. 80% of patients felt more general discomfort from conventional impression technique than digital technique. To the question “Which technique do you prefer in regards to tray size vs. intraoral scanner?”; responses were equally split amongst the two methods. A total of 95% of the patients stated that they preferred the digital impression technique “in regards to taste/smell” and “not triggering gag reflex”. Depending on the time it took to complete the impression, 75% of patients chose that digital impression was took less time, than the 25% that indicated conventional impression technique was faster.

The main clinical aspect that doctors looked for during the two impression techniques were the accuracy of the occlusal aspect, an importance for making future models.

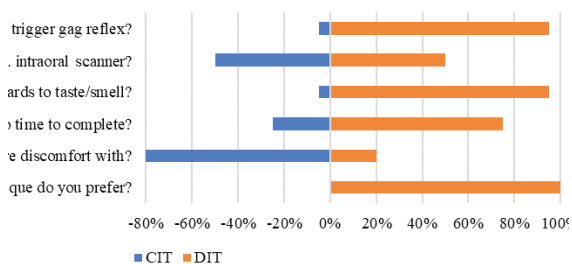


Figure 14. Results of Comparative Questionnaire

a questionnaire to assess their preference with which method.

Questionnaire of Doctor Preference:	CIT	DIT
1. Which impression technique do you prefer?	50%	50%
2. Which technique did you feel was technique sensitive?	20%	80%
3. Which technique would you prefer for more accurate final results of occlusal aspect?	45%	55%
4. Which technique do you prefer in regards to having to do multiple impressions?	10%	90%
5. Which technique did you feel put your patients at more discomfort?	75%	25%
6. Which technique took longer to obtain an impression?	40%	60%
7. Which technique will you continue to use in your practice?	25%	75%

Figure 15 represent the Doctor’s preference in different aspects of usage of the conventional and digital impression technique. Results of “which technique was preferred” was evenly split amongst both techniques. Some doctors felt that the traditional method was easier to use since they have years of experiencing doing it and their lack of practice with using the digital technique. This was further confirmed with 80% of doctors indicating that the digital impression method was more technique sensitive. Although 90% of doctors marked that it was more preferred to do multiple scans of the digital impression rather than having to repeat complete arch conventional impressions. 75% of doctors felt that their patients were experiencing increased discomfort during the conventional impression technique. Lack of experiencing and requiring to follow scanning sequences prolonged the time it takes to obtain digital impression.

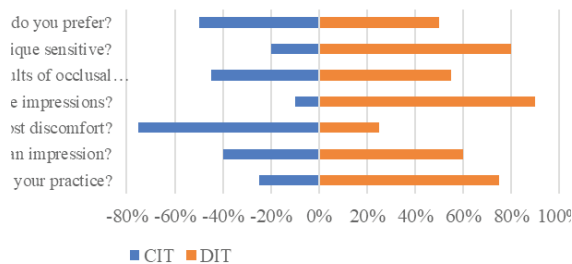


Figure 15. Doctor Preference Results

## Discussions

The results of this study indicate that the digital impression technique was preferred amongst patients with full dentition based on clinical experience. Dentist practitioners found that the digital impression method was easier to work with once practicing the technique to optimize scanning. In some cases, conventional impressions were preferred when doctors did not feel comfortable with the technique required to obtain intraoral scans. Digital impression technique provided the ability to pause during scanning process (due to saliva, blood, nausea or gag response) and then continue with the scan. Missed areas in the occlusal aspect or through the intraoral scans were

Subsequently, a total of 20 doctors that performed both techniques in their practice were provided with

able to be rescanned and fill in the missing components rather than redoing the whole impression. This saved clinical working time and provided better working efficiency and no wasted materials. Dental practitioners are able to weight out disadvantages and advantages in techniques to determine what fits best in their practice for better production and efficiency in workflow.

### Conclusions

1. Subjective assessment of the occlusal aspect of digital and conventional impression techniques determined that the digital impression technique produce more accurate and reliable representations of the patient's anatomy. Conventional impression would require to completely remake the impression if any distortion of the material occurred that affected the results of the occlusal aspect. Digital impression technique allowed the dentist to rescan areas that were missed or that required more detail.

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