Primescan Clinical Proof

Study Overview

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Accuracy of complete- and partial-arch impressions of actual intraoral scanning systems in-vitro

Study Background
- In-vitro study with local and global accuracy
- Translucent, ceramic tooth model was used
- Primescan, Omnicam, Trios3, Medit i500, CS3600, iTero

Talking Points
- In certain aspects, Primescan was viewed as the most accurate among the tested intraoral scanners that were compared in an in-vitro study
- In the peer group of intraoral scanners, which did not cover several systems commercially available today, Primescan showed the best median and mean values across complete arch, anterior and posterior segments, few statistical limitations apply
- Omnicam results have significantly improved with the latest CEREC SW 5

Abstract

Objective
Intraoral scanners (IOSs) are widely used for obtaining digital dental models directly from the patient. Additionally, improvements in IOSs are made from generation to generation. The aim of this study was to evaluate the accuracy of new and actual IOS devices for complete- and partial-arch dental impressions in an in-vitro setup.

Materials and methods
A custom maxillary complete-arch cast with teeth made from feldspar ceramic material was used as the reference cast and digitized with a reference scanner (ATOS III Triple Scan MV60). One conventional impression technique using polyvinylsiloxane (PVS) material (President) served as the control (CO), and eight different IOS devices comprising different hardware and software configurations (TRn: Trios 3; TRI: Trios 3 insane; CS: Carestream Dental CS 3600; MD: Medit i500; IT: iTero Element 2; OC4: Cerec Omnicam 4.6.1; OC5: Cerec Omnicam 5.0.0; PS: Primescan) were used to take complete-arch impressions from the reference cast. The impressions were repeated 10 times (n = 10) for each group. Conventional impressions were poured with type IV gypsum and digitized with a laboratory scanner (inEos X5). All datasets were obtained in standard tessellation language (STL) file format and cut to either complete-arch, anterior segment, or posterior segment areas for respective analysis. Values for trueness and precision for the respective areas were evaluated using a three-dimensional (3D) superimposition method with special 3D difference analysis software (GOM Inspect) using (90-10)/2 percentile values. Statistical analysis was performed using either one-way analysis of variance (ANOVA) or Kruskal-Wallis test (α = 0.05). Results are given as median and interquartile range (IQR) values in µm.

Results
Statistically significant differences were found between test groups for complete- and partial-arch impression methods in-vitro (p < 0.05). Values ranged from 16.3 [2.8] µm (CO) up to 89.8 [26.1] µm (OC4) for in-vitro trueness, and from 10.6 [3.8] µm (CO) up to 58.6 [38.4] µm (iT) for in-vitro precision for the complete-arch methods. The best values for trueness of partial-arch impressions were found for the posterior segment, with 9.7 [1.2] µm for the conventional impression method (CO), and 21.9 [1.5] µm (PS) for the digital impression method.

Conclusion
Within the limitations of this study, digital impressions obtained from specific IOSs are a valid alternative to conventional impressions for partial-arch segments. Complete-arch impressions are still challenging for IOS devices; however, certain devices were shown to be well within the required range for clinical quality. Further in-vivo studies are needed to support these results.

Go to study: https://ijcd.quintessenz.de/ijcd_2019_01_s0011.pdf
The effect different substrates have on the trueness and precision of eight different intraoral scanners

Study Background
- In-vitro study with local and global accuracy
- Primescan, Omnicam, Trios3, Element2, Medit i500, Emerald, Emerald S
- Dentin, Enamel, Gold, Amalgam, Resin, Zirconia, Lithium Disilicate, Enamel/Dentin Composite, White/Blue Core, Bulk Fill Composite
- 3D best fit alignment
- Average of the absolute values of the average positive and negative deviations of the IOS data.

Talking Points
- Except for Trios3, substrate influences trueness and precision -> doesn't say anything about the level of accuracy
- Different scanners show different accuracy for same substrate
- Latest generation scanners more accurate than older scanners
- Primescan ranked #1 in 11 out of 15 categories
- Amongst those the important categories: Enamel, Dentin, Cross arch
- Primescan ranked within top 4 for remaining 4 categories
- Omnicam was used with an old SW version, results are expected to be significantly better with latest version
- Study supports the proven accuracy of Primescan once again

Abstract

Objective
This in-vitro study compares the newest generation of intraoral scanners to their older counterparts, and tests whether material substrates affect the trueness and precision of intraoral scanners (IOS).

Material and methods
A custom model, used as the reference standard, was fabricated with teeth composed of different dental materials. The reference standard scan was obtained using a three dimensional (3D) optical scanner, the ATOS III. Experimental scans were obtained using eight different IOS, operated by experienced clinicians, using the manufacturer’s recommended scanning strategy. A comprehensive metrology program, Geomagic Control X, was used to compare the reference standard scan with the experimental scans.

Results
For all scanners tested, except Trios3, the substrate does influence the trueness and precision of the scan. Furthermore, differences exist when comparing the same substrate across different scanners with some of the latest generation scanners clearly leaping ahead of the older generation regarding both trueness and precision.

Conclusions
Substrate type affects the trueness and precision of a scan. Active Triangulation scanners are more sensitive to substrate differences than their parallel confocal counterparts. Some scanners scan certain substrates better, but in general the new generation of scanners outperforms the old, across all substrates.

Clinical significance
The substrates being scanned play an import role in the trueness and precision of the 3D model. The new generation of scanners is remarkably accurate across all substrates and for complete arch scanning.

Do “cut out-rescan” procedures have an impact on the accuracy of intraoral digital scans?

**Study Background**

- Complete-arch scan data of a maxillary master cast were generated 10 times with 3 intraoral scanners: TRIOS 3 [TR], Cerec Primescan [PR], and CEREC Omnicam [OM].
- For the “cut-out-rescan”:
  - all complete arch scans were duplicated
  - the posterior area from the right lateral incisor was cut out from the duplicated scan data and rescanned
  - superimposition of the rescanned area onto the cut-out scan ([TR_rs], [PR_rs], [OM_rs])
- As reference the master cast was scanned with a high precision industrial structured light scanner
- Evaluation of trueness and precision
- To evaluate statistical differences, either the Mann-Whitney U test or the t test was used (α=.05)

**Talking Points**

- The t test revealed statistically significant differences among the different scanners
- The comparison of the trueness values of the complete arch scan data with those of the corresponding “cut-out-rescanned” data of each scanner system did not reveal statistically significant differences in any scanner system
- Significant differences were found between the precision results of the OM and PR as well as for the pairs OM_rs/TR_rs and TR_rs/PR_rs

**Abstract**

**Statement of problem**

The software of digital intraoral scanners typically offers the option to cut out areas from 3D casts, to do rescans, and to merge them with the initial scan. However, evidence of whether this procedure has an impact on the accuracy of the scan is lacking.

**Purpose**

The purpose of this study was to determine whether “cut out-rescan” procedures change the accuracy of a 3D cast.

**Material and methods**

A maxillary master cast was digitized with an industrial structured light scanner to obtain a digital reference cast. This master cast was repeatedly scanned by 3 intraoral scanners: TRIOS 3 [TR], Cerec Primescan [PR], and Cerec Omnicam [OM]. The scan data were duplicated, and the posterior area from the right lateral incisor was cut out and rescanned to obtain complete-arch casts containing the rescanned data [TR_rs], [PR_rs], and [OM_rs]. The trueness and precision of the scans were evaluated by superimposing procedures of the relevant data sets. To evaluate statistical differences, either the Mann-Whitney U test or the t test was used (α=.05).

**Results**

The median precision values of the complete-arch scan data was 19 μm for [OM] and [TR], whereas the median for [PR] was 14 μm. In the “cut-out-rescanned” data group, the values were 25 μm for [OM_rs], 16 μm for [TR_rs], and 14 μm for [PR_rs]. Statistically significant differences were found among the scanners [OM]/[PR], [OM_rs]/[TR_rs], and [TR_rs]/[PR_rs]. The mean ± standard deviation values of trueness for the complete-arch scan data were 54 ± 4 μm for [OM], 42 ±5 μm for [TR], and 30 ±2 μm for [PR]. In the group of the “cut out-rescanned” data, the mean trueness results were 55 ± 6 μm for [OM_rs], 38 ±5 μm for [TR_rs], and 31 ±5 μm for [PR_rs]. Significant differences were found among the complete-arch scan data and the “cut out-rescanned” data of the different scanners, but not between the complete-arch scan data and the “cut out-rescanned” data within one scanning system.

**Conclusions**

Significant differences were found among the scanners, but “cut out-rescan” procedures did not affect the accuracy within each scanning system.

Go to study: https://www.sciencedirect.com/science/article/abs/pii/S0022391319307553
Impact of different scanning strategies on the accuracy of two current intraoral scanning systems in complete-arch impressions: an in-vitro study

Study Background

• A customized complete-arch maxillary cast was scanned
• A master reference scan was obtained through an ATOS III Triple Scan 3D optical scanner
• Omnicam (CEREC SW 5.1.0) and Primescan (CEREC SW 5.0.2) were used for complete-arch scanning with 13 different scanning strategies
• Best fit alignment of the scans with master scan
• Evaluation of trueness and precision
• Statistical analyses utilized Welch's unequal variances t test

Talking Points

• Scan strategy has an impact and we recommend the scan strategy in the manual. This scan strategy has very good value and is easy to use.
• Primescan featured a better trueness index (4.79 µm) than that of Omnicam (19.13 µm). Primescan, also featured a better precision index (4.67 µm) than Omnicam, group B (16.75 µm), with a statistically significant difference.

Abstract

Aim
To determine the scanning strategy that obtains the most accurate results for two intraoral scanners (IOS) in complete-arch digital impressions. Scan time was evaluated and correlated with scan strategies.

Materials and method
A custom model used as the reference standard was fabricated with teeth having dentin- and enamel-identical refractive indices simulating natural dentition. A reference scan of the custom typodont was obtained using an ATOS III Triple Scan 3D optical scanner. Two IOS setups – Omnicam v 5.1.0 and Primescan v 5.0.2 – were used for complete-arch scanning, each using 13 scanning strategies, obtaining 260 digital files (n = 10 per group), recording each scan time, converting all experimental scans to standard tessellation language (STL) format, and using a comprehensive metrology program to compare the reference standard scan with the experimental scans. Statistical analyses utilized Welch's unequal variances t test.

Results
Group M exhibited the lowest trueness and precision values (P < 0.05) for Primescan (47.5% of the average among all other groups) and the lowest trueness value (P < 0.05) for Omnicam (53.4% of the average among all other groups), where group B exhibited the lowest precision value (65.6% of the average among all other groups) with P < 0.05. Primescan featured a better trueness index (4.79 µm) than that of Omnicam (19.13 µm), with a statistically significant difference (P < 0.00001). Primescan, group M, also featured a better precision index (4.67 µm) than Omnicam, group B (16.75 µm), with a statistically significant difference (P < 0.00001).

Conclusion
For both IOS systems, group M provided the lowest scanning times. For trueness and precision of complete-arch scans, group M was the dominant scanning strategy in Primescan, while there was no dominant strategy in Omnicam. Group M had the best scanning time for both IOS systems.

Go to study: https://www.ncbi.nlm.nih.gov/pubmed/31840139

THE DENTAL SOLUTIONS COMPANY™

Dentsply Sirona
Abstract

Background
The authors evaluated the local accuracy of intraoral scanning (IOS) systems for single-tooth preparation impressions with an in-vitro setup.

Methods
The authors digitized a mandibular complete-arch model with 2 full-contour crowns and 2 multisurface inlay preparations with a highly accurate reference scanner. Teeth were made from zirconia-reinforced glass ceramic material to simulate toothlike optical behavior. Impressions were obtained either conventionally (PRESIDENT, Coltène) or digitally using the IOS systems TRIOS 3 and TRIOS 3 using insane scan speed mode (3Shape), Medit i500, Version 1.2.1 (Medit), iTero Element 2, Version 1.7 (Align Technology), CS 3600, Version 3.1.0 (Carestream Dental), CEREC Omnicam, Version 4.6.1, CEREC Omnicam, Version 5.0.0, and Primescan (Dentsply Sirona). Impressions were repeated 10 times per test group. Conventional (CO) impressions were poured with type IV gypsum and digitized with a laboratory scanner. The authors evaluated trueness and precision for preparation margin (MA) and preparation surface (SU) using 3-dimensional superimposition and 3-dimensional difference analysis method using (95% - 5%) / 2 percentile values. Statistical analysis was performed using Kruskal-Wallis test. Results were presented as median (interquartile range) values in micrometers.

Results
The authors found statistically significant differences for MA and SU among different test groups for both trueness and precision (P < .05). Median (interquartile range) trueness values ranged from 11.8 (2.0) μm (CO) up to 40.5 (10.9) μm (CEREC Omnicam, Version 5.0.0) for SU parameter and from 17.7 (2.6) μm (CO) up to 55.9 (15.5) μm (CEREC Omnicam, Version 5.0.0) for MA parameter.

Conclusions
IOS systems differ in terms of local accuracy. Preparation MA had higher deviations compared with preparation SU for all test groups.

Practical implications
Trueness and precision values for both MA and SU of single-unit preparations are equal or close to CO impression for several IOS systems.

Go to study: https://www.sciencedirect.com/science/article/abs/pii/S0002817719307664
Local accuracy of actual intraoral scanning systems for single-tooth preparations in-vitro

Study Background
The authors evaluated the local accuracy of intraoral scanning (IOS) systems for single-tooth preparation impressions with an in-vitro setup.

Talking Points
“We found statistically significant differences of CO for all IOS systems except PS. Among the IOS systems, our results showed that the PS group had higher trueness for SU parameter, with median (IQR) of 19.4 (5.0) mm; values were statistically significantly different from the other IOS systems, except TRn and TRh.”

Abstract
Background
Digital implant impressions (DII) with intraoral scanners (IOS) are a relatively novel, but continuously improving technique. Since IOS devices can only capture part of the object at a time, images have to be stitched together to form a 3D object and therefore it is the source of possible errors of the scan. Digital splinting at edentulous areas can possibly improve the accuracy of DII.

Aim/Hypothesis
The aim of this in-vitro study was to compare the trueness and precision of three different IOS scanning partially and fully edentulous models with 2 or 4 implants with attached scan bodies and digital splints.

Material and Methods
Two types of maxilla models were printed with Asiga Max 3D printer. The first model was missing both premolars and molars on the right side, so Straumann BL dental implants were inserted instead first premolar (straight) and second molar (tilted 20° mesially). Four implants were inserted in the second edentulous model symmetrically at second incisors (straight) and first molar areas (tilted 20° mesially). Scan bodies were attached to the implants and models were scanned with Nikon Altera 10.7.6, coordinate measurement machine (CMM) to form a reference scan. DII was taken with a Primescan (version 5.0.1), CS 3600 (version 3.1.0), Trios3 (version 1.18.2.10) IOS ten times each (n = 10) without digital splint. After that, tablets of hardened Fuji Plus cement was glued in edentulous areas to form digital splint and all models were scanned with three different IOS. Scanning data were exported in standard tessellation language format for analysis.

Results
Trueness of distance and angle in Carestream partially edentulous models was 185 μm in the group with splint and 280 μm without one and 0.22° in the group with splint and 0.29° in the group without respectively. Precision of distance and angle measurements in the splint groups were 87 μm and 0.13°, in the groups without −202 μm and 0.25°. In fully edentulous models trueness of distance varied 53–106 μm in the groups with splint and 67–8 μm in the groups without. Trueness of Primescan in partially edentulous models with splints was 21 μm and 0.16° in distance and angular measurements. Without splints −27 μm and 0.21°. For fully edentulous models trueness and precision of distance and angle was better n groups with splint than without. Trueness of distance and angle of Trios3 in partially edentulous splinted models was 15 μm and 0.3°;53 μm and 0.11° in unsplinted models respectively.

Conclusion and Clinical Implications
Primescan showed the best results of trueness and precision of distance and angle measurements. Since digital splints improve the accuracy of DII, the impact of their forms and materials should be more researched.

Accuracy of digital and conventional full-arch impressions in patients: an update

Study Background

- Five patients with a complete lower dental arch were included in this invivo study.
- Four bearing steel spheres with a diameter of 5 mm were reversibly luted on the teeth of the lower jaw using a flowable composite.
- Subsequently, in every patient four digital full-arch impressions were taken using the Trios 3 Cart wired, the Trios 3 Pod wired, the Trios 4 Pod wireless and the Primescan as well as a high precision Conventional impression was taken.
- Distances between the single spheres were compared.

Talking Points

- For the two short distances in the posterior segments (i.e., spheres D1_2 and D3_4), digital had more precise results were found using digital compared with conventional impressions.
- For long-span distances, the CVI technique provided the lowest deviation, although no significant difference was demonstrated for PRI and T4PODwl.
- Hardware components of the Trios scanner exhibited an influence on accuracy.

Abstract

The aim of this clinical study was to update the available data in the literature regarding the transfer accuracy (trueness/precision) of four current intraoral scanners (IOS) equipped with the latest software versions and to compare these data with conventional impressions (CVI). A metallic reference aid served as a reference dataset. Four digital impressions (Trios3Cart, Trios3Pod, Trios4Pod, and Primescan) and one CVI were investigated in five patients. Scan data were analyzed using three-dimensional analysis software and conventional models using a coordinate measurement machine. The transfer accuracy between the reference aid and the impression methods were compared. Differences with p < 0.05 were considered to be statistically significant. Overall, mean ± standard deviation (SD) transfer accuracy ranged from 24.6 ± 17.7 µm (CVI) to 204.5 ± 182.1 µm (Trios3Pod). The Primescan yielded the lowest deviation for digital impressions (33.8 ± 31.5 µm), followed by Trios4Pod (65.2 ± 52.9 µm), Trios3Cart (94.7 ± 120.3 µm), and Trios3Pod. Within the limitations of this study, current IOS equipped with the latest software versions demonstrated less deviation for short-span distances compared with the conventional impression technique. However, for long-span distances, the conventional impression technique provided the lowest deviation. Overall, currently available IOS systems demonstrated improvement regarding transfer accuracy of full-arch scans in patients.

Go to study: https://www.ncbi.nlm.nih.gov/pubmed/32143433
Digital versus conventional impression taking
Focusing on interdental areas: a clinical trial

Study Background
- Overcome limitations of in-vitro study
- Compare the ability of one conventional and four digital impression techniques to reproduce Interdental Areas (IA) of periodontally compromised dentitions (PCD)
- In-vivo, 30 patients, 1 experienced operator
- Four digital impressions were taken for each jaw with True Definition, Primescan, CS 3600, Trios 3
- Comparison against digitized conventional impression
- 3D best-fit alignment
- Calculation of percentage of displayed IA in relation to absolute IA

Talking Points
- IOS can display higher percentage of IAs then CVI
- IAs in the anterior area of the jaw are better displayed than in the posterior area by IOS
- A higher percentage of IA was displayed for class III PCD
- True definition displayed a higher percentage of IAs but requires application of optical powder for impression taking
- Primescan and CS 3600 displayed the highest percentage of IA amongst the powder-free IOS
- Trios 3 displayed the lowest percentage of IA compared to all other IOS

Abstract
Due to the high prevalence of periodontitis, dentists have to face a larger group of patients with periodontally compromised dentitions (PCDs) characterized by pathologic tooth migration and malocclusion. Impression taking in these patients is challenging due to several undercuts and extensive interdental areas (IAs). The aim of this clinical trial was to analyze the ability of analog and digital impression techniques to display the IAs in PCDs. The upper and the lower jaws of 30 patients (n = 60, age: 48-87 years) were investigated with one conventional impression (CVI) using polyvinyl siloxane and four digital impressions with intraoral scanners (IOSs), namely True Definition (TRU), Primescan (PRI), CS 3600 (CAR), and TRIOS 3 (TIO). The gypsum models of the CVIs were digitalized using a laboratory scanner. Subsequently, the percentage of the displayed IAs in relation to the absolute IAs was calculated for the five impression techniques in a three-dimensional measuring software. Significant differences were observed among the impression techniques (except between PRI and CAR; p-value < 0.05). TRU displayed the highest percentage of IAs, followed by PRI, CAR, TIO, and CVI. The results indicated that the IOSs are superior to CVI regarding the ability to display the IAs in PCDs.

Go to study: https://www.mdpi.com/1660-4601/17/13/4725

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Congruence between meshes and library files of implant scanbodies: an in-vitro study comparing five intraoral scanners

Study Background
• Assess and compare reliability of five different IOS in the capture of implant Scanbodies (SB)
• Verify dimensional congruence between meshes of SB captured during scan of a complete arch model with six implants and the corresponding library file
• In-vitro
• Gypsum cast representing a fully endentulous maxilla with 6 implant was scanned with: Primescan, CS 3700, Medit i-500, Elements 5D, Emerald S
• 3D analysis of the congruence between scanned mesh of SB and SB library file, best fit alignment
• Calculation of quantitative and qualitative deviation between scanned mesh of SB and SB library file

Talking Points
• Primescan and CS 3700 showed the highest congruence between SB MEs and LF, with the lowest mean absolute deviations
• statistically significant difference between these two scanners and the other three
• Primescan was the IOS with the lowest mean absolute deviation but the difference to CS 3700 was statistically not significant

Abstract

Purpose
To compare the reliability of five different intraoral scanners (IOSs) in the capture of implant scanbodies (SBs) and to verify the dimensional congruence between the meshes (MEs) of the SBs and the corresponding library file (LF).

Methods
A gypsum cast of a fully edentulous maxilla with six implant analogues and SBs screwed on was scanned with five different IOSs (PRIMESCAN®, CS 3700®, MEDIT i-500®, ITERO ELEMENTS 5D®, and Emerald S®). Ten scans were taken for each IOS. The resulting MEs were imported to reverse engineering software for 3D analysis, consisting of the superimposition of the SB LF onto each SB ME. Then, a quantitative and qualitative evaluation of the deviations between MEs and LF was performed. A careful statistical analysis was performed.

Results
PRIMESCAN® showed the highest congruence between SB MEs and LF, with the lowest mean absolute deviation (25.5 ± 5.0 μm), immediately followed by CS 3700® (27.0 ± 4.3 μm); the difference between them was not significant (p = 0.1235). PRIMESCAN® showed a significantly higher congruence than MEDIT i-500® (29.8 ± 4.8 μm, p < 0.0001), ITERO ELEMENTS 5D® (34.2 ± 9.3 μm, p < 0.0001), and Emerald S® (38.3 ± 7.8 μm, p < 0.0001). CS 3700® had a significantly higher congruence than MEDIT i-500® (p = 0.0004), ITERO ELEMENTS 5D® (p < 0.0001), and Emerald S® (p < 0.0001). Significant differences were also found between MEDIT i-500® and ITERO ELEMENTS 5D® (p < 0.0001), MEDIT i-500® and Emerald S® (p < 0.0001), and ITERO ELEMENTS 5D® and Emerald S® (p < 0.0001). Significant differences were found among different SBs when scanned with the same IOS. The deviations of the IOSs showed different directions and patterns. With PRIMESCAN®, ITERO ELEMENTS 5D®, and Emerald S®, the MEs were included inside the LF; with CS 3700®, the LF was included in the MEs. MEDIT i-500® showed interpolation between the MEs and LF, with no clear direction for the deviation.

Conclusions
Statistically different levels of congruence were found between the SB MEs and the corresponding LF when using different IOSs. Significant differences were also found between different SBs when scanned with the same IOS. Finally, the qualitative evaluation revealed different directions and patterns for the five IOSs.
Accuracy of intraoral scanning in completely and partially edentulous maxillary and mandibular jaws: an in-vitro analysis

Study Background

• Analyze the accuracy (trueness and precision) of IOS in completely and partially edentulous maxillary and mandibular models
• Evaluated the influence of the operators’ experience with this new generation IOS device on the scan accuracy and scan time
• Resin models: edentulous and partially edentulous, mandibular and maxillary models
• Digital scans were performed by two specialist prosthodontists, one experienced and one inexperienced in IOS. Neither of the clinicians had ever used the tested IOS device before
• For the reference data, all models were digitized using an industrial high-precision scanner
• Determination of trueness and precision

Talking Points

• Overall median trueness comprising of all digital scans by the two operators was 24.2 μm (IQR 20.7–27.4 μm)
• Significantly higher trueness was found in the scans of the edentulous mandibular model by the inexperienced operator
• No differences were detected among the other scans
• Overall median precision was 18.3 μm (IQR 14.4–22.1 μm)
• A significantly higher precision was found for the scans of the edentulous maxillary model by the inexperienced operator
• No differences were detected among the other scans
• Overall median scan time was 100.5 s (IQR 72.0–139.2 s)
• Scans of experienced operator were faster than the scans of inexperienced operator
• Longer scan times could be associated with a higher level of trueness

Abstract

Objectives

New generation intraoral scanners are promoted to be suitable for digital scans of long-span edentulous spaces and completely edentulous arches; however, the evidence is lacking. The current study evaluated the accuracy of intraoral scanning (IOS) in partially and completely edentulous arch models and analyzed the influence of operator experience on accuracy.

Materials and methods

Four different resin models (completely and partially edentulous maxilla and mandible) were scanned, using a new generation IOS device (n = 20 each). Ten scans of each model were performed by an IOS-experienced and an inexperienced operator. An industrial high-precision scanner was employed to obtain reference scans. IOS files of each model-operator combination, their respective reference scan files (n = 10 each; total = 80), as well as the IOS files from each model generated by the same operator, were superimposed (n = 45; total = 360) to calculate trueness and precision. An ANOVA for mixed models and post hoc t tests for mixed models were used to assess group-wise differences (α = 0.05).

Results

The median overall trueness and precision were 24.2 μm (IQR 20.7–27.4 μm) and 18.3 μm (IQR 14.4–22.1 μm), respectively. The scans of the inexperienced operator had significantly higher trueness in the edentulous mandibular model (p = 0.0001) and higher precision in the edentulous maxillary model (p = 0.0004).

Conclusion

The accuracy of IOS for partially and completely edentulous arches in in-vitro settings was high. Experience with IOS had small influence on the accuracy of the scans.

Clinical relevance

IOS with the tested new generation intraoral scanner may be suitable for the fabrication of removable dentures regardless of clinician’s experience in IOS.

Go to study: https://pubmed.ncbi.nlm.nih.gov/32812098/
Accuracy of three intraoral scans for primary impressions of edentulous jaws

Abstract

Objective
To provide a reference for using intraoral scanners for making clinical diagnostic dentures of edentulous jaws by comparing the accuracy of three intraoral scanners for primary impression and jaw relation record of edentulous jaws.

Methods
This study contained 6 primary impressions of the edentulous patients. Each of the impressions consisted of the maxillary primary impression, the mandibular primary impression and the jaw relation record. For each of them, a dental cast scanner (Dentscan Y500) was used to obtain stereolithography (STL) data as reference scan, and then three intraoral scanners including i500, Trios 3 and CEREC Primescan were used for three times to obtain STL data as experiment groups. In Geomagic Studio 2013 software, trueness was obtained by comparing experiment groups with the reference scan, and the precision was obtained from intragroup comparisons. Registered maxillary data of the intraoral scan with reference scan, the morphological error of jaw relation record was obtained by comparing jaw relation record of the intraoral scan with the reference scan. Registered mandibular data with jaw relation record of intraoral scan and the displacement of the jaw position were evaluated. Independent samples t test and Mann-Whitney U test in the SPSS 20.0 statistical software were used to statistically analyze the trueness, precision and morphological error of jaw relation record of three intraoral scanners. The Bland-Altman diagram was used to evaluate the consistency of the jaw relationship measured by the three intraoral scanners.

Results
The trueness of i500, Trios 3 and CEREC Primescan scanners was (182.34±101.21) μm, (145.21±71.73) μm, and (78.34±34.79) μm for maxilla; (106.42±21.63) μm, and 95.08 (63.08) μm, (78.45±42.77) μm for mandible. There was no significant difference in trueness of the three scanners when scanning the maxilla and mandible(P>0.05). The precision of the three scanners was 147.65 (156.30) μm, (147.54±83.33) μm, and 40.30 (32.80) μm for maxilla; (90.96±30.77) μm, (53.73±23.56) μm, and 37.60 (93.93) μm for mandible. The precision of CEREC Primescan scanner was significantly better than that of the other two scanners for maxilla (P<0.05). Trios 3 and CEREC Primescan scanners were significantly better than i500 scanner for mandible (P<0.05). The precision of the i500 and Trios 3 scanners for mandible was superior to maxilla (P<0.05). The upper limit of 95% confidence intervals of trueness and precision of three scanners for both maxilla and mandible were within ±300 μm which was clinically accepted. The morphological error of jaw relation record of the three scanners was (337.68±128.54) μm, (342.89±195.41) μm, and (168.62±88.35) μm. The 95% confidence intervals of i500 and Trios 3 scanners were over 300 μm. CEREC Primescan scanner was significantly superior to i500 scanner (P<0.05).The displacement of the jaw position of the three scanners was (0.83±0.56) mm, (0.80±0.45) mm, and (0.91±0.75) mm for vertical dimension; (0.79±0.58) mm, (0.62±0.18) mm, and (0.53±0.53) mm for anterior and posterior directions; (0.95±0.59) mm, (0.69±0.45) mm, and (0.60±0.22) mm for left and right directions. The displacement of the jaw position of the three scanners in vertical dimension, anterior and posterior directions and the left and right directions were within the 95% consistency limit.

Conclusion
Three intraoral scanners showed good trueness and precision. The i500 and Trios 3 scanners had more errors in jaw relation record, but they were used as primary jaw relation record. It is suggested that three intraoral scanners can be used for obtaining digital data to make diagnostic dentures and individual trays, reducing possible deforming or crack when sending impressions from clinic to laboratory.

Go to study: https://www.ncbi.nlm.nih.gov/pubmed/32071476