Review Article

# Digital Impressions: One-Step Closer to Precision

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**Abstract**

Intraoral scanners that record impressions digitally have been playing a major role in the field of prosthodontics. The classic method for recording impressions always included using of traditional impression materials and methods used with its basic understanding as per their manufacturer's instructions. However, the scope keeps expanding with the evolution in the field of impression by digitalization. All the data related to digital impressions as well as traditional impressions have been taken into consideration. The excluded literature includes the review kinds of literature that have already been done. This review article includes the pros and cons of digital impressions and information of the various systems that are available in the market.

**Keywords:** *Accuracy, digital impressions, intraoral scanners*

## Introduction

"Impressions" is simply meaning a negative replica of the hard and soft oral tissues from which a positive reproduction can be achieved.[1] The conventional methods to reproduce the oral conditions basically include working with different impression materials along with their laboratory technique. The conventional procedures have a long track record of proven accuracy for teeth, oral tissues, as well as dental implants. Although proven to produce repeatable accuracy, it is actually subjected to potential errors to reproduce the cast presentation of oral conditions.[2]

## Rationale for this Review

With the evolution of technology, dentistry continues to expand in the field of digitalization. It has been more than 27 years for digital dentistry to be evolved as computer-assisted design/computer-assisted manufacturing (CAD/CAM) system to fabrication of dental restorations.[3]

Digital dental impressions represent this resourceful procedure, which makes it easier for the dentist to produce a virtual software-generated copy of oral tissues with the help of lasers, as well as other optical scanning machines.[4] Even though most of the dental offices have not yet accustomed themselves with this digital technology, it is gaining popularity as the costs for the same are reducing as well as the accuracy and efficiency of these systems are increasing.[5]

Thus, the goal of this review article is to provide with adequate knowledge of digital impressions evolved in dentistry and its clinical application.

## History of Digital Impressions

CAD/CAM was first introduced in the field of dentistry by Dr. Duret in 1973. It was later modified and modifications were done by Dr. Mormann, a Swiss Dentist, along with Mr. Brandestini, who was an electrical engineer. The first ever digital system for dental impressions to be commercially available was CEREC. Over the years, many systems such as 3Shape Trios, Cadent iTero, 3M Lava Chairside Oral Scanner (C.O.S.), as well as E4D Dentist have been introduced.[6] Each system introduced is incorporated with a specific and its distinctive technique for impression making.[7]

To further evolve in this field, there are many manufacturers who have developed systems that work as a stand-alone intraoral optical impression unit as well

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as work as CAD/CAM restoration milling unit system, thus creating an "'a la carte" approach to this all-in-one philosophy, ultimately leading to digital growth.[2]

## Methods

A comprehensive search was performed in PubMed and EBSCOhost. Language restrictions were applied. The search strategy included Digital Impressions AND Traditional Impressions AND Accuracy.

### Inclusion criteria

1. Articles in English language or those having summary in English
2. Studies comparing digital impressions with traditional impressions: Literature articles
3. Studies including data regarding only digital impressions and only traditional impressions.

### Exclusion criteria

1. Review, case reports, abstracts, letters to editors, and editorials
2. Studies published in languages other than English.

PICO of this narrative review is as follows:

P – Impressions techniques
I – Traditional impressions
C – Digital impressions
O – Accuracy level.

Thus, PICO mentioned here is described as follows: The main criterion of any segregation is between the various impression techniques where we are comparing the accuracy of digital impression against the traditional impression techniques we use in our day-to-day life.

Optical impressions can be captured by two methods for fabrication of any dental restorations. The two methods include (i) using the 3D-printed model to fabricate a restoration and (ii) using the images that the optical impression generates and thus mill the restoration from a digital file that is created of the restoration.[2]

The digital model method is the first one mentioned earlier. This method uses 3D printed models that are similar to the models obtained from elastomeric impression materials. It is very similar to the conventional procedure, except for the fact that instead of using a die-trimmed gypsum cast, this system or method uses the 3D-printed model. All type of restorations can be fabricated with this approach. This system fabricates 3D-printed models that are resistant to damage, any technician errors, as well as distortion that are usually the disadvantages of a conventional die-trimmed gypsum model. In addition, a duplicate 3D-printed model can be fabricated with the same accuracy when compared with that of the original model if it is lost or damaged in any way.

The digital modeless method is the second method mentioned. It is usually used to fabricate any prosthesis from a solid block of material. This restoration is done by the reductive technique commonly known as milling. Once the restoration is approved virtually, it is milled using diamond burs, after which the technician can proceed with the finishing and polishing of the final restoration to be delivered. Now, this procedure is limited only to the restorations that are fabricated using lithium disilicate or zirconium material. However, newer researches and development are being carried on for the expansion of this method with other materials as well.[2]

## Various Systems

Digital systems that were majorly available in the market for intraoral imaging were CEREC, iTero, Lava C.O.S. system, TRIOS, and E4D. Each system has its own unique feature related to the principle on which it works, the source of light used, the powder necessity, the data acquisition process, as well as the final format of the file output.[8]

### CEREC system

The CEREC 1 system was first marketed in 1987 by Sirona, Bensheim, Germany, along with the Duret system. It was the first digital system that had intraoral imaging and a CAD/CAM device with it. This system works on the principle of light triangulation where there is interaction of three light beam sources that is focused on a specific point in 3D space. The most prevalent system is the CEREC AC Bluecam which was launched in 2009.[9] It is the product of fourth generation. The light source used is the LED blue diode which emits blue visible light to capture the images. A single quadrant is captured within the 1st min, and the antagonist is followed within few seconds only. This was then upgraded to the next-level generation by introducing the latest version in 2012 known as Omnicam. This system captures multiple images and creates a 3D model after it has acquired all the data. Bluecam can only be applied for a single tooth, while Omnicam can be used for a single tooth, quadrant, or full arch.[8]

### Lava Chairside Oral Scanner system

Lava C.O.S., 3M ESPE, Seefeld, Germany, invented Lava™ C.O.S, is an intraoral device that records impression digitally in 2006 and marketed this system in 2006. This system works on the principle of active wave front sampling where the imaging system has a single lens concept and is used for obtaining data in 3D format. Hence, a total of three sensors with smaller scanner tips of 13.2 mm width are used to capture the object images from different angles and develop patches on the surface using the in-focus and out-of-focus

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process of the imaging algorithms.[8] This system also requires a coating but in lesser amount that what is used in CEREC Bluecam. In fact, this coating is rather used as connectors that are the finest particles which are used for the process of intraoral scanning.[10] The light source used in this system is the pulsating blue light that is emitted to obtain the images. In most cases, it is used for designing as well as manufacturing of the data proprietary files exported by Lava C.O.S.[8]

### iTero system

iTero was introduced in the market in 2007 by Cadent Inc. (Carlstadt, NJ, USA). It works on the principle of parallel confocal imaging technology where it captures images intraorally and finally uses laser along with visual scanning it contours the images.[8] The iTero scanner does not require an antireflective coating powder for it to operate.[10] The light source used for this technology is the red laser light. iTero is usually used for dental procedures such as crowns, fixed partial dentures/prosthesis, veneers, aligners, as well as implants.[8] The sequential strategy when used for this scanner provides accurate trueness and precision during the recording of impressions intraorally of long-span areas.[11] The image files that are created digitally are stored in the STL format which makes it easy to share with any CAD/CAM-equipped laboratory.[8]

### E4D system

D4D technologies LLC (Richardson, TX, USA) developed the E4D system. It has the principle of confocal microscopy imaging technology and optical coherence tomography. This system uses a scanner that is powder-free and red lasers and micro-mirrors as a light source produce 20,000 cycles per second.[12] The high-speed lasers formulate an impression of the prepared hard tissues to create a 3D image in every angle. It then compiles all the images that are obtained and wraps a virtual model in few seconds. This system is also a powder-free scanning device which also works as a single-visit treatment providing prosthesis of high-strength ceramics or composites for teeth having minimum preparation.[8]

### TRIOS system

3Shape (Copenhagen, Denmark) introduced a new system for digital impressions in 2010 known as TRIOS and was marketed in 2011. It works on the parallel confocal imaging technology and ultrafast optical sectioning principle. Here, the system scanner maintains its spatial relation in a fixed position and the object is then scanned. The variation in pattern of focal plane is recognized over a range of focus plane. This system analyzes the images obtained and creates a 3D digital model which is an exact replica of the teeth and gingival color. This system is also a powder-free scanning device having two-part process, namely TRIOSR Cart and TRIOSR Pod.[8]

## Discussion

The basics of prosthodontics include the traditional method of making intraoral impressions which are then poured out using dental stone.[13] Any impression in its ideal form as required in fixed restorations should be precise as well as stable. This prevents the deformation and modification of the properties of the impression before producing a final model. Along with these stability and accuracy properties, an impression is ideal if it consumes shorter duration of clinical time and is biocompatible as well as safe to the oral tissues.[4]

With many pros for the traditional impression techniques as well materials, there are few cons that could be added to the list of these impressions materials, as well as the techniques. Few of the disadvantages for conventional impressions include messiness in handling and postimpression, discomfort for patients, especially for patients with very high gag reflex, as well as the inaccuracies that occur due to air bubble incorporation while fabricating a model out of impression.[4]

However, on the other hand, it is the concept of the digital impression that is proving to eliminate the drawbacks of the traditional impression materials and techniques. The advantages of digital impression include simplicity, patient discomfort as well as the elimination of the "dirty" cabinet.

However, still, digital impressions are yet unknown and less applied in our country probably due to availability of higher costs. It offers greater comfort to patients for numerous reasons only because the procedure is less time-consuming as well as self-corrects any minute imperfections if any. The outcome for the final restorations is impacted majorly by the molding, adjusting, as well as fitting each model. The laboratory imperfections are reduced to minimum using this method.[4]

In spite of the superiority of digital impressions when compared to traditional ones, it has its own cons, especially in the areas of subgingival preparation registry, where the marginal adaptation is compromised due to the gingival margin ultimately leading to failure.

## Conclusion

Prosthodontics has much to offer and plenty to gain from the current emergence of digital technology into all facets of dentistry. Thus, this rapid evolution of digital scanning technology is finally creating new future

establishments for dentists. Furthermore, evolution of the digital scanning systems in itself is making dentists to revisit its initial assessment of these systems in their practices.


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### Conflicts of interest

There are no conflicts of interest.

## References


1. The Glossary of Prosthodontic Terms: Ninth Edition. J Prosthet Dent 2017;117:e1-105.
2. Scherer MD. A Contemporary Approach to Intraoral Optical Scanning and In-Office 3-D Printing. Dent Today 2015;34:46-7.
3. Hwang YC, Park YS, Kim HK, Hong YS, Ahn JS, Ryu JJ. The evaluation of working casts prepared from digital impressions. Oper Dent 2013;38:655-62.
4. Gabor AG, Zaharia C, Stan AT, Gavrilovici AM, Negrutiu ML, Sinescu C. Digital dentistry — Digital impression and CAD/CAM system applications. J Interdiscip Med 2017;2: 54-7.
5. Weston JF, Roberts MB, Digital impressions: A dentist's and a laboratory technician's perspectives. J Cosmet Dent 2013;29:52-62.
6. Ali AO. Accuracy of digital impressions achieved from five different digital impression systems. Dentistry 2015;5:300.
7. Marti AM, Harris BT, Metz MJ, Morton D, Scarfe WC, Metz CJ, *et al.* Comparison of digital scanning and polyvinyl siloxane impression techniques by dental students: Instructional efficiency and attitudes towards technology. Eur J Dent Educ 2017;21:200-5.
8. Ruthwal Y, Parmar S, Abrol S, Nagpal A, Gupta R. Digital impressions: A new era in prosthodontics. IOSR J Dent Med Sci 2017;16:82-4.
9. Logozzo S, Franceschini G, Kilpela A, Caponi M, Governi L, Blois L. A comparative analysis of intraoral 3D digital scanners for restorative dentistry. J Med Technol 2011;5:1-18.
10. Patzelt SB, Lamprinos C, Stampf S, Att W. The time efficiency of intraoral scanners: An *in vitro* comparative study. J Am Dent Assoc 2014;145:542-51.
11. Medina-Sotomayor P, Pascual-Moscardó A, Camps I. Correction: Accuracy of four digital scanners according to scanning strategy in complete-arch impressions. PLoS One 2018;13:e0209883.
12. Rotar RN, Jivanescu A, Ille C, Podariu AC, Jumanca DE, Matichescu AM, *et al.* Trueness and precision of two intraoral scanners: A comparative *in vitro* study. Scanning 2019;2019:1289570.
13. van der Meer WJ, Andriessen FS, Wismeijer D, Ren Y. Application of intra-oral dental scanners in the digital workflow of implantology. PLoS One 2012;7:e43312.


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