



Digital impression technique versus conventional impression in implant: A Literature Review

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ABSTRACT:

Dental implants are prosthesis (artificial tooth roots) that are placed into the jawbone to support a dental prosthesis. They are typically made from a biocompatible metal that fuses with the jawbone over time. This process, known as osseointegration that creates a strong and stable foundation for the replacement tooth or bridge.

Success or failure of implants depends mainly on the thickness and health of the bone and gingival tissues that surround the implant, the health of the person that receive the treatment and the impression making for the implant is one of the important factors to obtain a good prosthesis because it is a key factor to achieve long-lasting, functional, passive and esthetic restorations. There are two types of impressions that can be used for dental implant treatment, conventional impression technique and digital impressions technique.

AIM: This study intended to perform a literature review to compare digital impression techniques and conventional impression techniques in dental implant treatment and to explore the findings of various studies that have compared the two methods. The review will assess the accuracy, speed, and comfort of both methods for the patient, as well as their impact on the success of the implant including accuracy and time, also explains how digital impression techniques use digital technology, including intraoral scanning, CAD/CAM to create precise and accurate restorations.

MATERIALS AND METHODS: A Medline, PubMed and EBSCO Host databases search, SCOPUS, and Google Scholar databases were analyzed, which collected studies published from 2015 to 2022. Laboratory studies, case reports and systematic reviews were included and, therefore, excluded articles that did not deal with the impression materials. We selected 34 articles.

CONCLUSION: The studies reviewed showed that there is no clear winner between digital and conventional impression techniques in terms of accuracy. Both techniques have their own strengths

and limitations, while some studies showing that digital impressions are more accurate, the others showed that conventional impressions are more accurate. The results vary depending on the type of implant, the number of implants, the angulation of the implants, and the level of edentulism. However, some studies suggest that digital impressions are becoming more accurate and are a viable alternative to conventional impressions. However, more research is needed to determine their clinical accuracy and to recommend them for routine clinical use.

Keywords: Digital impression, Dental Implant, Conventional Impression, Intraoral Scanning, CAD/CAM.

I. INTRODUCTION:

Dental implants are prosthesis (artificial tooth roots) that are placed into the jawbone to support a dental prosthesis such as a crown, bridge, denture, facial prosthesis or to act as an orthodontic anchor. They are typically made from a biocompatible metal that fuses with the jawbone over time. This process, known as osseointegration that creates a strong and stable foundation for the replacement tooth or bridge. Implants are an option for people who have lost one or more teeth due to injury, periodontal disease, or other reasons, also for full arch replacement, orthodontic anchorage, and facial reconstruction to support facial prostheses for people who have lost parts of their face due to cancer or other conditions.(1)

Dental implants offer many benefits, including improved chewing and appearance, enhanced comfort and speech, preservation of surrounding bone and gum health, and improved oral health without affecting other teeth. Success or failure of implants depends mainly on the thickness and health of the bone and gingival tissues that surround the implant, the health of the person that receive the treatment and the impression making for the implant is one of the important factors to obtain a good prosthesis because it is a key factor to



achieve long-lasting, functional, passive and esthetic restorations.(2)

There are two types of impressions that can be used for dental implant treatment, including: conventional impression technique and digital impressions technique. Conventional impression techniques in dental implantology which use the physical materials and tools to capture the patient's dental anatomy and create a replica of the teeth and gums, the cast is produced after an impression has been made with a tray filled with an impression material(3).

These techniques have been used for a long time in dentistry as they are the gold standard methods of transferring information from the patient to the dental laboratory when making indirect restorations. They are relatively simple, inexpensive, and easy to use. However, they are less accurate compared to digital impression techniques and require more time and steps in the laboratory to make the final restoration.(4)

Digital impression procedures have been introduced in fixed and implantprosthodontics; these procedures have several advantages over conventional impression techniques. They are more accurate, faster, and more comfortable for the patient, and can reduce the need for multiple appointments. The current applications of digital technology in fixed implant rehabilitation include: three-dimensional (3D) diagnostic imaging and related digital implant treatment planning, digitally-planned template guided implant placement, digital scans and (CAD/CAM).(5)

Dental CAD/CAM machine (computer-aided design and computer-aided manufacturing) is digital device used in the dental field to create precise and accurate restorations, including those for dental implant. In this system, digital impressions are taken by intraoral scanner, which collects information about projecting light. Reproducible tissues are shown on the hardware display as natural looking. The main structures of the prosthetic design in terms of data are 3D in the prepared teeth, the adjacent teeth, and the occlusion with the opposing bite. The intraoral scanner measures the light reflection times of the subject surface. The description, based on data and calculation algorithms to copy the software, calculates and generates a computer screen image of the prepared area.(6)

II. MATERIALS AND METHODS

A Medline, PubMed and EBSCO Host databases search, SCOPUS, and Google Scholar databases were analyzed, which collected studies published from 2015 to 2022. Laboratory studies,

case reports and systematic reviews were included and, therefore, excluded articles that did not deal with the impression materials. We selected 34 articles. The following titles of specific medical subjects and keywords were used: digital impression, dental implant, conventional impression, intraoral scanning and CAD\CAM.

Inclusion criteria comprised studies at all levels of evidence, excluding expert opinion, such as experimental clinical studies, in vitro and in vivo studies. All articles evaluating at least one of the following subjects were included: digital impressions in implant dentistry, digital scanning techniques, intraoral scanning, conventional impression CAD\CAM. Exclusion criteria comprised multiple publications based on the same population and with wrong study designs. Experimental clinical studies, and in vitro and in vivo studies, that analyzed the accuracy of digital impressions only on teeth were excluded.

This review intended to compare digital impression techniques and conventional impression techniques in dental implant treatment and to explore the findings of various studies that have compared the two methods. The review will assess the accuracy, speed, and comfort of both methods for the patient, as well as their impact on the success of the implant including accuracy and time, also explains how digital impression techniques use digital technology, including intraoral scanning, CAD/CAM to create precise and accurate restorations. There are many studies that talked about the digital and conventional impression techniques in implant and compare them to each other. In this review, we will explore the findings of these studies and their implications (7).

III. RESULTS

A total of 34 articles were reviewed in the present study, it was not possible to perform the statistical analysis due to the report variability and the limited number of identified studies.

Gherlone. E et al (2016) studied the accuracy of conventional and digital impressions for "All-on-Four" dental restorations in patients with severe mandibular or maxillary atrophy. They showed that digital impressions were faster than conventional impressions and that the CAD/CAM cobalt-chromium full-arch rehabilitations produced using digital impressions had satisfactory accuracy, with no implant dropouts observed in the study. (7)

Amin.S et al (2017) used CEREC Omnicam and 3M True Definition to compare the accuracy of digital full-arch implant impressions with conventional ones. They showed that digital impressions with the True Definition scanner were



significantly more accurate and had less 3D deviations compared to the Omnicam and the conventional splinted open-tray impressions.⁽⁸⁾

Rutkūnas. V et al (2017) evaluated the accuracy of digital implant impressions taken with intraoral scanners compared to conventional techniques. The accuracy of digital impressions was influenced by factors such as implant angulation, distance between implants, implant placement depth and operator experience. They concluded that digital implant impressions are a valid alternative to conventional impressions for single and multi-unit implant-supported restorations.⁽⁹⁾

Mangano.F et al (2017) evaluated the advantages and disadvantages of intraoral scanners (IOS) compared to conventional impressions, assessed the accuracy of IOS, compared the different IOS available, and determined the current clinical applications and limitations of IOS. The current IOS are sufficiently accurate for various prosthetic restorations but not for long-span restorations, and can be integrated in implant dentistry and orthodontics.⁽¹⁰⁾

Joda .T et al (2017) evaluated the benefits of using digital protocols, such as a reduced need for physical master casts, no space for storage, and reduced production costs. They concluded that the digitization process has the potential to change the entire dental profession and improve time efficiency, lower production costs, and meet patients' expectations for a modernized treatment concept.⁽¹¹⁾

Alikhasi .M et al (2018) compared the accuracy of digital and conventional impression techniques for maxillary full arch implants with different angulation and connection types. They used two maxillary acrylic resin models with straight and angled anterior implants and straight and angled posterior implants of two different connection types (internal and external) were used as a reference model. Impression techniques included digital impression with intraoral scanner (Trios 3Shape) and custom open and closed tray with additional silicone for direct and indirect conventional impression. They concluded that the digital impression technique had lower angular and linear distortions and more accurate compared to the conventional techniques, also, the connection type and implant angulation did not affect accuracy of digital impression, but had a significant effect on accuracy of conventional impression.⁽¹²⁾

Menini .M et al (2018) evaluated the accuracy of 8 different impression techniques for multiple dental implants. The techniques were tested on a master cast simulating a jaw with four

implants. They concluded that the digital impression technique performed the best and may offer a viable alternative to conventional impression, while conventional impression techniques showed greater variability in accuracy.⁽¹³⁾

An in vitro study for Marghalani .A et al (2018) compared the accuracy of digital implant scans using two different intraoral scanners (Omnicam and True Definition) with that of conventional impressions for partially edentulous arches. They used 2 partially edentulous mandibular casts with 2 implant analogs from 2 different implant systems as controls. They concluded that both the impression technique and the implant system affected accuracy, with the True Definition technique having the fewest 3D deviations compared to the other two techniques. However, all techniques were within clinically acceptable levels and not all differences were statistically significant.⁽¹⁴⁾

Alshawaf .B et al (2018) compared the accuracy of printed implant casts from digital impressions (with two different intra-oral scanners) to stone casts from conventional impressions. They concluded that the conventional stone casts had the best accuracy, followed by the printed casts from the white light intra-oral scanner, and the printed casts from the active wavefront sampling technology intra-oral scanner had the worst accuracy.⁽¹⁵⁾

Ahlholm .P et al (2018) evaluated the evidence of possible benefits and accuracy of digital impression techniques versus conventional impression techniques. They concluded that digital impression techniques can serve as a clinically acceptable alternative to conventional techniques for crowns and short FDPs, with the advantage of faster operation time. However, for full-arch impressions, the conventional impression technique is still recommended.⁽¹⁶⁾

Flügge .T et al (2018) compared the accuracy of conventional and digital implant impressions in implant-supported dental prostheses. They showed high heterogeneity for both conventional and digital impressions, and there is low evidence level for the accuracy of these techniques, lacking sufficient in vivo data for clinical recommendations.⁽¹⁷⁾

Cappare .P et al (2019) differentiated between conventional vs digital impressions for full-arch maxillary rehabilitations supported by 6 immediately loaded dental implants. They concluded that the use of an intraoral scanner (IOS) for digital impression was a reliable alternative for full-arch implant rehabilitations and



provided a satisfactory accuracy and predictability in clinical practice.⁽¹⁸⁾

RokKim.K et al (2019) tested the accuracy of two implant impression techniques: conventional open-tray impressions and intraoral digital scans. The study was conducted on a maxillary edentulous model with 6 implant replicas. They concluded that the conventional open-tray impressions were more accurate in terms of trueness and precision compared to the intraoral digital scans.⁽¹⁹⁾

Alsharbaty .M et al (2019) evaluated the accuracy of digital implant impressions made with a TRIOS 3Shape intraoral scanner (IOS) compared to conventional implant impression techniques (pick-up and transfer) in patients with two implants in the posterior region. They concluded that the digital implant impression technique had the least accuracy with large distance and angulation errors.⁽²⁰⁾

Rech-Ortega.C et al (2019) compared a conventional impression technique using an elastomeric impression material (EIM) with a digital technique using a scanner digital model (SDM) on a six-analog master model. They concluded that in a clinical situation with less than three implants, the EIM is more accurate than the SDM, but in cases of four implants, the SDM is more accurate. For rehabilitation cases with more than four implants, neither technique can be considered accurate, although the error falls within the tolerance limits established in the literature.⁽²¹⁾

Liu .Y et al (2019) compared the accuracy of multi-implant impressions for full dental arches made with 3D printing technology to those made with conventional techniques. They concluded that the 3D printed impressions showed less deviation in implant position and had stronger mechanical properties compared to the conventional impressions.⁽²²⁾

Chochlidakis .K et al (2020) compared the accuracy of digital and conventional maxillary implant impressions for edentulous patients. They concluded that full-arch digital scans are within clinically acceptable accuracy and can be used in the fabrication of maxillary fixed complete dentures.⁽²³⁾

Vazouras .K et al (2020) compared the 3D accuracy of digital and conventional implant impressions in both completely and partially edentulous patients. They concluded that digital impressions had less deviation compared to conventional impressions for completely edentulous patients, but for partially edentulous patient's conventional impressions had less deviation compared to digital impressions.⁽²⁴⁾

Huang .R et al (2020) compared the accuracy of digital impressions taken with three different scan bodies (original, CAD/CAM without extensional structure, and CAD/CAM with extensional structure) with that of conventional splinted open-tray impressions for complete-arch implant rehabilitation. They showed that the newly designed CAD/CAM scan body with extensional structure had the highest accuracy, while the conventional splinted open-tray impressions were still more accurate than the digital impressions.⁽²⁵⁾

Papaspyridakos .P et al (2020) compared the accuracy of 3D printed casts generated from complete-arch digital implant scans with traditional stone casts made from conventional impressions. They concluded that the implant 3D deviations of the printed casts from digital scans may be within the acceptable range for clinical use, but still showed statistically significant differences compared to the master cast.⁽²⁶⁾

Schmidt. A et al (2021) compared the transfer accuracy of conventional and digital implant impressions in patients using a new reference key-based method. They concluded that the digital impressions in the upper jaw showed comparable results to conventional impressions, but there were still limitations for digital impressions in the lower jaw with regards to transfer accuracy.⁽²⁷⁾

Siqueira.R et al (2021) evaluated the impact of intraoral scanning (IOS) on working time and patient-reported outcomes compared to conventional impressions (CI) in fixed prosthodontics and implant dentistry. Many studies were analyzed and they concluded that IOS is faster than CI, regardless of the size of the scanned area and nature of the restoration. Additionally, IOS was found to improve patient experience, as it was generally preferred by patients over CI. They suggested that IOS can improve clinical efficiency and provide reliable prosthodontic outcomes.⁽²⁸⁾

Albayrak. B et al (2021) tested the accuracy of digital impressions taken with three different intraoral scanners (Carestream 3500, CerecOmnicam and 3Shape Trios 3) to a conventional impression technique in a complete arch implant model. They showed that all digital impression groups had higher trueness compared to the conventional group. The Carestream 3500 showed the highest trueness in both distance and angular measurements. They suggested that intraoral scanners can be used in complete arch implant cases with high angulations.⁽²⁹⁾

Abduo. J et al (2021) evaluated the accuracy of digital impressions made using



intraoral scanners (IOS) systems in comparison to conventional impressions for recording the positions of 2 parallel implants and 2 divergent implants. They concluded that digital impressions appeared to have sufficient accuracy for 2 implants and were least affected by the presence of angle between implants.⁽³⁰⁾

Banjar.A et al (2021) compared the 3D accuracy of 3D printed casts made from digital implant impressions with an intraoral scanner to stone casts made from conventional impressions. They found that the casts generated from the Varese S 3D printer had better 3D accuracy than those from the Form 2 3D printer, while both the Varese S group and the conventional stone casts groups had similar 3D accuracy.⁽³¹⁾

Nagata et al. (2021) compared the accuracy of digital and silicone impressions for single-tooth implants and two- and three-unit implants for a free-end edentulous saddle. 30 patients were enrolled in the study, and conventional silicone-based and digital IOS-based impressions were made for all patients. They showed that IOS and CAD/CAM can find clinical applications for implant-supported prostheses of up to three units for a bounded edentulous saddle, and the use of IOS could make implant treatment easier. However, further validation of the accuracy of IOS impressions is required for patients with multiple missing teeth in long-span implant prostheses.⁽³²⁾

Revilla-León .M et al (2021) compared the accuracy of conventional impressions, photogrammetry, and 2 intraoral scanners in capturing the positions of implant abutment replicas. They concluded that the conventional impression method had the lowest 3D discrepancy, while photogrammetry had the highest 3D discrepancy and the least accurate values. The intraoral scanners provided similar linear distortion compared to the conventional method, but were not significantly different from each other.⁽³³⁾

Bowen Ma et al (2021) compared the accuracy of photogrammetry, intraoral scanning, and conventional impression techniques for complete-arch implant rehabilitation. They found that photogrammetry system showed the best accuracy followed by the conventional impression technique, while the intraoral scanner provided the least accuracy.⁽³⁴⁾

Marques.S et al (2021) determined the factors that may influence the accuracy of digital impressions in implant dentistry. The criteria included accuracy of digital impressions, design and material of intra-oral scan bodies (ISBs), scanning techniques, implant depth/angulation, and

accuracy of different intra-oral scanner devices. They concluded that the accuracy of digital impressions in implant dentistry depends on several factors, including implant depth/angulation, operator experience, intra-oral scanner used, and environmental conditions. However, the design and material of ISBs and scanning techniques were found to have a major impact on the trueness and precision of digital impressions in implant dentistry. Further research is needed to optimize ISB design and scanning protocols.⁽³⁵⁾

Lyu.M et al (2022) compared the accuracy of digital scans obtained using intraoral scanners to those obtained through conventional impression techniques in edentulous arches with multiple implants. They concluded that the accuracy of impressions with multiple implants was influenced by the method used for scanning or impression, the range of scanning, and the evaluation method used.⁽³⁶⁾

Papaspyridakos.P et al (2022) compared the accuracy of full-arch digital scans to conventional implant impressions in 36 edentulous jaws. They concluded that the 3D implant deviations found between the full-arch digital and conventional impressions were within the clinically acceptable threshold.⁽³⁷⁾

Li.J et al (2022) compared 8 impression-making methods for edentulous arches, including conventional impression materials (irreversible hydrocolloid, polysulfide, polyether, and polyvinyl siloxane) and two intraoral scanners (with and without the assistance of a 3-dimensionally printed polyetheretherketone (PEEK) scanning aid. They showed that intraoral scanners demonstrated accuracy comparable with conventional impression materials, regardless of the concepts used to express the trueness and precision. The use of PEEK-based scanning aid did not improve the accuracy of the intraoral scanners, but did result in higher accuracy compared to conventional impression materials.⁽³⁸⁾

Abdeen.L et al (2022) evaluated the accuracy of fit of a reference prosthesis on 3D-printed casts and stone casts. They used a partially edentulous maxillary master cast with two internal connection implants and a reference implant-supported prosthesis was fabricated. Conventional impressions were taken to create stone casts as the control group, and digital scans of the master cast were used to print 10 casts for each of four different 3D printers. They found that the reference prosthesis fit was clinically acceptable on all casts, and that the printed casts had statistically significant lower 3D deviations than stone casts. They concluded that 3D-printed casts may be used



as definitive master casts to fabricate implant-supported fixed dental prostheses for the partially edentulous anterior maxilla.⁽³⁹⁾

Albanchez-González.M et al (2022) evaluated the in vitro accuracy of dental implants impressions taken with intraoral scanner compared with impressions taken with conventional techniques. They concluded that digital impressions are a valid alternative to conventional impressions for partial dentation and single implants, but conventional impressions are considered more accurate. More studies are needed to recommend digital impressions for complete dentation.⁽⁴⁰⁾

IV. CONCLUSION:

Based on the limitation of the review, and considering the limitations mentioned, some preliminary conclusions can be drawn.

1. There is evidence that using digital impressions are an accurate procedure in implant dentistry
2. The scanning procedure may have an impact on the precision of the digital impressions, regardless of the intraoral scanner technology utilized.
3. it appears that the accuracy of the digital impressions is unaffected by implant angulation. On the other hand, implant depth may affect the accuracy of the procedure. However, clinical guidelines cannot be established based on the presented data.

Clinical guidelines cannot be drawn based on the current data. Further investigations focusing on the in vivo use of digital impressions in implant dentistry are required

REFERENCES

- [1]. Shuxratovich. SH, et al. The Country Of Dental Implanting, The Risks Involved. The American Journal Of Medical Science And Pharmaceutical Research.2021;Vol. (3), :142-46.
- [2]. Misch. C, et al. Implant success, survival, and failure: the International Congress of Oral Implantologists (ICOI) Pisa Consensus Conference. Implant Dent. 2008;Vol (1), : 5-15.
- [3]. Chee. W, et al. Impression techniques for implant dentistry.Br Dent J.2006; Vol. (7), pp: 429-32.
- [4]. Zarbakhsh. A,et al. Accuracy of Digital Impression Taking Using Intraoral Scanner versus the Conventional Technique. Front Dent. 2021; Vol. (18), pp: 6.
- [5]. Chochlidakis. K, et al. Digital Versus Conventional Full-Arch Implant Impressions: A Prospective Study on 16 Edentulous Maxillae.J Prosthodont.2020; Vol. (4), pp: 281-86.
- [6]. Kinga. B, et al. Accuracy of Digital vs Conventional Implant Impression Approach: A Three-Dimensional Comparative In Vitro Analysis. Int J Oral Maxillofac Implants.2017; Vol. (4);: 792-99.
- [7]. Gherlone. E, et al. Conventional Versus Digital Impressions for "All-on-Four" Restorations.Int J Oral Maxillofac Implants. 2016; Vol. (31);: 324-30.
- [8]. Amin. S, et al. Digital vs. conventional full-arch implant impressions: a comparative study.Clin Oral Implants Res. 2017; Vol. (11);: 1360-67.
- [9]. Rutkūnas. V, et al. Accuracy of digital implant impressions with intraoral scanners.Eur J Oral Implantol. 2017; Vol. (10);: 101-20.
- [10]. Mangano.F, et al. Intraoral scanners in dentistry: a review of the current literature. BMC Oral Health. 2017; Vol. (17);: 149-60.
- [11]. Joda. T, et al. Digital technology in fixed implant prosthodontics. Periodontol 2000. 2017; Vol. (73);: 178-92.
- [12]. Alikhasi. M, et al. Three-Dimensional Accuracy of Digital Impression versus Conventional Method: Effect of Implant Angulation and Connection Type. Int J Dent. 2018; Vol. (2018);: 1-9.
- [13]. Menini. M, et al. Accuracy of multi-unit implant impression: traditional techniques versus a digital procedure. Clin Oral Investig. 2018; Vol. (3);:1253–62.
- [14]. Marghalani. A, et al. Digital versus conventional implant impressions for partially edentulous arches: An evaluation of accuracy. J Prosthet Dent. 2018; Vol. (4);: 574-79.
- [15]. Alshawaf. B, et al. Accuracy of printed casts generated from digital implant impressions versus stone casts from conventional implant impressions: A comparative in vitro study. Clin Oral Implants Res. 2018; Vol. (8);: 835-42.
- [16]. Ahlholm. A, et al. Digital Versus Conventional Impressions in Fixed Prosthodontics: A Review.J Prosthodont. 2018; Vol. (1);: 35-41.
- [17]. Flüge.T, et al. The accuracy of different dental impression techniques for implant-



- supported dental prostheses: A systematic review and meta-analysis. *Clin Oral Implants Res.* 2018, Vol. (29),: 374-92.
- [18]. Cappari, P, et al. Conventional versus Digital Impressions for Full Arch Screw-Retained Maxillary Rehabilitations: A Randomized Clinical Trial. *Int J Environ Res Public Health.* 2019; Vol. (5),: 829.
- [19]. Kim, K, et al. Conventional open-tray impression versus intraoral digital scan for implant-level complete-arch impression. *J Prosthet Dent.* 2019; Vol. (6),: 543-49.
- [20]. Alsharbaty, M, et al. A Clinical Comparative Study of 3-Dimensional Accuracy between Digital and Conventional Implant Impression Techniques. *J Prosthodont.* 2019; Vol. (4),: 902-08.
- [21]. Rech-Ortega, C, et al. Comparative in vitro study of the accuracy of impression techniques for dental implants: Direct technique with an elastomeric impression material versus intraoral scanner. *Med Oral Patol Oral Cir Bucal.* 2019; Vol. (24),: 89-95.
- [22]. Liu, Y, et al. Accuracy of multi-implant impressions using 3D-printing custom trays and splinting versus conventional techniques for complete arches. *Int J Oral Maxillofac Implants.* 2019; Vol. (34),: 1007-14.
- [23]. Chochlidakis, K, et al. Digital Versus Conventional Full-Arch Implant Impressions: A Prospective Study on 16 Edentulous Maxillae. *J Prosthodont.* 2020; Vol. 29,: 281-86.
- [24]. Papaspyridakos, P, et al. Digital vs Conventional Implant Impressions: A Systematic Review and Meta-Analysis. *J Prosthodont.* 2020; Vol. (29),: 660-78.
- [25]. Huang, R, et al. Improved scanning accuracy with newly designed scan bodies: An in vitro study comparing digital versus conventional impression techniques for complete-arch implant rehabilitation. *Clin Oral Implants Res.* 2020; Vol. (31),: 625-33.
- [26]. Papaspyridakos, P, et al. Digital workflow: In vitro accuracy of 3D printed casts generated from complete-arch digital implant scans. *J Prosthet Dent.* 2020; Vol. (124),: 589-93.
- [27]. Schmidt, A, et al. A comparative clinical study on the transfer accuracy of conventional and digital implant impressions using a new reference key-based method. *Clin Oral Implants Res.* 2021; Vol. (32),: 460-69.
- [28]. Siqueira, R, et al. Intraoral scanning reduces procedure time and improves patient comfort in fixed prosthodontics and implant dentistry: a systematic review. *Clin Oral Investig.* 2021; Vol. (25),: 6517-31.
- [29]. Albayrak, B, et al. Three-Dimensional Accuracy of Conventional Versus Digital Complete Arch Implant Impressions. *J Prosthodont.* 2021; Vol. (30),: 163-70.
- [30]. Abduo, J, et al. Accuracy of digital impressions versus conventional impressions for 2 implants: an in vitro study evaluating the effect of implant angulation. *Int J Implant Dent.* 2021; Vol. (7),: 75.
- [31]. Banjar, A, et al. Accuracy of 3D Printed Implant Casts Versus Stone Casts: A Comparative Study in the Anterior Maxilla. *J Prosthodont.* 2021; Vol. (30),: 783-88.
- [32]. Nagata, K, et al. Comparison of digital and silicone impressions for single-tooth implants and two- and three-unit implants for a free-end edentulous saddle. *BMC Oral Health.* 2021; Vol. (21),:464
- [33]. Revilla-León, M, et al. Comparison of conventional, photogrammetry, and intraoral scanning accuracy of complete-arch implant impression procedures evaluated with a coordinate measuring machine. *J Prosthet Dent.* 2021; Vol. (125), : 470-78.
- [34]. Ma, B, et al. Accuracy of photogrammetry, intraoral scanning, and conventional impression techniques for complete-arch implant rehabilitation: an in vitro comparative study. *BMC Oral Health.* 2021; Vol. (21),: 636.
- [35]. Marques, S, et al. Digital Impressions in Implant Dentistry: A Literature Review. *Int J Environ Res Public Health.* 2021; Vol. (18),: 1020.
- [36]. Lyu, M, et al. Accuracy of impressions for multiple implants: A comparative study of digital and conventional techniques. *J Prosthet Dent.* 2022; Vol. (128),: 1017-23.
- [37]. Papaspyridakos, P, et al. Digital vs Conventional Full-Arch Implant Impressions: A Retrospective Analysis of 36 Edentulous Jaws. *J Prosthodont.* 2022; vol. (32),: 325-30.
- [38]. Li, J, et al. Accuracy of impression-making methods in edentulous arches: An



- in vitro study encompassing conventional and digital methods. *J Prosthet Dent.* 2022;Vol.(128),: 479-86.
- [39]. Abdeen. L, et al. Prosthesis accuracy of fit on 3D-printed casts versus stone casts: A comparative study in the anterior maxilla. *J Esthet Restor Dent.* 2022;Vol. (34),: 1238-46.
- [40]. Albánchez-González. M, et al. Accuracy of Digital Dental Implants Impression Taking with Intraoral Scanners Compared with Conventional Impression Techniques: A Systematic Review of In Vitro Studies. *Int J Environ Res Public Health.* 2022; vol. (19),: 2026.