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Application of Artificial Intelligence Graphics and Intraoral Scanning in Medical Scenes

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Abstract: Intraoral scanning technology has become an essential tool in current digital oral medicine, with rapid technological development and increasingly widespread clinical applications. This article reviews the development process of intraoral scanning technology, classifies and introduces the principles of commonly used intraoral scanning technology, and briefly explains the application of this technology in digital diagnosis and treatment in different fields of dentistry. The author analyzes and compares the scanning accuracy of five different types of oral scanners for scanning single jaw complete dentition plaster models. And evaluate the scanning quality to provide reference for clinical application and provide a basis for further improving the performance of domestic oral scanners in the future. The author used a high-precision desktop scanner (Yunjia UP560) to obtain a digital model and used it as truth group data. After using the analysis software Geomagic Studio14 for "best fit comparison", the author conducted deviation analysis on the true value group and experimental group data, evaluated the quality indicators of the scanned data, and compared the scanning accuracy. In terms of scanning accuracy, international manufacturers represented by iTeroElement1 and 3ShapeTrios3 are both at a high level. The Fusion Scanner, Aoralscan2, and Mediti500 instruments have different advantages in accuracy and precision across different measurement ranges. The accuracy of scanning single tooth crowns with several instruments is better than that of scanning single jaw full dentition, indicating that reducing the scanning range can improve the accuracy of the scanner.

1. Introduction

Digital intraoral scanning technology has become an advanced technology that is being popularized in clinical practice. In recent years, various new types of intraoral scanning systems have been iteratively launched based on different technological principles. The field of clinical application is constantly expanding to better assist physicians in accurately, meticulously, and efficiently carrying out digital oral diagnosis and treatment technology [1].

The traditional clinical collection and impression technology has complex operations and cumbersome steps, and the birth of digital intraoral scanning technology has overturned the traditional clinical operation process. The intraoral scanner scans the Internal environment of the mouth in real time and processes the data with the help of a computer. After technical processing, an in mouth digital model can be obtained without the assistance of traditional gypsum models, and the loss of raw materials is also reduced. The whole process of intraoral scanning is visualized, and both patients and doctors can clearly and intuitively view the scanning process and data. Therefore, ensuring the accuracy of scanned data is the key to digital impression production [2]. At present, there are various types of oral scanners on the market, and different instruments use different working principles [3]. The degree of being affected by oral Internal environment and other factors is also inconsistent. In addition, external factors such as the operating methods of clinical doctors can have a certain impact on scanning accuracy, which in turn affects the quality of the final digital impression [4]. The accuracy of intraoral scanning includes both accuracy and precision, and is usually measured by comparing multiple scans. According to the International Organization for Standardization standard (IOS5725-1), accuracy is also called accuracy or precision, which is used to describe the consistency of measured values and reference values. It reflects the systematic and random errors in the measurement results, including accuracy/truth and precision/consistency. Accuracy belongs to systematic error, which is the degree of consistency between the mean of a large number of measured values and the reference value. Precision refers to the repeatability of the measurement results of the equipment system itself, which is related to the stability of the equipment.

In this clinical context, it is necessary to review the development history of digital intraoral scanning technology, systematically learn the current status and development trends of this technology. Assist clinical science in selecting suitable intraoral scanning system products [5]. This article will outline the development process of digital intraoral scanning technology and provide a detailed explanation of its main technical principles based on the existing main intraoral scanning systems. The author quantitatively evaluates five mainstream oral scanning instruments from the perspectives of scanning accuracy and scanning data quality, providing reference for clinical applications. And prospects for its future development trends.

2. Literature Review - Development History of Digital Intraoral Scanning Technology

In 1977, Young et al. developed an export mesh drawing system based on holographic technology, which inspired the earliest idea of digital scanning of oral tissue [6]. In 1980, Dr. Werner Mrmann from Switzerland and an engineer from Marco Brandestini from Italy successfully collaborated to achieve this idea. Developed oral scanning technology for the first time, and two years later developed the world's first handheld oral scanner [7]. In 1984, Duret et al. developed the first dental specialized CAD/CAM equipment that included intraoral scanning technology. After obtaining patent authorization protection, it was acquired by Sirona (formerly Siemens) in Germany [8, 9]. In 1987, the first commercial digital dental CAD/CAM product, CEREC-1, was launched. The system initially used a 256 * 256 pixel camera for intraoral data collection, which could only meet the treatment needs of embedded chair side CAD/CAM. Subsequently, the performance of the upgraded CEREC-2 and CEREC-3 products continued to improve and expand. And it is applied to various types of restorations such as high inlay, single crown, fixed bridge, etc. [10, 11]. It is also gradually used for the restoration of complete dentures and removable dentures, becoming one of the standard technologies in digital oral restoration clinical practice today. The application of intraoral scanning technology in the field of orthodontics has achieved great success since the 1990s. In 1997, Align Company in the United States first produced an invisible orthodontic device using digital intraoral scanning data. This technology is more precise, fast, aesthetically pleasing, and comfortable than traditional orthodontic techniques. Subsequently, in 2002, Wiechmann first applied intraoral scanning technology to the CAD/CAM of lingual orthodontic brackets, facilitating efficient customization of personalized orthodontic devices for patients [12]. In the early days, oral scanner products required pre spraying powder on the surface of teeth and other oral tissues before operation, and only black and white digital models could be obtained. In 2006, Bush et al. achieved the first oral data collection for edentulous patients [13]. In 2011, Shape Company launched its first color digital intraoral scanner (Trios). Breaking through the technical barriers that require powder spraying, color image information of oral tissue can be obtained. Subsequently, other manufacturers also launched similar products and became the mainstream technology for oral scanners today. In 2016, Langcheng Medical launched the first DL-100 intraoral scanner developed in China. At present, digital intraoral scanning is being better integrated with multi-source oral and maxillofacial data obtained through various digital methods such as CBCT, facial 3D scanning, and digital mandibular trajectory tracing. And in clinical operations, it is more efficient and the scanning results are more accurate. For example, scanning management software that can be operated on mobile phones or tablets provides a one-stop digital solution that meets the different needs of patients, physicians, technicians, and others.

3. Technical principles of digital intra port scanning technology

The existing digital intraoral scanning system imaging is based on the principle of optical scanning technology, using a light source for intraoral tissue illumination. Then, the information is captured by digital sensors for post-processing and data output. Intraoral scanning systems can be mainly divided into two categories based on the different light sources used: one is based on laser technology, and the technical principles applied are mainly parallel confocal imaging technology and laser triangulation technology [14]. During intraoral scanning, oral tissue images can be captured from different angles and positions. The second type is an intraoral scanning system based on visible light technology. The technical principle is to collect images through techniques such as static image acquisition, video capture, and real-time image capture [15]. Below is a detailed introduction to the above technical principles:

3.1 Parallel confocal imaging technology

Parallel Confocal Imaging Technology originated from the field of microscopic imaging. The method is to scan the hair with a parallel laser beam through an intraoral scanner and project it onto the scanned object. After irradiating the target with a specific focal length, the laser beam will reflect and pass through a small hole and be collected by the laser detector [16]. Then convert it into a digital image, and finally construct a three-dimensional image of the tissue inside the outlet through layer by layer scanning (Figure 1). The representative product is the iTero (Align Technology, USA) system. When the scanner is working, it projects approximately 100000 parallel red laser beams with 300 different focal lengths, and can sample an area of 14 mm * 18 mm in 0.3 seconds. Then digitize and output the results. The latest iTero in port scanning system can capture approximately 3.5 million data, significantly enhancing data acquisition capabilities (scanning speed increased from 800 frames per second to 6000 frames per second) [17].

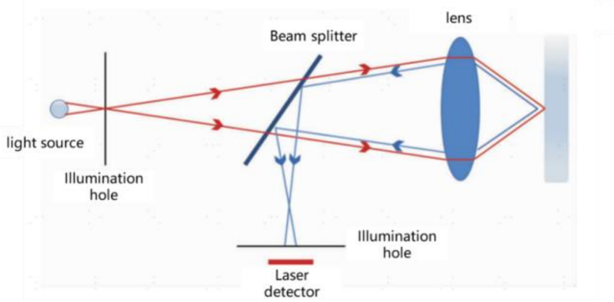

Figure 1 Schematic diagram of parallel confocal imaging technology

3.2 Laser triangulation technology

The principle of Laser Triangulation Imaging Technology refers to the scanner using a red laser beam and a micro mirror to oscillate at a frequency of approximately 20000 cycles per second [18]. Capture a series of still images from multiple angles around the scanned object to generate a three-dimensional model (Figure 2). Its outstanding technical advantage is that the camera only needs to scan a single direction to obtain all surface morphology details of the captured target area in the image [17]. Representative products are E4D Systems (D4D Technologies, USA) and Planmeca Systems (Finland). The difference between the two is that the former uses a red laser beam light source, while the latter uses a blue laser beam light source for projection.

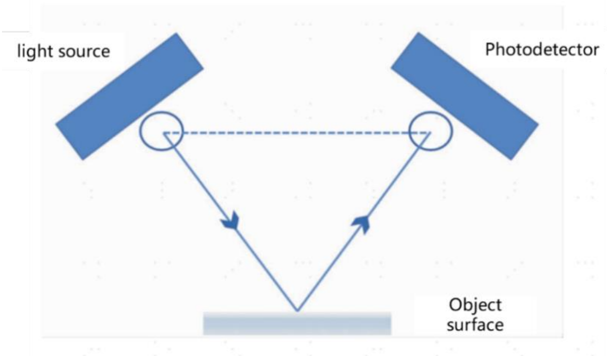

Figure 2 Counting principle of laser triangulation measurement

3.3 Structured light imaging and laser triangulation technology

The combination of Structured light imaging technology and laser triangulation technique helps to capture images continuously. Thus, it is possible to accurately identify the three-dimensional surface morphology of teeth. The representative product is CS3500 (Carestream Dental, USA). This product utilizes green lasers and four light-emitting diodes to collect and illuminate objects, and uses complementary metal oxide semiconductor (CMOS) sensors to receive the collected data. The scanning range of the scanner is 16 mm * 12 mm, with a working depth of 1-15 mm. It can perform full dentition scanning without the need for powder spraying, and the obtained digital data can be used to render color models.

3.4 Static Image Acquisition Technology

The StillImage Capture Technology uses a technique called active triangulation. The principle is to locate the intersection of three linear beams in three-dimensional space and collect data [19]. The representative product is the Cerec Omnicam/Bluecam (Sirona, Germany) system. Sirona's early product, Cerec Bluecam, uses infrared light technology (with a wavelength of 820nm). The new generation Cerec Omnicam products use blue light waves (470 nm) to scan the dentition, improving wavelength parameters and deepening the depth of field. The scanning accuracy is improved by about 60% [20]. In addition, it also helps to restore real images. The intraoral scanning system (Langcheng DL-202) in China is also based on this technical principle. The difference lies in its use of LED white light as a partial light source for the camera in the mouth, which allows for true color restoration of 3D data in the mouth without the need for powder spraying.

3.5 Video capture technology

The active wavefront sampling technique in Video Capture Technology is the only technique that can capture three-dimensional data in video sequences and model them in real-time. Active wavefront sampling refers to measuring depth through defocusing based on the main optical system [21]. Thus, obtaining 3D information from a single lens imaging system. The representative product is Lava COS (3M, USA) system. The system includes 192 blue LED lighting, 3 sensors, and 22 lenses. Scanning objects can be captured from different angles simultaneously, and then a specialized image processing algorithm can be used to generate a real-time 3D surface model of the object using the captured information. The scanning range of the scanner in this mouth is 10 mm * 13.5 mm. The system parameters using the triangulation principle are similar to those mentioned earlier, but the drawback is that the rendered model is monochromatic due to the need for powder spraying before scanning.

3.6 Extreme speed optical slicing technology

Ultrafast Optical Sectioning Technology, similar to video capture technology, can improve the scanning speed during continuous image capture. The representative product is the Trios system (3Shape, Denmark), which can capture over 3000 two-dimensional images per second during operation, with a viewfinder range of 17 mm * 20 mm and a working depth of 0-18mm. In addition, compared to other visible light based intraoral scanning systems, this type of product has the ability to capture and render full color models. The latest third-generation Trios product integrates an in mouth camera for capturing high-definition images, and also introduces a new version with a wireless scanner, which can significantly improve scanning speed and accuracy. Currently, there are over 22 products available for oral scanning systems on the market. Although the clinical workflow of digital intraoral scanning is similar, there are certain differences in the clinical indications of scanners from different manufacturers (Table 1). There are significant differences in the size and weight of scanning heads among different intraoral scanning systems (Table 1 and Figure 3). The author measured five common digital in mouth scanning system products in the market. In terms of scanning head size, the domestically produced Langcheng has the smallest intraoral scanning head and the iTero has the largest intraoral scanning head. Planmeca is the lightest in weight and iTero products are the heaviest.

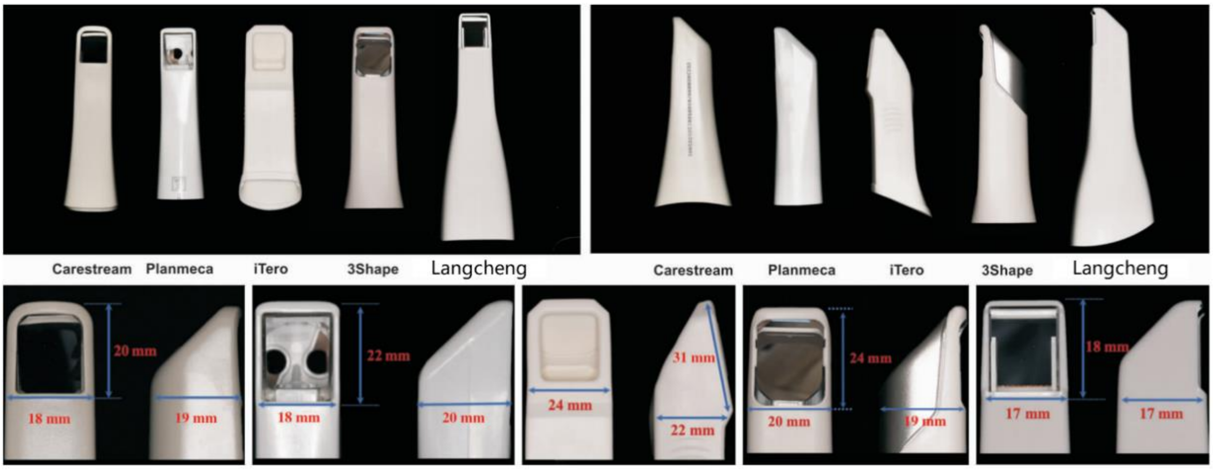

Figure 3 Measurement of scanning head size for 5 common intraoral scanning systems

Table 1 The functions and indications of five common digital intraoral scanners

system	manufacturer	system architecture	Indications	Do you need to spray feces	Scanning head weight	file format
iTero	AlignTechmology, USA	Open	Inlays, veneers, crowns, orthodontics, implants	No	1120g	STL
Trios	3Shape	Open	Inlays, veneers, crowns, surgical navigation, orthodontics, implants	No	625g	DCM/STL
PlanScan	Planmcca Oy	Open	Inlay, veneer, crown, implant	No	290g	STL
CS 3500	Carestream DentallLC	Open	Inlay, veneer, crown	No	295g	STL
DL-202	Langcheng, China	Open	Inlays, veneers, crowns, orthodontics, implants, industrial products, facial shape testing	No	300g	STL/PLY

4. Comparison of scanner model scanning accuracy and evaluation of scanning quality

4.1 Materials and Methods

4.1.1 Scanning equipment and equipment

Five scanning devices were selected based on the widely used international and domestic commercial scanners: 3 Shape Trios (3 Shape Company, Denmark) (system version 3Shape Version 21.4.3 (3.14.2.0), iTero Element 1 (Align Technology Company, United States) (system version 1.12.9.600), Fusion Scanner (Landsat Instrument, China) (system version 1.0.0.0) Aoralscan (2 Pro 3D, China) (system version v2.1.0.4), Medit i500 (MEDIT, Korea) (system version 2.6.5), high-precision desktop scanner Yunjia UP560 (Yunjia Technology, China) (system version UpScan 2.0.18.0808).

4.1.2 Acquisition of Experimental 3D Data

In the same indoor environment, the same scanner skilled in operating the intraoral scanner will use the above five intraoral scanners to scan along the side of the full dentition plaster model. At the same time, observe the dynamic 3D image on the computer display screen, and the scanning path is: single optical path cyclic scanning head motion path, that is, scan the occlusal surface of the dentition first. Gradually move from the left distal molar of the model to the central incisor and then to the right distal molar. Check if there are any missing parts, and if there are any, supplement the scanning of the missing parts (with a maximum of two areas scanned, and the amount of data will not affect the experimental results) to ensure that complete gypsum model data is obtained and stored in a stl format file. Among them, 3 Shape Trios 3, iTero Element 1, Fusion Scanner, Aoralscan 2, and Medit i500 were used as experimental groups; The digital model data obtained from the high-precision desktop scanner Yunjia UP560 was used as the true value control group [22], and each scanner in the experimental group was scanned five times.

4.1.3 Data processing methods

Import the stl data of the single jaw complete dentition plaster model obtained from five scanners into Studio14 (Raindrop Geomagic, USA) software. Based on the characteristics of the standard dental model, select three points to make a plane 1. Plane 1 is vertically translated downwards by the same distance, and the position after translation is the position of Plane 2. The author used software to obtain dental data (Figure 1) and extracted a single crown mold using the Geomagic software's polygonal interface curve cutting tool. The author matched the model data of the experimental group with the truth group data using the method of "best fit alignment", and presented it through a color deviation map (Figure 2), where different colors represent different deviation ranges [23].

4.1.4 Evaluation method for measurement data quality

The author used the Geomagic Studio 14 software "Grid Doctor" command to calculate the "non-manifold edge", "self-intersection", "height increasing edge", "peak", "small component", and "small hole" indicators for each group of data, as scanning data quality indicators. The definitions of each indicator are as follows: non manifold edges refer to two edges of some triangles that exist on natural boundaries and are not connected to the overall mesh. Self-intersection refers to the interweaving of adjacent triangles. The highly refracted edge refers to the sharp angle between adjacent triangles. A nail shaped object refers to a protruding point on a smooth surface, formed by three or more triangles. Small components refer to certain triangles that are independent of the whole and are usually considered noise points. A small hole refers to a very small opening that exists on the overall mesh surface.

4.1.5 Scanning accuracy evaluation method

The mean RMS values obtained from the "best fit alignment" and deviation analysis of the experimental group and the truth group reflect the accuracy of single jaw scanning. Each instrument undergoes five repeated scans to generate 5 stl files [24]. The author Perform the "best fit alignment" with the truth data to calculate the average distance and RMS, and calculate the average of the 5 rounds of results to determine the accuracy of the single jaw scan. The precision of single jaw scanning is determined by the standard difference between the average distance and RMS (root mean square) obtained from repeated scanning models using the same scanner after "best fit alignment" and deviation analysis. Segmenting the entire dental model into single crowns resulted in 14 single crowns. The author Compare the deviation results with the truth group data separately to calculate the mean of all intercepted single crown deviation results scanned by the same instrument, which is the accuracy of the single crown phantom [25, 26]. The standard deviation of all intercepted single crown deviation results is the precision of the model.

4.1.6 Statistical methods

Perform statistical analysis on experimental data using SPSS 26.0 software.

(1) Precision analysis

The mean and standard deviation of the mean distance and RMS value between the experimental group and the truth group, as well as between the experimental group itself, are used as econometric indicators. After conducting normality tests and homogeneity of variance tests on the data of each group, univariate analysis of variance was used to test the differences among the five groups. Set 3 Shape Trios3 as the first group, iTero Element 1 as the second group, Fusion Scanner as the third group, Aoralscan 2 as the fourth group, and Medit i500 as the fifth group. Univariate analysis of variance ANOVA and SNK were used to test the inter group differences among the five scanners, with $P<0.05$ indicating statistically significant differences.

(2) The impact of scanning data quality on scanner accuracy

In the scanning quality data, there are many highly refracted edges and spikes. This paper mainly analyzes the impact of these two parts on the scanning accuracy. Perform Spearman correlation analysis on the data quality indicators and scanner accuracy of five experimental groups.

4.2 Results

4.2.1 Comparison of measurement data quality

The data quality of the experimental group after scanning a single jaw full dentition model with an intraoral scanner is shown in Table 4. The scanning data of the five types of intraoral scanners are mainly concentrated on nail shaped objects and highly refractive edges. Except for iTero Element 1 and Aoralscan 2, the other three types of intraoral scanners have a small number of small holes. There are a few self-intersections in Fusion Scanner, Aoralscan2, and Medit i500 scans. 3 ShapeTrios 3, FusionScanner, iTero Element 1 have fewer highly refractive edges. There is a significant increase in the number of nail shaped objects in the 3 Shape Trios compared to other types of intraoral scanners. Overall, iTero Element 1 has the best scanning quality except for a small amount of nail like objects, while Shape Trios 3 performs poorly on nail like objects, with good scanning quality for other indicators. Fusion Scanner, Aoralscan 2, and Medit i500 all have certain data indications on various indicators, each with its own advantages and disadvantages.

4.2.2 Precision evaluation

The accuracy of the experimental group's intraoral scanner for single jaw full dentition is shown in Table 2. Accuracy represents the magnitude of the deviation between experimental data and true value data, represented by the mean distance and RMS. Precision represents the magnitude of deviation between data within a group, represented by the standard deviation of mean distance and RMS. In terms of accuracy of single jaw full dentition, iTero Element 1 and 3Shape Trios 3 have the highest accuracy, at 50 μ Within m. Mediti500, Fusion Scanner, and Aoralscan 2, with accuracy ranging from 50 to 70 μ Within the range of m, the difference is relatively small. In terms of precision, the average distance and RMS values of iTero Element 1 and Fusion Scanner precision are relatively small, indicating good stability. The Aoralscan 2, 3 Shape Trios3, and Medit i500 have larger RMS values and slightly lower precision compared to the first two models.

The accuracy of the single tooth crown of the experimental group's intraoral scanner is shown in Table 3. Based on the comparison results of single crowns, the accuracy of iTero Element 1, 3 Shape Trios3, and Medit i500 is not significantly different, and they are relatively high, all within 10-15 μ Within the range of m. The single coronal accuracy of Fusion Scanner and Aoralscan 2 ranges from 15 to 30 μ Within the range of m. In addition, the average distance standard deviation of the single crown precision of the five types of intraoral scanners is lower than 3 μ M. The RMS standard deviation for the precision of Aoralscan2 and Medit i500 is between 4-7 μm, the RMS of the remaining three models is below 3 μ m. Higher precision. Overall analysis shows that the precision of the five models of the single crown is relatively good.

Table 2: Evaluation of the accuracy of single collar full dentition in the experimental group's intraoral scanner

Intraoral scanner	Scanning rounds	Single jaw accuracy		Single jaw precision	
		Average distance (um)	RMS（um）	Average distance (um)	RMS（um）
3 Shape Trios 3	5	2.88	47.44	3.09	15.6
iTero Element 1	5	4.42	44.43	5.29	5.66
Fusion Scanner	5	2.1	67.6	2.37	6.62
Aoralscan2	5	9.6	65.03	10.5	16.01
Medit i500	5	6.8	52.2	2.59	12.44

Overall, compared to the five types of intraoral scanners mentioned above, iTero Element 1 has higher accuracy and precision in both single crown and full dentition. 3 Shape Trios followed by 3. Fusion Scanner, Aoralscan2, and Medit i500 have different advantages in accuracy and precision across different measurement ranges. In addition, compared with Table 4 and Table 2, the accuracy of scanning a single crown with several instruments is better than that of scanning a single full dentition, indicating that reducing the scanning range can improve the accuracy of the scanner.

Table 3 Evaluation of Single Crown Accuracy of Intraoral Scanners in the Experimental Group

Intraoral scanner	Scanning rounds	Single jaw accuracy		Single jaw precision	
		Average distance (um)	RMS （um）	Average distance (um)	RMS （um）
3 Shape Trios 3	5	2.66	11.25	2.17	1.81
iTero Element 1	5	2.3	12.94	2.65	2.34
Fusion Scanner	5	3.56	17.96	2.32	1.54
Aoralscan2	5	3.08	30.71	2.41	6.39
Medit i500	5	2.84	13.22	1.4	4.38

Table 4 Data quality of the experimental group after scanning the single collar full dentition phantom with an intraoral scanner

Intraoral scanner	frequency	Non manifold edge	Self-intersecting	Highly refractive edge	Nail like object	Small components	Small channel	Small hole
3 Shape Trios 3	1	0	0	0	91	1	0	1
	2	0	0	0	123	1	0	1
	3	0	0	0	140	3	0	3
	4	0	0	0	106	3	0	3
	5	0	4	4	108	1	0	1
iTero Element 1	1	0	0	5	62	0	0	0
	2	0	0	5	53	0	0	0
	3	0	0	8	131	0	0	0
	4	0	0	0	35	0	0	0
	5	0	0	0	76	0	0	0
Fusion Scanner	1	0	0	0	246	0	0	4
	2	0	3	0	58	0	0	6
	3	0	8	4	98	0	0	10
	4	0	6	45	76	0	0	0
	5	0	10	4	98	0	0	4
Aoralscan2	1	0	3	51	73	0	0	0
	2	0	3	40	75	0	0	0
	3	0	10	68	77	0	0	0
	4	0	6	76	83	0	0	0
	5	0	3	47	65	0	0	0
Medit i500	1	0	8	5	55	0	0	2
	2	0	0	0	37	0	0	0
	3	0	0	35	42	0	0	1
	4	0	0	5	55	7	0	8

5. Clinical application of digital intraoral scanning technology

5.1 Tooth and dentition defects

The intraoral scanning technology was first applied in the field of oral restoration, and has been widely and maturely applied in the repair of tooth defects and local dentition defects. The data system architecture obtained by the vast majority of existing intraoral scanning system products is in an open format, which can be easily imported into dental digital oral restoration design software for subsequent design and production, greatly improving clinical diagnosis and treatment efficiency and accuracy, and reducing patient waiting time and visits. For example, compared to traditional impression methods, intraoral scanning technology eliminates clinical processes such as oral impression preparation, injection of plaster models, and disinfection of plaster models. The obtained digital model has higher accuracy, stability, and repeatability [27]. The current intraoral scanning system is combining with various other digital means to form new clinical diagnosis and treatment technologies. Advanced technologies such as Digital Smile Design (DSD) and digital implant guides guided by repair results can quickly present expected repair results [28]. This is conducive to promoting doctor-patient communication and effectively improving patient satisfaction.

The correction of dental deformities is another major field of clinical application of digital intraoral scanning technology. Since the successful production of invisible orthodontic products without brackets by Align Company in the United States based on data obtained from intraoral scanners in 1997, digital orthodontic technology has achieved tremendous commercial success. Compared to traditional orthodontic diagnosis and treatment models, the use of an intraoral scanner for rapid mold removal can immediately present the design and present the corrective effect. Orthodontists can also use digital models to simulate the position of brackets in advance, which can be used to create personalized bracket bonding guides. This greatly improves the accuracy of adhesive brackets and reduces chair side operation time. The analysis software equipped with the 3Shape Trios intraoral scanning system can also achieve virtual tooth arrangement, tooth movement analysis, etc., greatly enhancing the controllability of orthodontics.

In recent years, the author has applied intraoral scanning technology to the treatment of patients with Periodontal disease to control the occlusal force and evaluate the efficacy. Teeth caused by loss of periodontal attachment are prone to loosening or displacement, and there may be secondary occlusal early contact and non-functional lateral occlusal interference. Intraoral scanning avoids model accuracy issues caused by tooth displacement in traditional oral impressions.

5.2 Defects or missing jawbones and soft tissues

Imprinting of maxillofacial defects caused by various types of congenital Cleft lip and cleft palate or acquired tumor trauma has always been a difficult clinical problem. Traditional oral impression methods are not suitable for use due to the use of upper and lower jaw, palate, and facial organ tissues as the objects of impression. In recent years, the author has applied intraoral scanning technology to obtain satisfactory results in case data of jaw bone defects and palate defects. Yu Xiaonan et al. used intraoral scanning technology to collect data on the Surface finish of the contralateral orbital skin of patients with unilateral orbital defects, and successfully obtained the patient's personalized skin texture, color spots, even pores and other color morphological information. The design and production of digital orbital prostheses using mirror flipping technology. The author also used intraoral scanning technology to achieve the data acquisition of intraoral tissues of infants with Cleft lip and cleft palate in neonatal period (within 28 days after birth) and infancy (within one year after birth), further expanding the clinical application of intraoral scanning [29]. Because of the special pathological structure of Cleft lip and cleft palate, the opening of children with cleft lip and palate is larger and wider than that of normal infants. This can effectively accommodate the oral scanning head into the mouth of the child. When entering the intraoral scanning, there is a Cleft lip and cleft palate in the upper part of the mouth of the child, and there is a space generated by the retraction of the tongue below, which provides a space for the mouth scanner head to rotate up and down to capture a complete image. The scanned 3D model data of cleft palate can be used for clinical design, making preoperative plastic orthodontics, or as a digital storage 3D model of cleft palate. The antuor compare and study the indicators of cleft palate deformity correction and tissue development changes before and during treatment to monitor the growth and development of the child's jaw bones and evaluate the effectiveness of wearing appliances.

6. Conclusion

In summary, digital intraoral scanning technology has achieved good clinical application results at this stage. However, there are still issues such as the oversized size of the intraoral scanning head, the need to improve the accuracy of full arch scanning, and the unclear impact of the number of disinfection times on the scanning accuracy of the scanning head. Further exploration and research are needed in future clinical work. It should be pointed out that although digital intraoral scanning technology has advantages such as speed, comfort, and flexibility. But at present, it cannot completely replace traditional oral impression technology. For example, obtaining impressions for edentulous and free end dentition defects cannot meet clinical treatment needs. In addition, due to the limitations of existing scanning technology principles, intraoral scanning belongs to an object surface scanning technology. Therefore, only surface morphology data of oral soft and hard tissues can be obtained, and it is necessary to combine CBCT and other methods to objectively and scientifically evaluate the internal structure of oral and maxillofacial tissue structures such as jawbones and dental roots. It is worth noting that the latest Optical coherence tomography (OCT) technology is expected to change this situation. This technology is based on optical coherence tomography, which can scan subgingival tissue without damaging soft tissue. On this basis, developing new image processing algorithms may break through the technical bottleneck of surface scanning in existing technologies [30, 31].

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