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An introduction to dental digitizers in dentistry; systematic review

Ola Al-Jubouri[1,2] and Abbas Azari[3]

[1]*Prosthodontics Techniques Department, College of Health & Medical Technology, Middle Technical University, Baghdad, Iraq*
[2]*Department of Prosthodontics Technology, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran*
[3]*Department of Removable Prosthodontics, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran*

ABSTRACT

Application of computer assisted design/ computer assisted manufacturing (CAD/CAM) and digital workflow counterpart provides more innovative, high quality dental restorations which in turn lead to utilize different types of dental scanners in contemporary dental practice. This article aimed to provide the readers historical backgrounds of dental scanner and their various kinds; the benefits and pitfalls. A deep search was performed in available databases as well as the black areas of internet for trials keywords to find the data. Dental scanner used to measure the entire 3-dimensional (3D) of the external surface of a physical object either intraorally or extraorally from multiple directions. Implementation of the methods of 3D digitization in dental practice is a new methodology for dentistry which may revolutionize the routine techniques used commonly in dental practice. With this opportunity in hand easier, faster, accurate and more predictable dentistry is anticipated.

Key words: Computer aided design; Dental imaging; Dental scanner; Dental laser scanner; 3D analysis; Dental digital device.

INTRODUCTION

The conventional concept of "model" in dentistry is actually very different in which some type of specially designed liquefy materials (Impression material) set in the mouth and then poured to produce a physical model (Dental cast). The cast can then be used to make a restoration in the laboratory. Despite of simplicity, this technique has many objections in term of precision and may cause iatrogenic esthetic/hygienic errors, especially in difficult cases. The introduction of modern technology to manufacture dental restorations has generated opportunities to introduce materials that cannot manipulated by traditional techniques. During the past decades, the development in the area of CAD/CAM systems has accelerated. In the process based on CAD/CAM technology, a series of the digital geometrical data exchanged occurred:

1) Outer surface digitization of the proposed area by 3D acquisition device (Dental scanner)[(1, 2)].Digitizer term in dentistry means data collection tools that accurately measure three dimensional surface contours of oral structure(s) and transform them into digital data sets[(3)].

2) Manipulation of the digital data with a software program to create a virtual model and freeform addition of the proposed restoration to it (CAD)[4].

3) A series of production process which translates the freeform model into the physical object (CAM)[4].

The first attempts for computer-assisted production of dental restorations were made in 1971[5]. In contrast to the conventional impression techniques, the CAD technology uses another approach for data acquisition; namely digitizing[3]. In early days, the capturing mode was only made over the patient mouth but nowadays, the data acquisition may either performed directly in the patient's mouth (intraoral scanner) or indirectly on an poured impression; model (Extraoral scanner)[6]. The captured data consist of data spatial coordinate of points from the scanned surfaces[7] whatever technique used, the scanning process is a prerequisite for any CAD/CAM methodology and necessitate to use hard/software which are technically different; The number of cameras, light technology, scan accuracy, scan speed and many other characteristics are not the same and one may confused on the most appropriate system for special purposes.

The main objective of this systematic review is to assess the historical overview, their development and outcomes of 3D dental scanner currently used in dental CAD/CAM technology.

EXPERIMENTAL SECTION

At first, a deep search was performed in major common databases; PubMed, for trials keywords (Dental digitizing, Computer aided design, Dental digital impression, Intraoral acquisition, Extra oral acquisition, Dental imaging, Dental scanner, Dental laser scanner, 3D analysis, Dental digital device). Due to lack of data collected, another search was implemented to find any possible information related to dental scanner by manual hand search on Google scholar,(table 1).

Table 1: Shown the keywords trial in both PubMed and Google scholar and where can be found them.

Keywords found in PubMed:	Keywords not found in PubMed:	Keywords found in Google scholar:
Dental digitizing	Dental digital impression	Dental digitizing
Computer aided design	Intraoral acquisition	Computer aided design
	Extraoral acquisition	Dental digital impression
	Dental imaging	Intraoral acquisition
	Dental scanner	Extraoral acquisition
	Dental laser scanner	Dental imaging
	3D analysis	Dental scanner
	Dental digital device	Dental laser scanner
		3D analysis
		Dental digital device

At next step, two other big databases were concluded (Wiley online library and Sciencedirect). To be more accurate, it was decided to define an inclusion and exclusion criteria to classify the data in a manner that can be accurately approached. These are:

Inclusion criteria: dental scanner and their processes including data acquisition process for fabricating dental restoration and prosthodontics, data acquisition from the external surface of the tooth or restoration, dental scanner, dental laser scanner, dental light scanner and dental digital impression, and 3D analysis.

Exclusion criteria: Computer Tomography CT scan, Magnetic Resonances Imaging (MRI), other scanners include ones used for engineering or medical purposes.

The total articles collected from Wiley online library and Sciencedirect 1.017 articles, 20 articles of them were included as pertinent articles, but there were un benefit as a references for this article. The total articles collected from the manual hand search on Google scholar were 19; Wikipedia and technical paper were also included as a data collected for this study, (table 2).

Table 2: represented the articles that collected by manual hand search in Google scholar with data that included and excluded from the collected articles.

No	Author's Name	Article's Name	Article's Type	Cons	Pros
1	Dianne Rekow	Computer-aided design and manufacturing in dentistry: A review of the state of the art	Review article	-The French system/ intraoral (laser) optical scanner has been defined. -The Swiss system/ intraoral optical topographic scanner have been defined. -The Minnesota system/ intraoral photographic based system have been defined.	
2	JankoHodolič TatjanaPuškar Igor Bešič	Current status and future trends in dental CAM restorative systems	Review article	-Digitalization process has been defined. -CAD software has been defined. -CAM process has been defined.	-Dental CAD/CAM process well defined. -Open/closed system defined.
3	Magnus Persson Matts Andersson Bo Bergman	The accuracy of a high-precision digitizer for CAD/CAM of crowns	Original article	Data captured by contact scanner has been defined.	
4	Perng-Ru Liu	A panorama of dental CAD/CAM restorative systems	Review article	Data captured by: -Optical (Intraoral/Extraoral) non contact scanner has been defined. -Contact scanner has been defined.	Restorative material for CAD/CAM system well defined.
5	Anna Person Matts AnderssonAgneta Oden GunillaSandborgh-England	A three-dimensional evaluation of a laser scanner and a touch-probe scanner	Original article	Data captured by: a- Optical (Extraoral) non contact (laser) scanner has been defined. b- Contact scanner has been defined. c- 3D data analysis has been defined.	
6	Anna S.K. Perssona Matts Andersson AgnetaOdénGunillaSandborgh-Englunda	Computer aided analysis of digitized dental stone replicas by dental CAD/CAM technology	Original article	Data captured by contact scanner and; 3D analysis has been defined.	
7	BrankaTrifkovic Igor BudakAleksandarTodorovic DjordjeVukelic VojkanLazic TatjanaPuskar	Comparative analysis on measuring performances of dental intraoral and extraoral optical 3D digitization systems	Original article	Data captured by optical (Intraoral/Extraoral) non contact (light) scanner and the accuracy of optical scanner has been defined.	
8	Scotty L. Bolding	Advanced digital implant dentistry	A peer-reviewed publication	Data captured by optical Intraoral (light/laser) non contact scanner has been defined.	-Computerized Axial Tomography (CAT) well defined. -Cone Beam computed Tomography well defined. -Surgical template construction well defined.
9	Takashi Miyazazi Yasuhiro Hotta Jun Kunii SoichiKuriyama Yukimchi Tamaki	A review of dental CAD/CAM: current status and future perspectives from 20 years of experience	Review article	Data captured by: -Optical (Intraoral/Extraoral) non contact (light/ laser) scanner has been defined. -Contact scanner has been defined.	-Data captured inoffice and inLaboratory well defined. -Restorative materials for CAD/CAM system well defined.
10	Jan-Frederik Guth Christine Keul Michael Stimmermayr Florian Beuer Daniel Edelhoff	Accuracy of digital models obtained by direct and indirect data capturing	Original article	Accuracy of optical (Intraoral/Extraoral) non contact (laser) scanner has been defined.	
11	Simon T. Vlaar	Accuracy of dental digitizers	Original article	Data captured by optical non contact (laser)	

	Jef M. van der Zel			scanner has been defined.	
12	The dental company Sirona	CAD/CAM cameras. Mad to inspire. CEREC OMNICAM and CEREC BLUCAM. The first choice in every case	Catalog	Data captured by optical (intraoral/ light) non contact scanner has been defined.	
13	Budak I., Kosec B., Sokovic B.M	Application of contemporary engineering techniques and technologies in the field of dental prosthetics	Research paper	3D digitalization has been defined.	Data captured by: A-Contact scanner well defined. B-Optical (Intraoral/Extraoral) non contact scanner well defined. C-Optical (Extraoral) non contact scanner (CT scan) well defined.
14	Igor Budak DjordjeVukelić DragoBračun JankoHodolič MirkoSoković	Pre-processing of point-data from contact and optical 3D digitization sensors	Original article	Data captured by contact scanner and; Non contact optical (laser) scanner has been defined.	
15	R.G. Luthardt R. Loos S. Quaas	Accuracy of intraoral data acquisition in comparison to the conventional impression	Original article	Accuracy of digital data gained by optical (Intraoral) non contact scanner has been defined.	
16	Abbas Azari, SakinehNikzad	The evolution of rapid prototyping in dentistry: a review	Review article	Data captured by contact/non contact optical scanner has been defined.	Additive technique (Rapid prototyping) well defined.
17	Karl Hollenbeck Mike van der Poel	White light or laser-what makes the best dental 3D scanner?	Technical paper	Composition of whit light and laser light has been defined.	Properties of whit light and laser light well defined.
18	Karl Hollenbeck Thomas Allin Mike van der Poel	Dental Lab 3D Scanners-How they work and what works best.	Technical paper	Basic principle of 3D scanner has been defined.	Scanning mechanism, accuracy, scan speed and productivity well defined.
19	Wikipedia	3D scanner		Contact/ non contact scanner	3D scanner, triangulation process well defined.

RESULTS

The results of this article will explain each type of dental scanner that used in dental CAD/CAM system that found during search strategy. This article classified dental scanner according to the following diagram, Fig.1:

1- Extra oral scanners:

All the scanning procedure done out of the oral cavity, its applied on the master cast. Unfortunately, there are few published reports regarding Extraoral scanning.

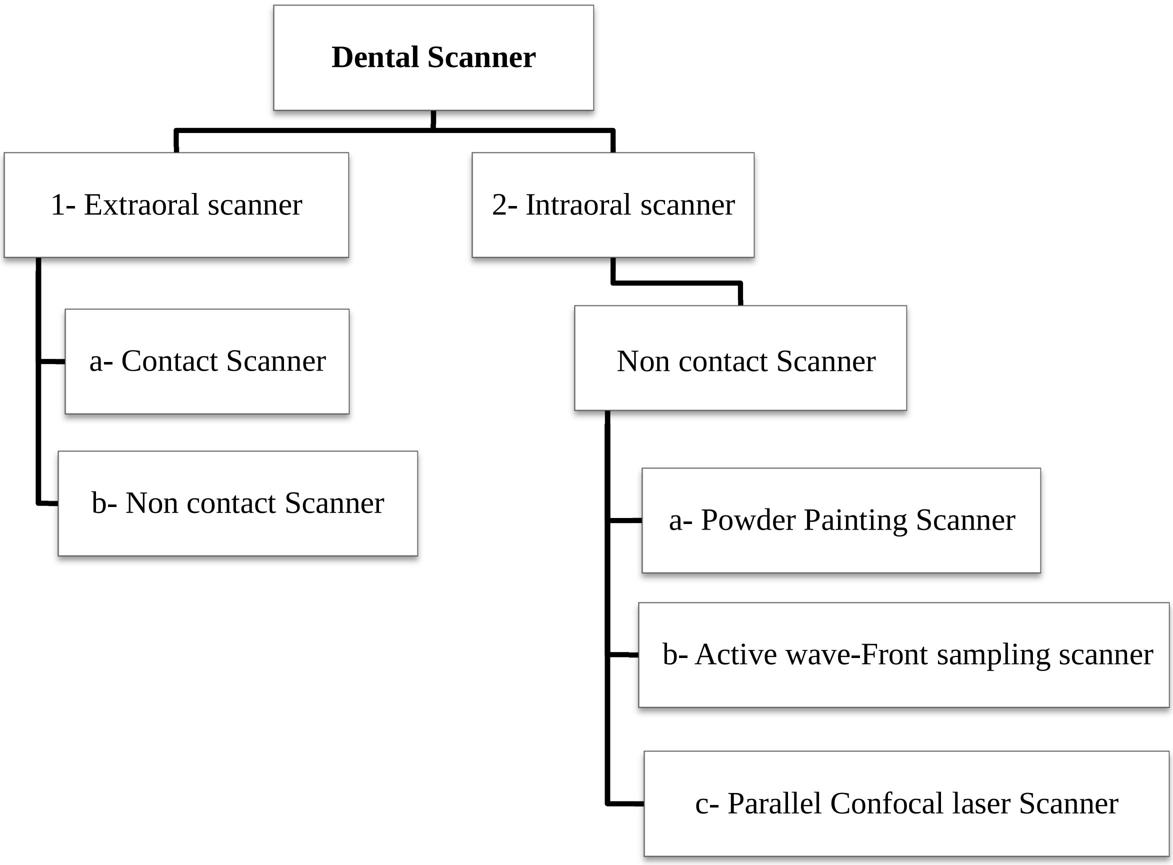

Fig. 1 represented a diagram of dental scanner's classification

It is done either with contact scanner or non-contact scanning systems[3].

a- Contact system:

It's called mechanical scanner or non-active scanner that mean the operation of digitizing basically accomplished by mechanical reading by moving a touch probe (ruby ball) line-by-line around the object and the 3D structure measured [(2, 3, 8)].

The input data for this system are principally from a contact probe surface digitizer which can only digitize the outer surface data and not the internal tissue structure of the proposed object [(3)]. Extraoral scanners use technologies that prevent them from being used intraorally [(9)].

Although dentistry continues to search a proper method to be as alternative for fabricating the metal portions of single crowns and fixed partial denture (FPDs), a combined method that includes machine duplication and spark erosion (Procera® system[i]) has been developed for manufacturing titanium coping [(10)].

To produce all ceramic crowns, Procera® milling and duplication have also been applied in combination with dry-bag pressing and sintering ceramic material [(1)]. Procera® system developed later used telecommunication system as a processing center networked with satellite digitizers around the world for fabrication of all ceramic frameworks. Such communicated production systems are currently being introduced by a number of companies worldwide [(11)]. A 3D images of the master dies that acquired by scanning stylus are sent to the processing center via internet [(12)]. In order to achieve virtual master models with high resolution, the scanner was calibrated according to the manufacturer's instructions the settings of the scanner were adjusted to be used as measuring device [(13)], (Fig. 2) [(14)].

Fig.2: Contact or Mechanical scanner (Procera-forte) (www.procera.com)[(14)]

According to the clinical trials of the California Dental Association quality assurance criteria were used to assess crowns that were fabricated with the Procera® system. The crowns were found to have clinically satisfactory marginal integrity [(15)]. Crown marginal integrity in two separate follow-up studies of patients whose dentition were restored by use of Procera® system was found satisfactory in all cases and the majority reported excellent clinical marginal fit [(16, 17)].

The manufactured sapphire ball at the tip of the measuring probe which is held to the surface of the die claimed to be in high precision [(8)]. One of the limitation of this system is that the probe must be fixed at a 45-degree angle to the axis of rotation of the model [(2, 8)], while the object is in contact with or resting on a precision flat surface plate, if the object to be scanned is not flat or cannot rest stably on a flat surface, it is supported and held firmly in place by a fixture [(18)]. During scanning process, the model was moved in a helical movement, the probe was elevated 50µm during each turn and one data point was collected at every degree. The table lowered at a constant speed while the attached mode is rotated. In order to minimize undercuts and reduce the digitization noise, the long axis of the object to be digitized was aligned in the scanner's holder. In this way, the whole surface is registered in one reading. A sapphire ball with a radius of 0.5mm formed the tip of the contact probe [(13)]. Continuously, the position of the probe is registered and noted 360 times for each revolution, namely once for every degree [(8)]. In the surface digitization the software used to register the center point of the contact probe and the point cloud is recalculated by making an offset of the collected points, based on the radius of the sapphire ball. By combining the points with a polygon, a triangulated surface-model is created [(13)].

The dimensions of milling tool and milling machine are the same as those of the probe tip and the geometry of reader, respectively. Therefore, no calculations are needed to create the file for milling; thus no errors resulting from data processing are introduced between reading and milling [(8)]. When a fine-tipped probe is used as the contact probe, even if it is very precise, its takes time to scan the entire model surface [(11)].

b- **Non Contact scanner:**

It's also called optical scanner or active scanner [18]. Another technique for digitizing using optical methods, by which the data capturing mechanism done by non-contact method, a ray of light (which is a combination of all colors) or a laser (which is single color light source) are the source of illumination [19]. The basis of this type of scanner is the collection of 3D structure in a so-called triangulation procedure [7].

Here, white light or laser used for surface data digitized by projecting them on the object, and a digital camera which is represented by the receptor unit registered the reflected patterns. Therefore, there is a relationship between the light sources and the receptor unit, this relationship represented by a definite angle [20]. The manufacturer describes this technology as projected and reflected beams travel the same linear pathway. This allows scanning of steep slopes of up to 85° [3]. After the reflections have been tacked in the camera image, triangulation technology used to calculate a 3D data using computer [2].

An initial prototype of a compacted and integrated CAD/CAM machine was developed in 1994 which incorporated a small laser displacement gauge and milling machine that permitted measurement and processing to take place in the same chamber. Researchers continued to develop compact and increase-performance digitizing machines. In 2003, the (DECSY®scan[ii]) produced CAD/CAM machine incorporated line laser and Charge-Coupled Device (CCD) camera that produced higher-precision digitization at higher speeds [11].

While a digitization took place as the model itself was rotated, the projection of the line laser and imaging with the CCD camera were performed at an angle. Therefore, the precision of margin digitization was drastically improved. Furthermore, digitized data currently being gathered with this machine could be transferred to DECSY® via a network for operating to increase the productivity [11].

2- Intraoral scanner or digitizers:

A digital data captured directly from the patient mouth [11]. When having this capability, the model making phase is avoided. Consequently, this digitization technique is also referred to as digital impression taking [9].

Dental CAD/CAM firstly developed with Dr. Duret in 1971; he began to produce crowns with the manipulation shape of the occlusal surface using a chain of systems that started with an optical impression of the prepared tooth in the mouth [11]. Also, Young and Altschuler developed an intraoral grid surface mapping system by suggesting the idea of using optical instrumentation to in 1977 [21]. However, this system was not successful in the dental market because of its complexity and cost [12].

A laser displacement gauge and a line laser beam with a Couple Charger Device or Detector (CCD) camera are the methods currently available for practical used [11]. A laser displacement gauge is relatively cheaper and measurement takes less time than with a contact probe. However, corner was particularly difficult to obtain because the reflected light of the projected laser beam is recognized by a Position Sensitive Device (PSD) sensor, the precision decreases with the effects of diffusion [22, 23]. While a line laser is used, the scanning time is greatly reduced, but the resolution of the CCD camera affects the precision [11].

In dentistry today there are several commercially available approaches to scan intraoral surfaces in details and this article divided the intraoral scanner into three approaches:

a- Powder painting scanner,
b- Active wave-front sampling scanner and,
c- Parallel confocal laser scanner.
a- Powder painting scanner:

The principle of this type of scanner in United States' market called a triangulation technique. It is used a timed laser light that directed at the tooth structure that is then reflected back to the CCD camera and the data is captured to record the image [24].This scanner necessity of matting powder application and limitations regarding the size of digitized area. All previously mentioned factors have limited the indicated area of application. The idea to completely replace conventional impressions with intraoral optical 3D digitization has met a number of obstacles, such as inadequate optical properties of the tooth surface, most environments in the oral cavity[25, 26, 27], (Fig. 3) [28].

Fig.3: Intraoral (powder coating) scanner (CerecBluecam) (www.Sirona.com) [(28)].

Against a limited number of an intraoral 3D digitization that supported by specialized dental CAD/CAM systems, numerous systems that allow extraoral optical 3D digitization are available on the market [(2, 27)], (CEREC ® Bluecam[iii])system is an example of this type of scanner [(28)].

b- Active wave-front sampling scanner:

Powder is also necessity with this technique, it is utilized a lens with a rotating aperture instead of using laser light to capture data of the prepared tooth that permit the digitization of 3D data in a video sequence and models the data in real time. The (lava ® C.O.S.[iv]) intraoral scanner by 3M ESPE is example of this type of scanner [(24)].

c- Parallel Confocal laser scanner:

Here, Laser utilization allows scanning of a variety of different surface types and colors without the need for a contrast agent (powder). Its powder-free scanning projected a laser beam onto the surface of the tool and gingiva without a powder. Simply place the camera over the relevant area and the scan starts automatically and then the immediate reflection along the same ray-path are put through a conoscopic crystal and projected on the camera. The result was a diffraction pattern that can be frequency analyzed to determine the distance to the measured surface [(24)]. (Cerec ® Omnicam[v]) is an example of that type of scanner; it is impressive to see the 3D model displayed in full color on the monitor. The various surfaces are shown in their natural shades[(29).]

There are three groups actively integrated in applying CAD/CAM techniques. For each group there are slightly different concept and philosophy. One group is supported by Hennson International of France. Another is a combined effort between the Universities of Zurich and Brains, Brandestini Instruments of Switzerland. The third group is at the University of Minnesota; its major sources of support are the U.S. National Institute of Dental Research and the University of Minnesota. Each group has a slightly different philosophy and approach [(30).]

Table 3 represented three groups applied in CAD/CAM techniques.

NO.	The French System:	The Swiss system:	The Minnesota system:
1	The French system uses a laser scanner to produce images of the patient's mouth[(31)]. A hand-held optical probe measures the three-dimensional coordinates of the tooth prepared for a restoration and of the adjacent teeth [(32).]	a non contacting scan head is positioned over a prepared tooth[(33)].	Data are acquired with a standard 35 mm camera through a 10 mm diameter single-rod lens magnifying laryngopharyngoscope(Richard Wolf Medical Instruments, Rosement, III), which attaches to a standard 55 mm lens[(34)].
2	The scanner probe, with a theoretical basis similar to Moire[39] fringe techniques, has a resolution of 20 pm[(35)].	The scanner incorporates a light-emitting diode (LED) and lens system to illuminate the cavity of the tooth[(33)].	A prism system at the distal end of the rod lens permits the field of view to be 90 degrees from the long axis of the lens. Depth of field is essentially infinite[(34)].
3	The probe consists principally of a laser-diode source and a CCD	Before reaching the tooth, the light rays are deflected by reflections from a mirror,	An entire crown preparation can be viewed from a single position approximately 25 mm above

	photoreceptor[35].	permitting easy access in a patient's mouth. The rays pass through a set of ruled lines and a lens system[33].	the surface of the tooth[34].
4	A non reflective substance is applied to the patient's teeth to eliminate spurious reflections[35].	Light passing through the ruled lines casts a pattern of light and dark stripes on the prepared cavity[33].	A number of views are used, however, to ensure that complete information is obtained and to minimize the likelihood of blur caused by the patient moving[34].
5	The probe is passed over the teeth. The signal created by the laser light reflected by the teeth is picked up by the CCD arrays, converted to a digital signal, and relayed to the computer [35].	The light is reflected back to the scan head where it is sensed (at a different angle) by a CCD sensor with resolution of 256 by 256 pixels[33].	The tooth is illuminated with fiber-optics, which surround the lens[34].
6	Data from the signal are then processed and the results are displayed on a video monitor (a process that requires 2 to 4 min. A foot pedal permits the image to be fixed for further examination so that it can be accepted or rejected[36].	The intensity of this reflected light is recorded as voltage values proportional to the intensity of the light reflected back to the CCD chip[33].	To permit three-dimensional surface reconstruction and reconstruction of the movements of the jaw (at least in the positions where the teeth are in contact), stereo pairs of images are made. The images are recorded on standard film (Eclachrome, ASA 400). The exposed film is developed by commercial processors[37].
7	The probe must pass over the teeth four times and four acceptable images must be obtained[36].	The voltage values are recorded in digital form and are transmitted of the computer for subsequent analysis[33]. The scanning of a class II cavity requires only 0.2 seconds [38].	The color slides are digitized by using an Eikonix EC 850 (Eikonix Corp., Bedford, Mass.) digitizing system interfaced with a PDP 11/44 with RSX 11-M-PLUS operating system (Digital Equipment Corp.)[37].
8	In expert hands, data of the prepared tooth, the adjacent teeth, and the opposing dentition can be acquired in less than 3min. [34].	The vertical dimension of the depth of the cavity is determined by the apparent shift between the incident and reflected light; deeper parts of the cavity exhibit more apparent shift than shallow areas[33].	The digitizer has a resolution of 4096 X 4096 pixels [37].
9		Although the accuracy of the readings obtained with the scan head are generally adequate, they can be improved by coating the cavity with a layer of white, glare-free substance (such as CAVISON, Sved a Dental Industry, Enkoeping, Sweden) [33].	Digitizing time is 10 to 90 seconds per slide, depending on the color scale being used[37].

DISCUSSION

This article can't decide which type of scanner is better than another because decision is depend on the usage of the user. Here we can discuss some information related to the accuracy of dental optical scanner. Previous researches in this field had concluded different results of the accuracy and precision of 3D optical digitization devices. From the literature review it is difficult to identify the precision of clinical acceptable marginal gap.

American Dental Association (ADA) specification No. 8 showed that the luting agent's type I thickness should be not more than 25 µn and 40 µn when applied type II luting agent [39]. Some articles agreed with ADA No.8 specification and others suggested modified it.

Contemporary optical 3D digitization devices offer a measuring accuracy under 20µm [40, 41].Luthardt et al. Found the accuracy of digital impression obtained with Cerec 3D camera, equal to 28µm in cases when impressions were taken of tooth group [42]. Also, Guthetal. Found that direct 3D digitization with Lava ® C.O.S. showed statistically significantly higher accuracy compared to the conventional procedure of impression taking and indirect digitization [43]. Fransson et al [44] and McLean and von Fraunhofer[45] suggested that after cementation, the clinical acceptable marginal gap should be less than 150 µm and 120 µm. McLean and von Fraunhofer[45] tested the marginal fit of 1000 fixed restoration over 5 years period and found that a marginal gap less than 80 µm is difficult to obtain.

Holmes et al defined the marginal gap as the measurement between the axial wall of the finishing line of the prepared tooth and the internal surface of the restoration's margin. While the absolute marginal discrepancy defined as the linear distance from the surface finish line of the prepared tooth to the margin of the restoration [49].

More recent 3D optical digitization devices showed better measurement accuracy and precision. One among them is the new Cerec ® AC Bluecam that better accuracy than the conventional Cerec ® 3D camera[11]. WhileMehletal.

Reported on an accuracy of 19μm for Cerec ® AC Blue Cam and this value were close to the accuracy of extraoral reference scanner-laser scan 3D (50).

Here we can mention some information regarding some production of CAD/CAM system present in the market. Table 4 represented some production of the existing systems.

Table 4 shows some type of the existing scanning system of CAD/CAM technologies.

Company	Branyd type	Country	Type of scanner	Powder Required
Sirona	Cerec®Bluecam	Germany	Blue light	Yes
Sirona	Cerec®Omnicam	Germany	Parallel laser confocal	NO
Sirona	Cerec® AC	Germany	LED (light emitting diode)	Yes
D4D Technologies	E4D®	USA	Laser	Yes
Cadent Inc	iTero®	USA	Laser	NO
3M Espe	Lava® COS/ intraoral scanner	USA	Active wavefront sampling	Yes
	Lava®/ extraoral scanner	USA	Laser	---
Procera-forte	Procera®/AllCeram	Processing center in New Jersey or Sweden	Manual	---
Degudent	Cercon®	Germany	Laser	No

CONCLUSION

In the last several years, exciting new developments in dental scanner and computer technologies led to advance and success of contemporary dental CAD/CAM technology. Several highly sophisticated dental scanners have been introduced or under development.

Implementation of the methods of 3D digitization in dental practice is modern and new option for dentistry creating an alternative technique to the method of conventional impressions, especially in the field of prosthodontics. Scanner device with digital technology made what were previously manual tasks easier, faster, accurate and more predictable.

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[i] Nobel forte- New Jersey or Sweden.
[ii] Digital Process LTD., Japan.
[iii] CerecBluecam, Sirona Dental system, Germany.
[iv] Lava ™ C.O.S, 3M ESPE, US.
[v] CerecOmnicam, Sirona Dental System, Germany.