ORIGINAL ARTICLE

COMPARISON BETWEEN CONVENTIONAL AND DIGITAL IMPRESSION IN IMPLANT SUPPORTED RESTORATIONS

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Abstract: *Background*: The digital revolution has already had an impact in the field of dentistry, and today we are only witnessing the gradual implementation of new digital technologies, depending on each dental office to decide when it is the right time to become an integral part of the technological process that will be indispensable to this field. *Methods*: In this comparative study two types of impression options for implant-supported fixed prosthetic restorations are presented. Moreover, some important information was gathered regarding the type of impressions used, and the number of implants in a private clinic. *Results*: Phases of the digital impression for the restoration of a single missing upper right lateral incisor using an implant-supported crown and the conventional impression technique using the pick-up technique with a transfer device for the maxillary arch are presented with suggestive figures. *Conclusions*: Each branch of dentistry is important, but when it comes to the fabrication of implant-supported prosthetic restorations, digital technology is extremely necessary. It is crucial to understand that software has significantly evolved, and new scanning systems are constantly emerging – each surpassing the previous ones by incorporating specific improved features.

Keywords: conventional impression, digital dentistry, intraoral digital impression, implant supported restorations

1. Introduction

Twenty to thirty years ago, the use of intraoral scanners in dental offices could have been considered fiction, but today this has become not only a reality but also an integrated part of many current dental practices. Until a few years ago, the possibilities for creating implant-supported prosthetic works were limited to traditional impression techniques that were time-consuming and required dental materials. Now, thanks to technological evolution, we have the possibility to create these works using modern methods, concretized through digital impressions. The digital revolution has already had an impact in the field of dentistry, and today we are only witnessing the gradual implementation of new digital technologies, depending on each dental office to decide when it is the right time to become an integral part of the technological process that will be indispensable to this field.

Both conventional and digital impressions for implant-supported prosthetic restorations transfer the intraoral position of dental implants to a working model. Digital impressions use optical methods to capture the position of the implant and transpose it into a virtual model. Conventional methods use impression material and impression techniques to transfer the implant positions onto a cast model made of gypsum, with implant analogs placed in the original positions of the implants.

Digital impressions transfer all intraoral details into a virtual model and represent the first step in the digital workflow. They can accelerate the data acquisition process and eliminate most of the disadvantages commonly associated with conventional impressions, thereby reducing patient discomfort while improving the predictability of prosthesis design and manufacturing procedures [1,2].

Several in vitro studies have demonstrated that intraoral scanners are a reliable and valuable tool for capturing high-quality impressions, suitable for the fabrication of both simple prostheses (such as onlays, inlays, or single crowns) and complex ones, including those supported by implants [3,4].

Thus, the position of the dental implants is recorded and transferred to a cast working model for the subsequent fabrication of implant-supported prostheses [5].

The intraoral scanner workflow begins with the emission of a beam of light (laser or structured light) directed at the object to be scanned. When the light reaches the surface of the object, it is deformed, and this optical effect is captured by two or more cameras located at the tip of the intraoral scanner (IOS) devices. Then, processing software is used to calculate the 3D coordinates (x, y, z) and generate point clouds and meshes [6]. The recording and further interpretation of these point clouds allow the three-dimensional reconstruction of the scanned object, thus creating the model [6-9].

Aim: The aim of this comparative study is to present two different impression options for implant-supported fixed prosthetic restorations. For the selected case studies, either the conventional or the digital method was used alternatively, in order to highlight the accuracy of the impressions obtained through the two different techniques. In this study, the frequency of scanned impression in a private clinic was also evaluated.

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2. Materials and method

In this study it was evaluated the frequency of scanned impression among the patients of a private dental clinic from Craiova, Romania. The results obtained were first noted in a table using as parameters the sex, site of the implants, the number of implants and the impression used. The data was statistically analyzed with Microsoft Office Excel Data Analysis tool kit software (Microsoft Corporation, U.S.A) and presented using suggestive graphics.

For this paper, two relevant cases were documented where partial edentulism was treated with implant supported restorations. The cases were treated by the same doctor, in the same private clinic. Written informed consent was given by all participating patients.

Materials used:

- photos of selected clinical cases;
- consultation kits;
- impression materials (silicones and alginate);
- impression trays (standard and individualized);
- spacers;
- rhodium mirror;
- transfer devices;
- prosthetic key;
- intraoral scanner Medit-i500;
- scanning abutments;
- Medit-i500, a fast intraoral scanner, which, by using two cameras and scanning algorithms, offers increased comfort to the patient in the scanning process.
- export of .STL files allows for a special digital workflow.

Methods used:

- conventional open-tray impression technique (pick-up technique);
- modern intraoral scanning impression technique.

3. Results

In total, 18 patients were selected from the database of a private clinic, patients that were treated with implant supported restorations in the period between 2022-2023. We have gathered information regarding the site of the implants, the number of implants and the impression used.

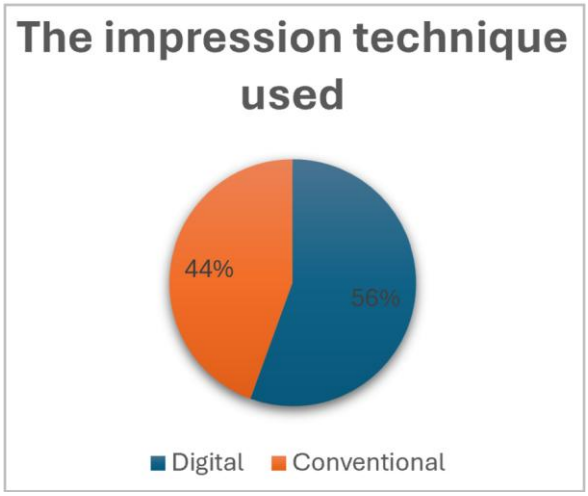

Figure 1. The difference between the digital and conventional impression used.

Our study has shown that there was a higher percentage of the digital impression used in comparison with the conventional one.

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Table 1. Data regarding the selected patients from the clinic.

Patient	Sex	Maxillary	Area	Number of implants	Impression
1	F	Mandible	Lateral	1	Digital
2	M	Mandible	Terminal	1	Conventional
3	F	Maxilla	Lateral	1	Conventional
4	M	Maxilla	Lateral	1	Digital
5	F	Maxilla	Lateral	1	Digital
6	M	Maxilla	Lateral	1	Conventional
7	M	Maxilla	Lateral	1	Digital
8	F	Maxilla	Terminal	1	Digital
9	F	Mandible	Lateral	2	Digital
10	M	Mandible	Lateral	2	Conventional
11	M	Mandible	Terminal	2	Conventional
12	M	Mandible	Terminal	2	Digital
13	F	Maxilla	Lateral	2	Conventional
14	F	Maxilla	Terminal	2	Conventional
15	F	Mandible	Terminal	3	Digital
16	M	Maxilla	Lateral	3	Digital
17	M	Maxilla	Lateral	3	Digital
18	F	Mandible	Terminal	4	Conventional

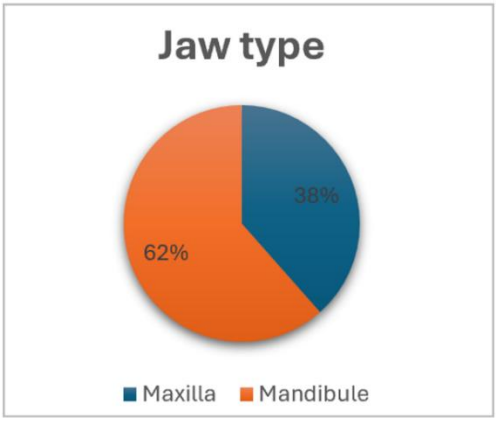

Figure 2. The difference between maxilla or mandible for the implants' placement.

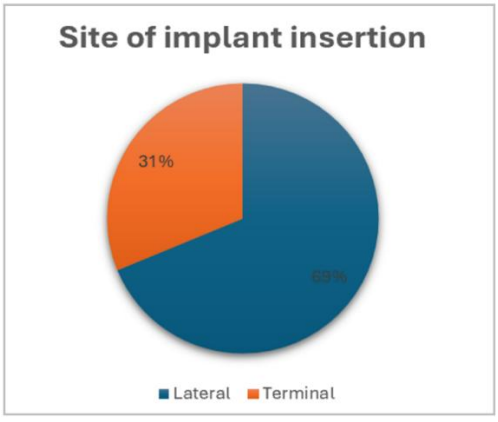

Figure 3. Distribution of patients according to the class of edentulism in the mandibular arch.

From the total of the cases that we selected, the implants were placed predominantly on the mandible level.

Regarding the distribution of the implant sites, we placed the most implants predominantly in the lateral areas of both maxilla and mandible.

The highest percentage of the cases regarding the number of implants places were the cases where 1 implant was placed, whereas the lowest percentage held the cases where 4 implants were used.

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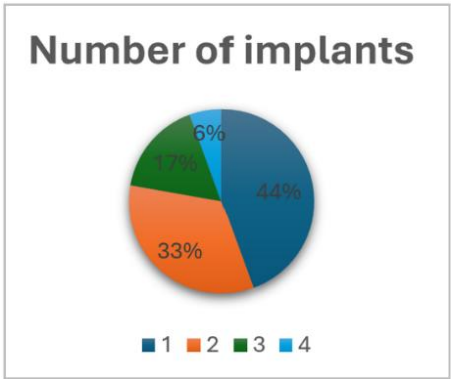

Figure 4. The distribution regarding the number of implants.

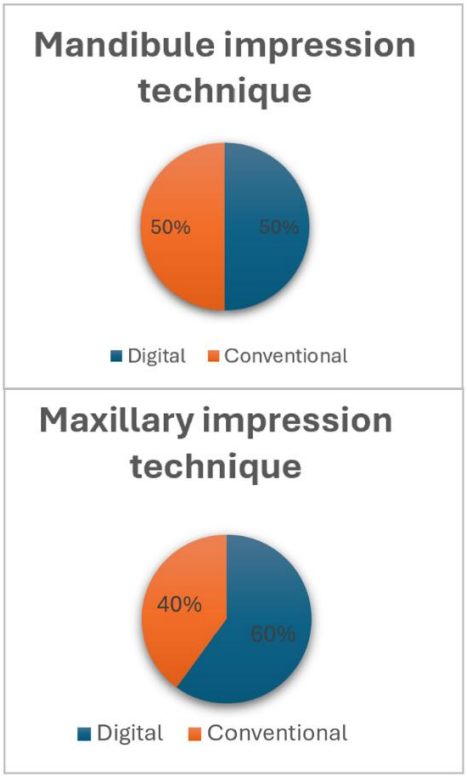

Figure 5. Distribution regarding the impression used on maxilla and mandible.

Regarding the impression used, on the mandible level there was an even distribution of the digital and conventional impression, and on the maxilla level there was a higher percentage of the digital impression.

In our study we noticed that there was no specific correlation between the number of implants used and the type of impression.

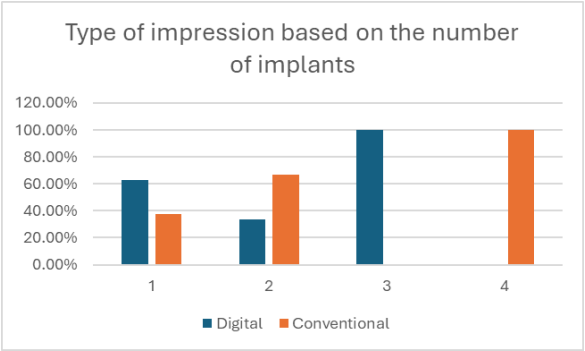

Figure 6. The type of impression used regarding the number of implants.

Relevant cases

The first case involves the restoration of a single missing upper right lateral incisor using an implant-supported crown. After a 6-month period during which osseointegration of the implant was achieved, the provisional restoration was removed, and the prosthetic field was scanned in order to fabricate the definitive implant-supported crown.

The second case involved the fabrication of an implant-supported crown corresponding to the second premolar in the first quadrant. After the implant insertion and a six-month period for its osseointegration, we carried out the stages of the prosthetic treatment. For this case, we chose to perform a conventional three-step impression, using the pick-up technique using an open tray with a transfer device for the maxillary arch. For the impression we have used two types of silicone. For the occlusion we have used Zeta putty silicone (Zhermack, Italy). For the antagonist we have used Tropicalgin alginate (Zhermack, Italy), and for the implant impression we used a polyvinyl siloxane silicone in two consistencies (President Putty + Light Body, Coltene Switzerland).

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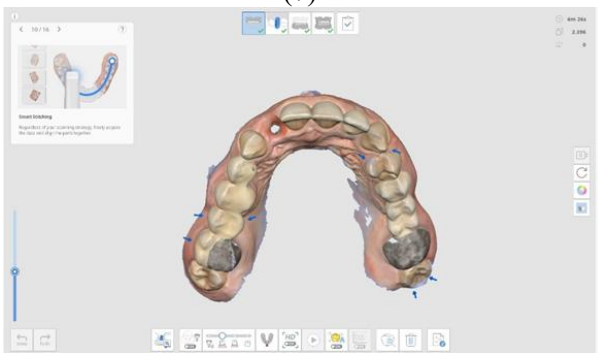

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Figures. (7) Initial view of the clinical situation after removal of the provisional restoration, showing the gingival profile; (8) Scanning of the area of interest without the body scan in place, to capture the gingival profile, using the Medit I500 intraoral scanner; (9) Scanned gingival profile, occlusal view – image captured from the scanner software; (10) Placement of the body scanning abutment for digital impression-taking, occlusal view; (11) Digital impression of the area of interest with the body scan, from different angles.

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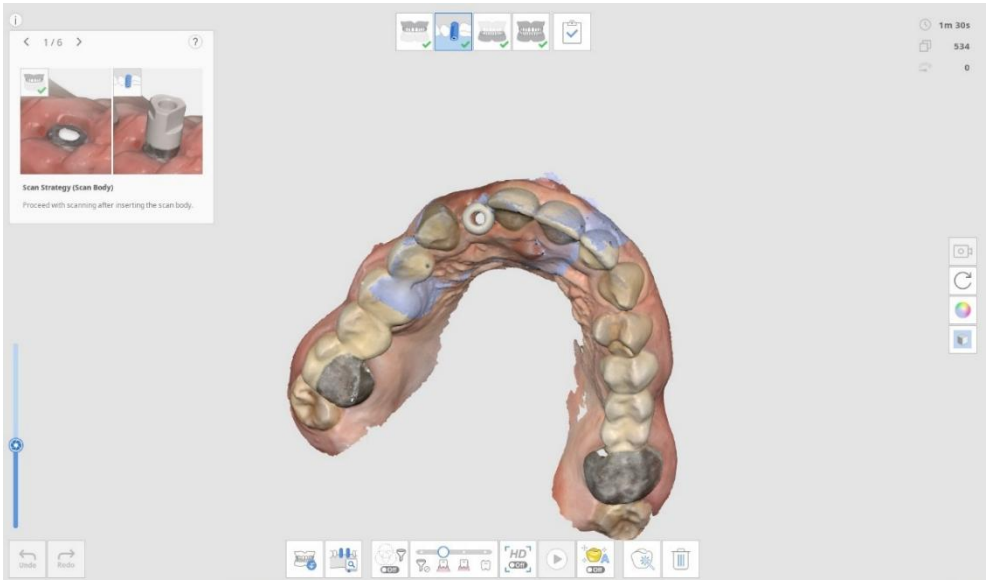

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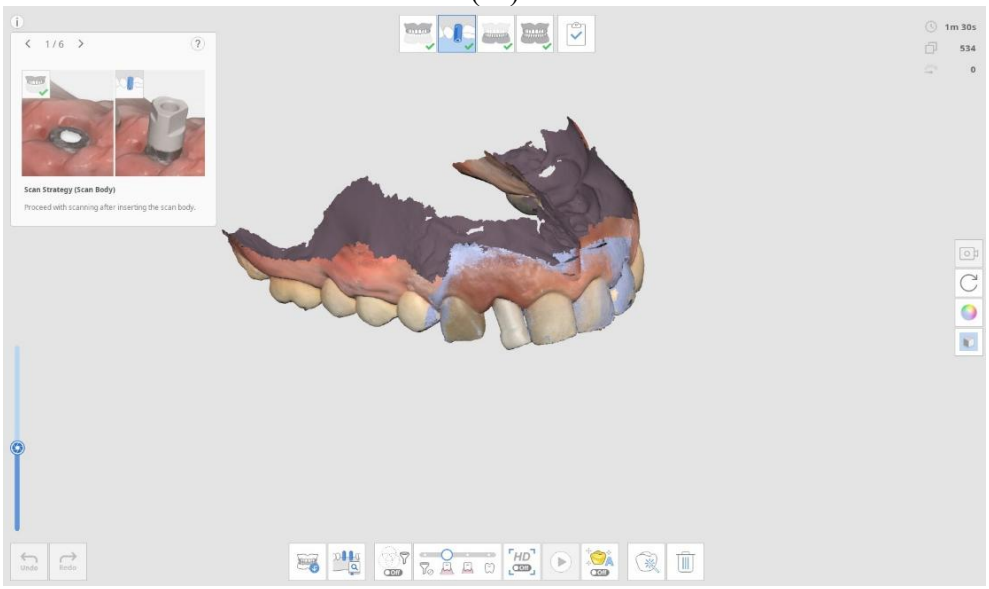

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Figures. (12) Scanning of the body scan, view from the occlusal plane – image taken from the scanner software; (13) Scanning of the body scan, from the buccal view – image taken from the scanner software.

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Figures. (14) Intraoral appearance of the implant inserted in position 15 and the healing abutment, from the lateral view; (15) Preparation of the impression material for determining the occlusal relationships in order to homogenize the two components; (16) Recording of the occlusal relationship in maximum intercuspidation position, frontal view; (17) Impression of the occlusal relationship, extraoral view; (18) Appearance of the transfer device mounted for impression-taking, occlusal view: (19) Selection and verification of the individualized maxillary impression tray for impression-taking of the prosthetic field, lateral view.

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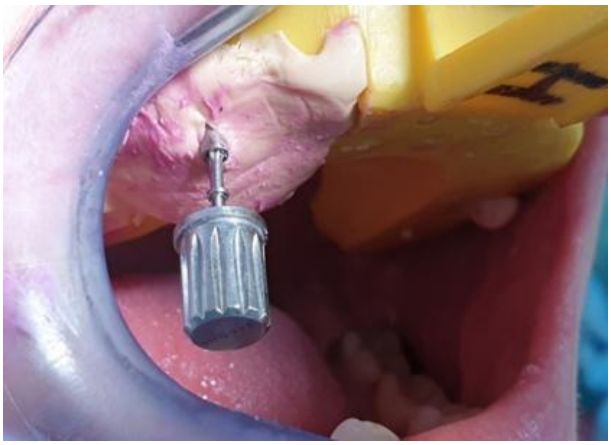

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Figures. (20) Impression of the prosthetic field using the pick-up technique (with an open tray), tray positioning and centering; (21) Unscrewing of the transfer device through the perforations in the impression tray after the material has set; (22) Extraoral appearance of the maxillary arch impression; (23) Positioning of the impression tray loaded with alginate at the level of the opposing arch; (24) Extraoral appearance of the three impressions taken (occlusal relationship, arch with the restoration, opposing arch).

4. Discussion

Recent studies have shown that digital impressions have become increasingly favored due to their enhanced patient comfort, faster data acquisition, and improved accuracy. And that while digital impressions are particularly effective in single-unit and short-span restorations, conventional methods still maintain a significant role in complex cases requiring full-arch accuracy, such as edentulous arches and angulated implants. This aligns with our findings, where digital impressions were predominantly used in single-implant restorations, but conventional methods were still preferred in multi-implant cases, suggesting a selective and case-dependent approach to impression technique [10,11.12].

Onbasi et al. demonstrated that while digital impressions are a reliable alternative to conventional ones, they tend to produce higher local deviations within the complete arch. This observation suggests that clinicians should exercise caution when using digital impressions in the posterior region, where anatomical complexity and limited intraoral space can compromise accuracy. Moreover, conventional impression techniques may still offer superior reliability in such clinical scenarios, particularly for multi-unit and full-arch implant-supported restorations [13,14].

The performance of digital methods can vary depending on the number of implants, arch type, and scanner used. Therefore, the choice of impression technique should be carefully tailored to the individual case, weighing the specific benefits and limitations of each method [15].

In our statistical study, digital impressions were used more frequently than conventional methods, especially in cases where only one implant was required. This trend can be attributed to the ease of use, increased patient comfort, and reduced chairside time associated with digital scanning. Additionally, intraoral scanners eliminate the need for impression materials, which are often uncomfortable for patients and require careful handling and storage.

Multiple studies have investigated the accuracy of digital versus conventional implant impressions in both partially and completely edentulous patients. Digital techniques have also been proven to have difficulties in free-end saddle partially edentulous patients, supporting the continued use of traditional methods in such cases [16].

Although digital systems are promising, their performance is influenced by clinical variables such as implant number, angulation, and arch form [17]. Zhang et al. have stated that several factors—such as scanner type, operator experience, and scanning strategy—can significantly affect the accuracy of full-arch digital impressions [18]. In our study, digital impressions were not only more frequently used, but also appeared to be the default choice in simple clinical cases—indicating a growing confidence for the practitioner in using digital workflows, despite the continued reliance on conventional techniques in more demanding cases.

Over time, various impression techniques have been used to achieve the best results, but the optimal method has not yet been established and may vary from case to case. The goal is to make the process as easy as possible in order to cause minimal discomfort to the patient and, most importantly, to provide the highest accuracy [19]. In our

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study, the use of digital impression was well accepted by the patients, as the use of the conventional tray can be uncomfortable.

Living in the digital era, implant prosthetics is also evolving positively, both in terms of the accuracy of impressions for making implant-supported prosthetic works and in saving time through intraoral scanning, completely eliminating the need for dental materials.

Several in vitro studies have shown that intraoral scanners are an important and reliable tool for capturing high-quality impressions, which can be used for the fabrication of both simple prostheses (onlays, inlays, or single crowns) and complex ones, including implant-supported restorations [20,21]. Taking a digital impression is a very user-friendly procedure that serves everyday clinical practice. However, behind the simplicity of this procedure lies a rather complex working mechanism [22,23]. In our study the majority of digital impression methods were used in the cases of single implants, but we have also started to use this technique in multiple implant cases, which suggests that it has the potential to be used more frequently in the future.

Every branch of dentistry is important, but when it comes to making implant-supported restorations, digital technology is extremely necessary. It is very important to know that software has advanced significantly, and new systems for impression-taking are constantly appearing, surpassing previous ones with specific added features.

A continuous analysis of available dental impression materials on the market and their properties, as well as the various digital systems and their characteristics, is absolutely necessary.

The accuracy of the impression is crucial for ensuring the good prognosis of implant supported restorations. Therefore, particular attention should be given to factors such as the impression material, technique, type of tray used, and whether or not splinting is performed [24]. Although custom trays generally provide more consistent results, accurate impressions can still be achieved using stock trays. When a rigid stock tray is combined with an appropriate impression material and a well-executed protocol, it can serve as a viable alternative to custom trays for implant fixture-level impressions [25]. With the availability of various techniques and developments the clinician must select the material and technique best suited to the particular situation [26]. In our cases we have successfully used the open tray technique, a technique which has been used in the last years successfully. It is a very reliable technique with the condition of the very good placement and tightly screwing the transfer device to prevent potential errors.

Regarding the digital impression, in order to accurately capture the position of the implant with a digital impression, it is necessary to use a specific transfer device called an intraoral scan body (ISB) [27].

In cases where mouth opening is limited, the direct technique is difficult to perform due to the length of the scan body. Clinical situations such as patients with a strong gag reflex also compel the clinician to use the indirect technique [28].

By using a prefabricated impression tray, the thickness of the impression material around the impression coping is greater,

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thereby providing more support and a more stable impression [29,30].

5. Conclusions

Living in the digital era, implant prosthetics has also evolved positively, both in terms of impression accuracy for implant-supported restorations and in terms of time efficiency through intraoral scanning, which completely eliminates the need for impression materials.

Each branch of dentistry is important, but when it comes to the fabrication of implant-supported prosthetic restorations, digital technology is extremely necessary. It is crucial to understand that software has significantly evolved, and new scanning systems are constantly emerging—each surpassing the previous ones by incorporating specific improved features. Thus, a comprehensive understanding of each technique's limitations and appropriate clinical indications is essential for optimal outcomes

The conventional impression is a very reliable option. However, the comfort that digital techniques can bring could place greater emphasis on the use of digital techniques in the future.

It is absolutely essential to continuously analyze the dental impression materials available on the market and their properties, as well as the various digital systems and their specific characteristics.

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Author contributions

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Conflict of interest statement

There are no potential conflicts of interest concerning this study.

Data availability statement

Data available on request.

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