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Accuracy of Intraoral Digital Impression (IDI) in Fixed Prosthodontics: Systematic Review

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ABSTRACT

Aim: To evaluate the accuracy of Intraoral digital impression (IDI) in fixed prosthodontics and possible advantages related to IDI in comparison with conventional methods of impression. Methodology: Various studies of IDI were searched using the PubMed database. A well defines criteria for exclusion and inclusion of articles was followed.
Results: A total of 17 studies were included in this systematic review. Digital impression showed the shorter time. It has many benefits over the regular impression method and improved accuracy. However, in some studies, conventional methods exhibited high accuracy. Conclusions: Digital impression can be a substitute for conventional methods. However, for better understanding, more clinical trials are needed to perform for the evaluation of the accuracy of IDI in fixed prosthodontics.

Key words: Fixed prosthodontics, Intraoral digital impression, Accuracy

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INTRODUCTION

The success of fixed restoration depends upon the accurate impression [1]. In the conventional method, impression material is used to record the details of the preparation of tooth and anatomy of the oral cavity of patients, and then this impression has to send to the laboratory for further processing. This procedure contains many errors and operating steps. In the fixed treatment of restoration, the system of Intraoral Digital Impression (IDI) has developed with the improvement in digital technology [2]. In the fixed prosthodontics field; the use of IOS (Intraoral scanners) has become more common to obtain direct digital impression. This is because of numerous benefits that come from their use, for example, it could be more comfortable for patients and faster [3-5]. These benefits make this procedure possible to replace with the regular ones, which are more easily shared and stored [6]. A scanning probe is used in IDI to record the oral cavity's anatomy in three dimensions and transfer it to the laboratory in the meantime, it saves consumption of both material and time, thus enhance the economic benefits [7]. Intraoral scanning is considered a faster and more convenient technology from the point of view of both dentists and patients [8]. This technique has many advantages e.g., real-time visualization, no need to clean and disinfect the impression tray and dental impressions, easily repeatable, selective capture of relevant areas, fast availability and communication, no wear of the model and caste pouring [9,10].

In spite of having the obvious benefits of intraoral digital scanning, this is also necessary to investigate whether this technique could prove itself as a suitable substitute for conventional impressions regarding accuracy. This quality represents an essential condition of fixed prosthodontics for its proper adaptation. In this regard, accuracy can be defined as the collection of two elements, precision and trueness, both are complementary and necessary. The capability of capturing the real entity of a quantity is termed as trueness [3,11] and to record this same quantity with following samplings [12,13].

It has been reported that the use of digital impressions can acquire more accuracy for restoration but in fixed restoration, the current IDI clinical effects in comparison with the conventional methods are still not clear [14]. So in the present review, the studies that compare the digital scanning with conventional methods which used highly accurate material in fixed prosthodontics like polyvinyl siloxane and polyether were included.

The main aim of the current review was to determine the accuracy of IDI in comparison with the conventional impression method and to assess whether it could be a substitute to conventional impressions for the preparation of fixed prosthodontics.

METHODOLOGY

A literature search was performed electronically in the PubMed database by using the following terms; IOS techniques, IDI, Digital impression, accuracy of digital impression, digital impression in fixed prosthodontics, restoration accuracy to obtain some potential references for this review. The aim of the search was to collect those articles that determine the accuracy digital impressions for arch/teeth published until 2021.

The inclusion criteria for the articles was if it was in English, clinical or laboratory study, assessing the IOS system, scanning accuracy and those articles which were not in English language, review articles and duplicate articles were excluded.

Based on the inclusion criteria, the selection was performed in 4 steps. In the first step, a list of titles was collected from the database and those titles which didn't match the criteria were not included. In 2nd step, duplicated articles were excluded. In step 3rd the abstracts of the articles were screened to check the inclusion criteria. In the 4th step, the full-length articles were analyzed and verified qualitative analysis.

RESULTS AND DISCUSSION

After selection, the authors finalized the 17 studies for this review. These studies include different intraoral scanning systems such as Lava COS (3M ESPE) [9,12,13,15-19] iTero [12,13,15,18-21] Cerec [12,13,15,18,19,22,23] and Trios [12,13,24-28] The development in the digital technology makes IDI convenient for the patients in oral fixation treatment. After many years of its development, the intraoral digital impression has improved greatly in its repeatability, comfort and accuracy [29,30].

Various studies investigated the accuracy of impression methods [9,12,13,16-28]. Flugge et al. [21] investigated the precision of intraoral scanners and compared it with conventional highly accurate impression material. Results showed that conventional impression presented the highest precision. Similar results were reported by other researchers in which precision belonged to the conventional method [12,13]. It has been reported that the digital scan group showed better marginal fitness as compared to the conventional group [9,16,18,20]. Standard probes were used in some studies to determine the edge tightness of the prosthesis [22,23,24,26,27]. Better adhesion was presented by the digital scanners. To check the accuracy of impression in clinical trials, the stability of edge adhesion and restoration is used. The correct edge adhesion for restoration is very essential for the success of treatment [31]. Gan et al. [25] measured both precision and trueness of full-arch digital impression. They concluded that trueness could not be affected by arch width but it can affect the precision of impression.

Four papers recorded the operation time [9,15,22,24]. Results showed that the operation time of the oral scan group was shorter than that of the control group. Regular impression techniques may create distress to patients e.g. nausea, breath shortness and retching [32]. Continuous improvement in IDI system reduced the volume of IOS, the 3D (three dimensional) digital image is more clear and operating time is short. Digital impression also causes a number of discomforts due to impression materials. The experience of patients has increased steadily [33]. It has been shown that patients experience more comfort when the time of mold-taking is short (Table 1 and Figure 1) [32,34].

Table 1: The analysis of included literature.

Reference	Number of participants	Grouping		Restoration type	Material	Parameters	Results
		Digital scan	Control/ Conventional				
Syrek et al. [17]	20	Lava	silicone rubber	Single crown	ZrO2	Restoration Accuracy	No significant results
Flugge et al. [21]	10 in each group	iTero	Plaster	----	---	Accuracy (precision and trueness)	iTero intraoral scan represents lowest precision, However extraoral iTero scanning model presented higher precision
Ender, et al. [19]	5	CEREC AC Omnicam, CEREC Bluecam, iTero, Lava	Direct scannable vinyl siloxanether, Polyether, Vinyl siloxanether, Irreversible hydrocolloid	----	---	Accuracy (precision and trueness)	Vinylsiloxanether, CEREC Bluecam and direct scannable vinylsiloxanether showed highest accuracy (precision and trueness)
Ender et al. [12]	5	CEREC Omnicam Lava Trios CEREC Bluecam iTero	Full-arch conventional polyether impression, viylsiloxanether	----	---	Precision of impression of full-arch	For full-arch Conventional high precision materials for impression exhibited better precision than digital scanning

							methods. But it has been showed that all digital scanning can measure complete dental-arches
Ender et al. [13]	5	CEREC Bluecam with CEREC software 4.0 and 4.2 Lava, CERE Omnicam Trios, iTero	Full-arch conventional impression and dual-arch quadrant impression using Viylsiloxanether material	----	---	Precision of quadrant impressions	Digital impressions can measure the quadrant impression with better precision but for full-arch, conventional impressions showed high precision
Zarauz et al.[20]	20	iTero	silicone rubber	Single crown	ZrO2	Restoration Accuracy	Better marginal fitness, internal fitness showed no significant results
Ahrberg et al.[19]	25	Lava	Polyether, silicone rubber	Fixed bridge and Single crown	ZrO2	operation time of impression, Restoration Accuracy	Internal fitness showed no difference in both groups, but Marginal fitness was better in scan group than control group,
Gan et al. [25]	34	Trios	Full-arch conventional impression of maxilla using polyvinyl siloxane	----	---	Accuracy (Trueness and precision)	For taking the impression of maxilla, the use of scanner is feasible and had satisfied accuracy
Benic et al. [15]	10	Cerec, iTero, Lava	silicone rubber	Single crown	Ceramic	operation time of impression,	Digital group has Shorter time
Gjelvold et al. [24]	48	Trios	Polyether silicone rubber	Fixed bridge and Single crown	Co-C, ZrO2, IPS Emax	operation time of impression, Restoration Accuracy	Digital scan group had better adhesion and shorter time
Sakornwimon, et al. [16]	16	Lava	silicone rubber	Single crown	ZrO2	Restoration Accuracy	Internal fitness showed no difference in both groups, but Marginal fitness was better in scan group than control group,
Zeltner et al., [18]	10	Cerec, iTero, Lava,	silicone rubber	Single crown	IPS Emax	Restoration Accuracy	Internal fitness showed no difference in both groups, but Marginal fitness was better in scan group than control group,
Haddadi et al. [26]	19	Trios	silicone rubber	Single crown	IPS Emax	Restoration Accuracy	Digital scan group showed better edge adhesion
Han et al., [27]	90	Trios	silicone rubber	Single crown	ZrO2	Periodontal tissue index, Restoration Accuracy	Scan group had better edge adhesion,
Zhang, et al. [22]	120	Cerec	silicone rubber	Single crown or Inlay	Ceramic	Operation time of impression, Restoration Accuracy	Scan group had better adhesion and shorter time
Zhang et al. [23]	240	Cerec	silicone rubber	Single crown	Ceramic, Co-Cr	Periodontal tissue index, Restoration Accuracy	Control group had higher PD and SBI than digital scan

							group, Better edge adhesion of digital scan
Tohme et al. [28]	15 in each group	Trios	polyether	----	---	Accuracy (precision and trueness)	Better precision was exhibited by digital impressions but conventional methods presented better trueness

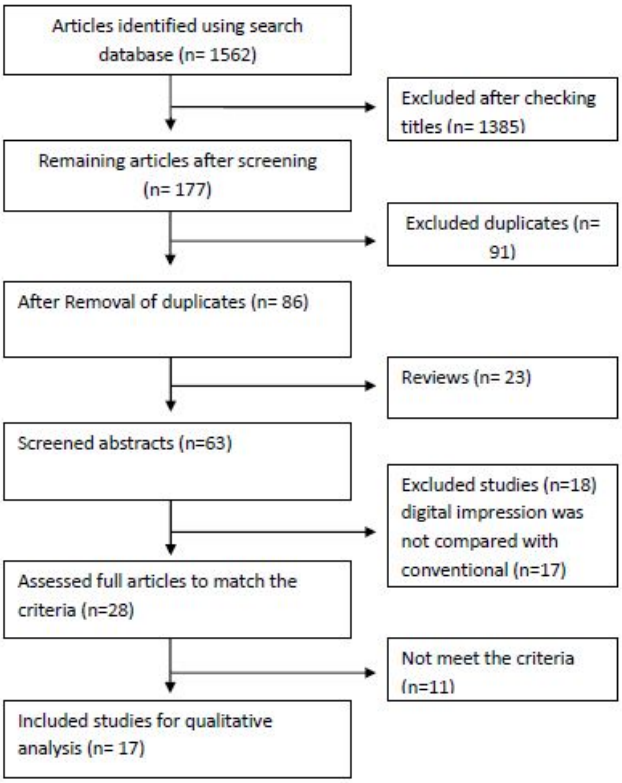

Figure 1: Diagrammatic representation of data collection.

CONCLUSION

The qualitative analysis of these studies shows that digital impression could be a substitute for the conventional method to a certain limit because its operating time is shorter as compared to the regular impression method. It may become the better option for the restoration impression of fixed prosthodontics. But in order to effective and complete evaluation of clinical effects in the oral fixation field related to IDI technology, long term follow up and more clinical studies with high quality should be performed for further guidance.

LIMITATIONS

None.

CONFLICT OF INTEREST

None of the authors have conflict of interest regarding the manuscript.

ANIMAL AND HUMAN RIGHTS STATEMENTS

No animal or human study was carried out by the authors for this research.

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SCIENTIFIC RESPONSIBILITIES STATEMENTS

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

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