

CONVENTIONAL VS. DIGITAL IMPRESSION TECHNIQUE FOR MANUFACTURING OF THREE-UNIT ZIRCONIA BRIDGES: EVALUATION OF PATIENTS' PERCEPTION, PREFERENCE AND TREATMENT COMFORT

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ABSTRACT

INTRODUCTION: Taking an impression of the oral cavity, which accurately recreates the prosthetic field, the surrounding hard dental and soft tissues, is one of the main and most important stages in the process of making any fixed prosthetic structure.

AIM: The aim of the present study is to compare the comfort and satisfaction of patients in need of prosthetic restoration of a defect in the dentition, using conventional and digital impression techniques and to determine their preference for any of them.

MATERIALS AND METHODS: The satisfaction of 36 patients in need of prosthetic rehabilitation treatment with conventional and digital impression techniques was analyzed and compared. After completing the stages of conventional and digital impressions, patients were asked to complete a comparative questionnaire of 9 questions using a numerical rating scale (NRS), stating their preference for one of the two techniques.

RESULTS: Regarding the conventional impression technique, we obtained the lowest average values according to the criteria "general discomfort" (6.44 ± 2.09), "total time for execution of the impression technique" (6.14 ± 1.53), and "nausea" (6.17 ± 2.86). The results of the same criteria in digital impression technology showed a significantly better response. All examined patients preferred the digital impression technique in cases where more than one impression had to be taken.

DISCUSSION: Our results show that patients identify digital impressions as more comfortable for them. Differences in the level of comfort, which included nausea, difficulty breathing, discomfort in the TMJ with a wide open mouth, were statistically significant ($p < 0.001$).

CONCLUSION: In terms of patient comfort and satisfaction, the digital impression technique is better perceived than the conventional one.

Keywords: *clinical study, digital, impression, preference, comfort, patient*

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INTRODUCTION

Taking an impression of the oral cavity, which accurately recreates the prosthetic field, the surrounding hard dental and soft tissues, is one of the main and most important stages in the process of manufacturing any fixed partial denture (1).

From its beginning around 7000 BC. until now, the development of dental medicine has invariably

been associated with remarkable inventions, innovations and achievements. Over the last three decades, the CAD/CAM (computer-aided design and computer-aided manufacturing) technology has entered rapidly and gained great popularity, providing better working conditions and increasing the comfort of both doctors and their patients. The purpose of the creation and introduction of CAD/CAM technology is to solve three main challenges in dentistry—to ensure sufficient durability of restorations, especially in the distal area, to create restorations with a more natural appearance, and to facilitate and shorten the process of making these restorations, which would also increase their accuracy (2).

Digital impressions eliminate some of the steps in conventional impression techniques (CIT), such as tray selection, adhesive application, disinfection, transportation to the dental laboratory. This saves clinical time and reduces patient discomfort when taking a conventional impression. According to Haddadi et al. the time required to take a digital impression from a whole dental arch is less compared to a conventional impression with PVS. The results of the study also show significantly less discomfort when using a digital impression technique (DIT) (4).

A certain amount of patients who needed prosthetic treatment associated the taking of a conventional impression with the appearance of discomfort, and very often—a gag reflex (4,5,6).

With the digital impression technique, these problems are overcome due to the lack of an impression tray and material filling the patient's mouth (7,8,9).

In the studied literature there is data on improving the communication between the dentist and the dental laboratory when working with DIT. An example is the ability to send and evaluate a digital dental impression and, if necessary, take a new one from the patient at the same clinical visit, which saves clinical time and reduces patient discomfort (10,11,12).

AIM

The aim of the present study is to compare the comfort and satisfaction of patients in need of prosthetic treatment with fixed partial dentures, using conventional and digital impression techniques and to determine their preference for any of them.

MATERIALS AND METHODS

The satisfaction of 36 patients in need of prosthetic treatment with 3-unit fixed partial denture was analyzed and compared regarding the conventional and digital impression technique and their preference for any of them. A controlled clinical trial was conducted in two private practices in Varna. All participants were selectively informed about the possible risks and benefits and signed an informed consent form for participation in the research. The research protocol was approved by the Commission for Scientific Research Ethics at the Medical University of Varna.

All subjects met certain criteria for inclusion in the present study: *To be over 18 years of age; to have distally limited dental defects; have a signed informed consent; have good or satisfactory oral hygiene; need prosthetic treatment with three-unit bridge constructions, and patients in whom the abutments do not need long-term pre-prosthetic preparation (teeth with periapical lesions).* Fig. 1 presents a scheme of the conducted clinical trial.

To achieve the goal of this study, each patient was subjected first to the conventional impression technique and one week later—to the digital one. The stages of the implementation of the two techniques were performed by a dentist with a specialty in prosthetic dental medicine according to the instructions and recommendations of the manufacturers. In order to master the technique of working with the intraoral scanner, the clinician underwent special training lasting more than 20 hours.

At the beginning of each clinical visit, a preparation of the abutment teeth was done, including: removal of the temporary restoration, cleaning of the prepared hard dental tissues from the temporary cement, and retraction of the soft tissues using two retraction cords (Ultrapak, Ultradent Products Inc., USA.) and an impregnating agent from the group of α -adrenomimetic decongestants (xylometazoline 0.05%, Warsaw Pharmaceutical Works Polfa SA, Poland) in order to clearly visualize the preparation margin (13). In both impression techniques, impressions were taken separately for the upper and lower jaw, as well as occlusal registration.

In the implementation of the **conventional impression technique**, a two-stage two-phase impres-

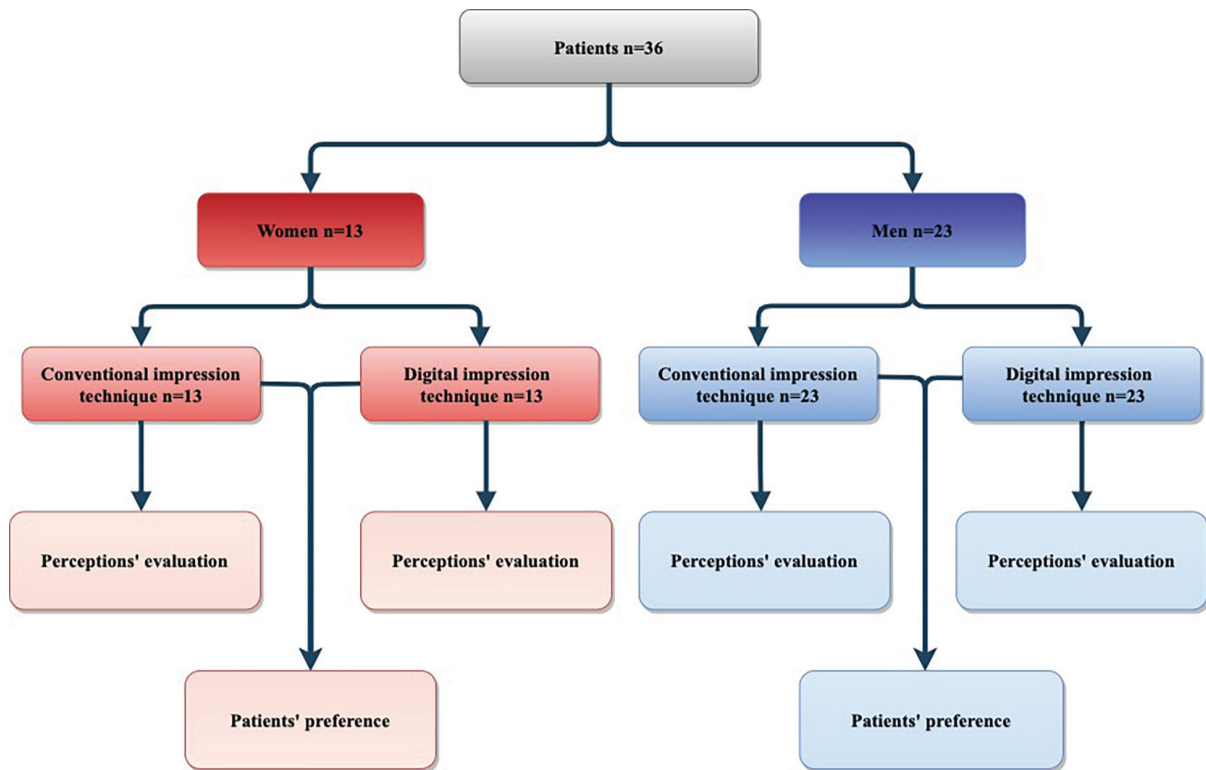


Fig. 1. Scheme of the clinical trial



Fig. 2. Conventional impression using a two-stage two-phase impression technique.

A) Tray selection. B) Primary impression. C) Preparation of the primary impression. D) Final impression.

sion with additive silicone impression material (Variotime 2 putty and light body, Kulzer, GmbH, Germany) and standard metal trays (Medesy, Impression trays, Italy) were used (Fig. 2). We used an irreversible hydrocolloid (Tropicalgin, Zhermack, Dental Products, Italy) to take an impression of the antagonists. The occlusal registration was taken in a state of central occlusion using a special PVS material (Varitotime bite, Kulzer GmbH, Germany). Immediately after the completion of the clinical stage of the conventional impression technique, patients' attitudes and perceptions were assessed by completing a standardized questionnaire using a numerical rating scale (NRS) ranging between 0 and 10 (where 0 is strongly negative and 10—strongly positive).

We used an intraoral scanner (Trios, 3Shape, Denmark) to perform the **digital impression technique**. It is not necessary to use a coating agent when working with it. Scanning of both jaws and the occlusal register in a state of central occlusion was performed in the sequence recommended by the manufacturer, namely: starting from the occlusal-palatal surface of the last molar in the first quadrant, moving to the opposite side of the jaw, always including two surfaces, and return to the first quadrant of the vestibular. We repeated the same sequence for the lower jaw, starting from the third or fourth quadrant (Fig. 3). Immediately after the completion of the clinical

stage of the digital impression technique, patients' attitudes and perceptions were assessed by completing a standardized questionnaire using a numeric rating scale (NRS) ranging between 0 and 10 (where 0 is strongly negative and 10 is strongly positive).

After completing the stages of the conventional and digital impression techniques, patients were asked to complete a comparative questionnaire of 9 questions about their preference for one of the two techniques.

The obtained data was entered and processed with the mathematical-statistical package SPSS (SPSS Statistics v.20; IBM Corp).

RESULTS

The current clinical trial included 36 patients, of whom 13 were women and 23 were men. Their average age was 48.3 ± 6.89 years (minimum age—31 years, maximum—59 years). The total number of prepared teeth was 72 of which 5 were incisors, 10—canine teeth (9 on the upper jaw and 1 on the lower jaw), 26—premolars (13 on the upper jaw and 13 on the lower jaw), 31 were molars on the upper jaw and 18—on the lower jaw). The pontics were 36 of which 5 were incisors, 11 were premolars (7 on the upper jaw and 4 on the lower jaw) and 20 were molars (8 on the upper jaw and 12 on the lower jaw).

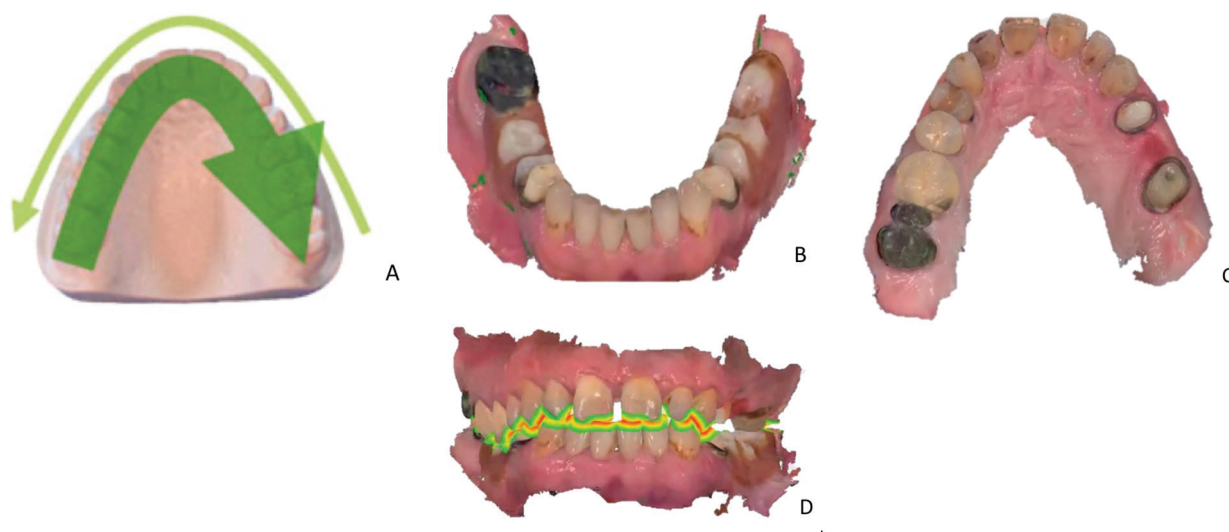


Fig. 3. Digital impression technique.

A) Scan sequence (14). B) Lower jaw scan. C) Upper jaw scan. D) Completed digital impression and strength of occlusal contacts.

Table 1. Assessment of patients' attitude and perceptions to conventional and digital impression techniques.

Criteria for Evaluation	Conventional Impression Technique				Digital Impression Technique				P Value
	Mean	SD	Min	Max	Mean	SD	Min	Max	
1. Discomfort	6.44	± 2.09	2	9	9.44	± 0.65	8	10	<0.01
2. Time needed to execute impression technique	6.14	± 1.53	4	9	9.58	± 0.69	8	10	<0.01
3. Smell/Sound	9.19	± 0.75	7	10	9.47	± 0.91	7	10	> 0.05
4. Taste/Heat	9.19	± 0.89	7	10	9.41	± 1.02	6	10	> 0.05
5. Nausea	6.17	± 2.86	2	10	8.33	± 1.14	6	10	< 0.05
6. Discomfort during opening	6.61	± 2.23	3	10	8.69	± 0.92	7	10	< 0.05
7. Size of tray/scanner	6.5	± 2.21	3	10	8.22	± 1.12	6	10	< 0.05
8. Difficulty in breathing	6.8	± 2.57	3	10	8.91	± 1.02	7	10	< 0.05
9. Teeth/gums sensitivity	8.89	± 1.14	5	10	9.91	± 0.28	9	10	> 0.05

Table 1 presents the results of the assessment of patients' attitudes and perceptions of the conventional and digital impression techniques. The lowest mean values were obtained for the criteria "general discomfort" (6.44±2.09), "total time for execution of the impression technique" (6.14±1.53) and "nausea" (6.17±2.86) in relation to the conventional impression technique. The results of the same criteria in the digital impression technique showed significantly

better receptivity—"general discomfort" (9.44±0.65); "total execution time of the impression technique" (9.58±0.69), and "nausea" (8.33±1.14). These results show a statistically significant difference between the studied indicators ($p<0.01$).

A statistically significant difference was found in relation to three other criteria ($p<0.01$). These were "discomfort during opening" (6.6±2.23 for CIT

Table 2. Results of a comparative questionnaire on patients' preference for one of the two impression techniques.

Question	CIT	DIT
1. Which impression technique do you prefer when more than one impression is necessary?	0%	100%
2. During which impression technique did you generally feel more discomfort?	100%	0%
3. Which impression technique would you recommend to a friend?	0%	100%
4. Which impression technique do you prefer in terms of time required to complete?	0%	100%
5. Which impression technique do you prefer in terms of taste/smell or sound/heat?	14%	86%
6. Which impression technique do you prefer in terms of the size of the intraoral scanner/ impression tray?	14%	86%
7. Which impression technique do you prefer in terms of the occurrence of sensitivity of the teeth or gums?	0%	100%
8. Which impression technique do you prefer in terms of difficulty breathing during the impression?	9%	91%
9. Which impression technique do you prefer in terms of the occurrence of a gag reflex?	6%	94%

Table 3. Results of a comparative questionnaire on women's preference (n = 13) for either of the two impression techniques.

Question	CIT	DIT
1. Which impression technique do you prefer when more than one impression is necessary?	0%	100%
2. During which impression technique did you generally feel more discomfort?	100%	0%
3. Which impression technique would you recommend to a friend?	0%	100%
4. Which impression technique do you prefer in terms of time required to complete?	0%	100%
5. Which impression technique do you prefer in terms of taste/smell or sound / heat?	23%	77%
6. Which impression technique do you prefer in terms of the size of the intraoral scanner/impression tray?	23%	77%
7. Which impression technique do you prefer in terms of the occurrence of sensitivity of the teeth or gums?	0%	100%
8. Which impression technique do you prefer in terms of difficulty breathing during the impression?	23%	77%
9. Which impression technique do you prefer in terms of the occurrence of a gag reflex?	0%	100%

and 8.69 ± 0.92 for DIT), "size of the impression tray/scanner" (6.5 ± 2.21 for CIT and 8.22 ± 1.12 for DIT), and "breathing difficulties" (6.8 ± 2.57 for CIT and 8.91 ± 1.02 in DIT). The results of these criteria show a better perception and positive attitude of patients to DIT compared to CIT. Only for the indicators "smell/sound" (9.19 ± 0.75 for CIT and 9.47 ± 0.91 for DIT) and "taste/heat" (9.19 ± 0.89 for COT and 9.41 ± 1.02 for DIT) we did not find a statistically significant difference ($p > 0.005$).

The results of the comparative questionnaires, which are presented in Table 2, show that 100% of patients preferred the digital impression technique when taking more than one impression is neces-

sary and would recommend it to a relative or friend. All subjects indicated that they felt greater discomfort in general during the implementation of the conventional impression technique. To the questions "Which impression technique do you prefer in terms of time required to perform?" and "Which impression technique do you prefer in terms of tooth or gum sensitivity?", 100% of patients indicated the digital impression technique. A total of 14% (n=5) indicated that they preferred the conventional impression technique in terms of taste and smell, while 86% (n=31) preferred the digital impression technique in terms of sound and heat. Depending on the size of the intraoral scanner or impression tray, 86% (n=31)

Table 4. Results of a comparative questionnaire on the preference of men (n = 23) for either of the two impression techniques.

Question	CIT	DIT
1. Which impression technique do you prefer when more than one impression is necessary?	0%	100%
2. During which impression technique did you generally feel more discomfort?	100%	0%
3. Which impression technique would you recommend to a friend?	0%	100%
4. Which impression technique do you prefer in terms of time required to complete?	0%	100%
5. Which impression technique do you prefer in terms of taste/smell or sound/heat?	9%	91%
6. Which impression technique do you prefer in terms of the size of the intraoral scanner/impression tray?	9%	91%
7. Which impression technique do you prefer in terms of the occurrence of sensitivity of the teeth or gums?	0%	100%
8. Which impression technique do you prefer in terms of difficulty breathing during the impression?	0%	100%
9. Which impression technique do you prefer in terms of the occurrence of a gag reflex?	9%	91%

indicated that they preferred DIT and 14% (n=5) preferred the conventional. A total of 91% of the respondents (n=33) stated that they preferred the digital impression technique based on the indicator “difficulty breathing”, and 94% (n=34)—based on the indicator “appearance of a nausea reflex”.

The acquired results by gender are presented in Tables 3 and 4. To the question “*Which impression technique do you prefer in terms of taste/smell or sound/heat?*”, 23% of women (n=3) indicated the conventional impression technique, and 77% (n=10)—the digital one. Similarly, in men the results were: 9% (n=2) indicated CIT, and 91% (n=21)—DIT 6, the distribution of the answers given by gender was similar. Three women (23%) and 2 men (9%) preferred the conventional impression technique in terms of size of the intraoral scanner/impression tray, and 10 women (77%) and 21 men (91%)—the digital one. In regard to the “difficulty breathing” indicator, 23% of women (n=3) preferred CIT, and 77% (n=10)—DIT.

DISCUSSION

In the present study, we focused mainly on patients’ perceptions, comfort, and preference for one of the two impression techniques. Our results show that patients prefer digital over conventional impression technique, because it is more comfortable for them. Differences in the level of comfort, including nausea, difficulty breathing, discomfort in TMJ with a wide open mouth were statistically significant ($p < 0.01$). Similar results have been reported by other authors in their studies (9,15,16). As a disadvantage of some of these studies, it can be pointed out that both types of impression techniques were performed in one clinical visit, which may affect the results obtained (9,15). Because of this reason, we decided to leave an interval of one week between the two visits when performing the impression techniques. In a 2016 study, Joda also reported a preference for the digital impression technology over the conventional impression technology (7). The increased patient comfort with the digital impression technique is due to the ability to interrupt the scanning process if necessary (such as the appearance of saliva, blood, nausea or gag reflex) and its resumption without having to start over.

These results differ from those obtained by Grünheid et al. (17), who reported the preference of

conventional impression technique by patients due to the larger head size of the intraoral scanner. Although the first generations of intraoral scanners were larger, the trend is to reduce them and increase their efficiency. This in turn leads to an increase in patient comfort during the digital impression stage (16,18). Regarding the size of the impression trays/scanner in the present study, only 3 women and 2 men indicated that they preferred the conventional impression technique. Comparing conventional and digital impression techniques with three different types of intraoral scanning systems (ISS), Seiler et al. reported that patients and dentists preferred the CITs in terms of comfort, as well as those ISS that do not require the use of a coating agent (19).

In an in vitro study, Lee & Gallucci compared the preferences of inexperienced students in taking digital and conventional impressions on phantom models. They concluded that digital impression technology was preferable (20).

As a possible drawback of the study, it can be pointed out that all clinical manipulations related to the implementation of both impression techniques were performed by one dentist. However, the inclusion of a second operator would not serve the main purpose of the study, which is to assess patients’ perceptions and attitudes rather than the effectiveness of the method.

The results obtained in the present study show the main reasons why patients prefer digital over conventional impression technique (Table 2).

CONCLUSION

Within the limitations of the current controlled clinical trial in terms of patient comfort and satisfaction, the digital impression technique is better perceived than the conventional one.

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