



DIGITAL VS. CONVENTIONAL IMPLANT IMPRESSIONS: A SYSTEMATIC REVIEW

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ABSTRACT As we move from conventional analog treatment protocols to the ever evolving digital universe, the world of dentistry has forever changed. Implant dentistry is one of the most dynamic and rapidly developing areas within oral healthcare. The implementation of digital processing can be regarded as the technological key development for the next generation of implant treatment protocols, including 3D cone beam computed tomography planning software, intraoral scanning and computer assisted design and computer assisted manufacturing (CAD-CAM). This new technology has become easier and convenient to use for the clinicians & offers technological advances over conventional techniques. The purpose of this present review were to investigate the scientific data related to digital vs. Conventional implant impression accuracy.

KEYWORDS : implant, implant impressions, digital implant impressions, impression techniques, intraoral scanning, CAD-CAM.

I. INTRODUCTION:

An accurate impression and definitive cast are fundamental to a successful outcome in any prosthodontics rehabilitation. This remains true for implant-supported prostheses, for which impression techniques have been directly adapted from traditional prosthodontics. An essential first step in the fabrication process is the accurate three-dimensional (3D) capture and transfer of the implant position from the mouth to the definitive cast via an impression. An inaccurate impression results in an inaccurate definitive cast, making it impossible to fabricate a prosthesis that is appropriately related to the 3D position of the implant(s) in the patient's mouth. The resultant prosthesis misfit can lead to potential biomechanical complications due to excessive stress within the prosthesis and bone-implant-prosthesis interface.²⁻⁵ Because osseointegrated implants have approximately one-tenth the movement allowance of teeth,⁶ they have a very limited capacity to compensate for discrepancies in prosthetic framework fit. It is therefore critical that an implant impression and resultant definitive cast be as accurate as possible in order to fabricate a successful implant-supported prosthesis. All current conventional impression techniques result in some degree of error, manifested as displacement of the implant analogs in the definitive cast compared with the true intraoral positioning of the implants.⁷⁻⁹ Variables that have been shown to influence implant impression accuracy include impression material selection,¹⁰⁻¹² tray selection,¹³ impression approach,^{9,14} implant angulation,^{15,16} and the inherent fit of impression components.^{17,18} While numerous studies have evaluated and compared existing implant impression techniques, research to date does not support one single impression technique as superior to all others.⁹

The advent of digital technology gives clinicians the option to use intraoral scanners in place of conventional impression techniques. The use of digital impressions eliminates the need for traditional impression materials, making the procedure technique potentially more comfortable for patients while decreasing error from analog techniques.^{19,20} Digital impressions have the capacity to simplify the impression procedure, reduce chair time, and ease communication between the clinician and the laboratory.^{19,21,22} Several in vitro studies have compared traditional impression procedures with digital impression approaches, yet there remains a lack of consensus regarding the accuracy and clinical acceptability of digital techniques.²³⁻²⁶

This review examines studies on the accuracy and on the precision of different digital impressions versus conventional implant impressions techniques.

II. MATERIAL AND METHODS:

PubMed MEDLINE, Cochrane, EMBASE and Google Scholar databases were electronically searched and enriched by hand searches. Hand searching was performed of the following journals: Clinical Implant Dentistry and Related Research, Clinical Oral Implants Research, Implant Dentistry, International Journal of Oral and Maxillofacial Implants, Journal of Clinical Periodontology, Journal of Computerized Dentistry, Journal of Implantology and Journal of Periodontology. Studies evaluating the accuracy of implant impressions made with digital and conventional impression techniques were identified. Relevant studies published between 2005 and 2018 were included in this review. The abstracts of the articles were retrieved, reviewed, and sorted based on the following inclusion and exclusion criteria. To be included in the study, the article had to be published in an English peer-reviewed journal and be an experimental & clinical studies investigating the accuracy of implant impressions. Excluded were the following: structurally incomplete publications such as abstracts only, Animal studies. After executing the search strategies, 29 articles were selected.

III. RESULTS:

Table 1: Studies comparing implant impression accuracy: Digital vs Conventional impression techniques

Author	Study outcome
Ortorg et al ²⁷ 2005	Photogrammetry is a valid option for recording implant positions and has a precision comparable to that of conventional impression techniques.
Chia va et al ²⁸ 2017	Conventional and digital scanning were not significantly different.
Papasparyidakos p et al ²⁶ 2016	Digital implant impressions are as accurate as conventional implant impressions.
Karl M et al ²⁹ 2012	Intraoral digitization of dental implants appears to be at least as precise as conventional impression taking
Eliasson a et al ²⁴ 2012	Both conventional and robot technique presented low levels of displacement of the implant analogues in all casts.

Stimmelmayer M et al ³⁰ 2012	the systematic error by scanning the stone models was less in contrast to the polymer models.
Andriessen fs et al ³¹ 2014	Based on the intraoral scans obtained in this study, distance and angulation errors were too large to fabricate well-fitting frameworks on implants in edentulous mandibles.
Lee sj et al ²¹ 2015	Milled models from digital impressions had comparable accuracy to gypsum models from conventional impressions.
Amin Set al ³³ 2017	Full-arch digital implant impressions using True Definition scanner and Omnicam were significantly more accurate than the conventional impressions with the splinted open-tray technique.
Basaki k et al ³⁴ 2017	Definitive casts fabricated using the digital impression approach were less accurate than those fabricated from the conventional impression approach for this simulated clinical scenario.
Alsharbaty MHM et al ³⁵ 2018	Based on the study outcomes, the digital implant impression technique had the least accuracy
Alessandro mangano et al ³⁶ 2018	Digital impressions resulted the most accepted and comfortable impression technique, when compared to conventional techniques.
Marzieh Alikhasi et al ³⁷ 2018	Digital techniques demonstrated superior outcome in comparison with conventional methods
Ribeiro P et al ³⁸ 2018	Digital impressions of full-arch models were able to achieve the accuracy of conventional impressions in an in vitro model.
Alshawaf B et al ³⁹ 2018	Printed casts generated from digital impressions for partially edentulous posterior mandibular arches had inferior accuracy to conventional stone casts fabricated from splinted open tray impressions.
Moura RV et al ⁴⁰ 2018	no differences were found among the conventional impression and the combination of conventional and digital impressions,
Malik j et al ⁴¹ 2018	Conventional full-arch PVS impressions exhibited improved mean accuracy compared to two direct optical scanners.
Bergin JM et al ⁴² 2013	The overall measurement accuracy of the photogrammetric and conventional methods was similar.
Gherlone E et al ⁴³ 2016	Results demonstrate that it is possible to develop computer-aided design/computer-assisted manufacturing (CAD/CAM) cobalt-chromium full-arch rehabilitations with satisfactory accuracy using digital impression techniques.
Ajioka H et al ⁴⁴ 2016	In this study, distance error of the optical impression was slightly greater than that of conventional method.
Alikhasi m et al ⁴⁵ 2018	CAD/CAM-fabricated wax patterns showed significantly higher retention for implant-supported cement-retained frameworks
Chew AA et al ⁴⁶ 2017	The 3D accuracy of implant impressions varied according to the impression technique and implant level. For BL test groups, the conventional impression group had significantly lower distortion than the digital impression groups.
Lin WS et al ⁴⁷ 2015	The digital pathway produced less accurate definitive casts than the conventional pathway with the tested two-implant scenarios.
Marghalani A et al ⁴⁸ 2018	The accuracy of all impression techniques was within clinically acceptable levels, and not all differences were statistically significant.

Table. 2: Studies comparing implant impression techniques applying intraoral scanning (IOS) and the conventional method according to time efficiency, difficulty, operator's and patients preference.

Study	Efficiency outcomes
Joda t et al ⁴⁹ 2017	For single-implant sites, the quadrant-like intraoral scanning (IOS) was more time efficient than the conventional full-arch impression technique in a phantom head simulating standardized optimal conditions. A high level of acceptance for IOS was observed among students and dentists.

Wismeijer D et al ³² 2014	In this research, based on a relatively small cohort of patients, the overall conclusion is that the preference of patients for the IO scan is statistically significant.
Schepke u et al ¹⁹ 2015	Digital impression making for the restoration of a single implant crown takes less time than analog impression making. Furthermore, participants preferred the digital scan and reported less inconvenience, less shortness of breath, less fear of repeating the impression, and fewer feelings of helplessness during the procedure
Joda t et al ²⁰ 2016	The digital technique emerges as the most preferred one according to patient-centered outcomes and was more time-effective compared to conventional impressions.
Joda T et al ²² 2015	This investigation shows that the digital workflow seems to be more time-efficient than the established conventional production pathway for fixed implant-supported crowns. Both clinical chair time and laboratory manufacturing steps could be effectively shortened with the digital process of intraoral scanning plus CAD/CAM technology

IV. DISCUSSION:

The systematic review on the accuracy of conventional and digital implant impressions is based on experimental, clinical, in vitro, in vivo, randomized controlled clinical trial and retrospective study. Of the 29 studies, 24 studies comparing digital vs. conventional implant impression accuracy. (Table 1):

- 1) Studies showing conventional method is more accurate than digital are: Andriessen fs et al³¹, Basaki k et al³⁴, Alsharbaty MHM et al³⁵, Malik j et al⁴¹, Ajioka H et al⁴⁴, Lin WS et al⁴⁷.
- 2) Studies showing digital method is more accurate than conventional are: Stimmelmayer M et al³⁰, Amin Set al³³, Alessandro mangano et al³⁶, Marzieh Alikhasi et al³⁷, Alshawaf B et al³⁹, Alikhasi m et al⁴⁵, Chew AA et al⁴⁶.
- 3) Studies showing no significant difference between Digital and conventional technique are: Ortorp et al²⁷, Chia va et al²⁸, Papaspyridakos p et al²⁹, Eliasson a et al²⁴, Lee sj et al²¹, Ribeiro P et al³⁸, Moura RV et al⁴⁰, Bergin JM et al⁴², Gherlone E et al⁴³, Marghalani A et al⁴⁸.

Several studies have compared the conventional and digital impressions from both the patient's and the dentist's point of view: (table 2) - Joda t et al⁴⁹, Wismeijer D et al³², Schepke u et al¹⁹, Joda t et al²⁰, Joda T et al²².

V. CONCLUSION:

Within the limitation of this study, the conclusion based on literature review it seems that the accuracy of digital impression is at the same levels as conventional impression methods and thus both of these techniques can be used. The comparison of deviations resulting from conventional and digital impressions suggests that digital implant impressions are as accurate as conventional implant impressions. Conventional impressions are more accurate for partially edentulous jaws than for completely edentulous jaws for linear and angular deviations. Digital impression making seems to be the preferred method over conventional impressions, with regard to time efficiency and patient preference.

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