IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 22, Issue 1 Ser.2 (January. 2023), PP 42-46
www.iosrjournals.org

Intra Oral Versus Desktop Scanners Effect On Adaptation Of Three Unites Implant Supported Zirconia Bridge

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Abstract
statement of problem*: Rapid increase in using digital systems with monolithic restorations had occurred. Either intraoral scanning can produce reliable results or not must be carefully assessed.*
Purpose: *The purpose of this study was to compare the marginal adaptation of implant retained zirconia bridges scanned with the use of intraoral digital scanner with those scanned by the conventional impression technique followed by scanning using desktop scanner.*
Material and methods: *14 monolithic implant supported zirconia bridges were constructed, either using intraoral scanner (Group A) or desktop scanner (Group B) The marginal adaptation of each specimen was measured with a light microscope at 40X magnification. Paired t test was used for statistical analysis.*
Results: *Statistically in-significant differences were found between the 2 scanning protocols.*
Conclusions: *Intraoral scanners can be used successively for restorations production with high precision.*

Date of Submission: 27-12-2022 Date of Acceptance: 07-01-2023

I. INTRODUCTION

One of the most important criteria for the long- term success of ceramic restorations is their marginal adaptation i.e. the distance between the finish line and the restoration margin (1)

The fit of a coping can be defined best in terms of the ―misfit‖ measured at various points between the coping surface and the implant. Measurements between the copings and the implant can be made from points along the internal surface, at the margin, or on the external surface of the coping.(2) Since marginal adaptation of the superstructure of implant supported prosthesis has great influence on the success of restoration thus current developments in materials and techniques have attempted to overcome disadvantages of the traditional methods used to construct the ceramic crowns. The development of CAD/CAM technology has focused on precise and consistent manufacturing of Zirconia ceramics. It is an economical, reproducible method, that relies on exact dimensional predictions to compensate for sintering shrinkage and, in addition, has demonstrated improved marginal fit (3)

More than thirty years ago (1985) the first prosthetic restoration based on a digital intraoral impression has been fabricated and presented to the prosthodontics society. Since then technologi- cal modification continued in progress. This was combined with the laboratory scanners and then the intraoral ones which decisively simplifies the workflow and avoid inaccuracies linked to the con- ventional impression and model casting. Studies (1-3) (4-6) show a higher marginal accuracy of restorations derived from an intraoral scanner in comparison to conventional impressions. Intraoral scanners allow the dentist to check the preparation and their rela- tions to the antagonists enlarged on the screen and apply corrections, if necessary, without having to repeat the entire digital impression process. Addi- tionally, no physical impressions have to be shipped then the dentist and the dental technician can view the preparation simultaneously and discuss possible problems later on in the workflow.

The comfort in treatment of the intraoral scan also needs to be discussed, as a lot of patients dis- like conventional impressions for different reasons. Initial first studies on this topic indicate that patients tend to favor digital intraoral impressions.(7,8)

Despite the positive aspects of digital intraoral impression procedures, one fundamental clinical problem remains: All scanners are optical systems that only can record visible areas. Thus, blood, sa- liva, combined with sub-gingivally located finish lines, substantially complicate the scanning pro- cess. This holds especially true for the molar region, where the limited space in the oral cavity limits the handling of the so-called scanning wand. (8)

Thus this research is prompted to evaluate which is better regarding the accuracy of marginal adaptation of three units implant supported bridge either using intraoral scanner or laboratory desktop scanner

II. MATERIALS AND METHODS

An in vitro study to assess marginal gap was carried out on three units zirconia fixed-bridges construct by two different types of scanners retained by two dental implants placed in epoxy resin model,

Master epoxy model was constructed, to simulate the clinical situation of missing lower second premolar.

The model contains 2 implants* of the same length (13mm), one implant of small diameter (3.7mm) representing the lower first premolar, and other one of larger diameter (4.2mm) representing the lower first molar.

A dental surveyor was used for implant placement. The small diameter implant (3.7 mm) was attached to the surveyor by using sticky wax at the abutment top.

A rectangular plastic box with dimensions (7cm length, 2.5cm width and 2cm height) was divided into two compartments by a piece of pink wax to allow filling of each compartment separately with the silicone impression material and it was then mounted on the cast holder table of the surveyor.

One of the compartments of the plastic box was filled with a mix of condensation silicone impression material.

The implant was then seated into the mixed impression material midway (measured using a ruler) between the borders of the plastic box until complete setting of the impression material then the implant was detached from the surveyor.

* Implant direct Sybron, USA

The same steps were then repeated to seat the larger diameter implant in the second compartment after measuring the predetermined distance between the two implants using a ruler. The implant was seated 11mm apart from the first one.

After complete setting of the impression material in the second compartment, the larger diameter implant was detached from the surveyor. The top of the plastic box was then boxed using pink wax

Dental stone was then mixed according to the manufacturer instruction regarding water/ powder ratio and mixing time and rate. The stone was then poured covering the tops of the abutments and it was left to set, after complete setting of the stone, the boxing wax was then removed.

The plastic box was removed followed by removal of the impression material from around the implant fixtures, and thus assuring complete parallelism between the implants and also proper vertical alignment of each implant.

The stone was then boxed using pink wax .Epoxy resin base and catalyst were then proportioned according to manufacturer instructions in a glass container, and mixed using a glass rod on top of a vibrator. The epoxy resin was then left aside for ten minutes to allow air bubbles to escape and then it was poured slowly around the implant fixtures and left to set (initial setting took about 24 hours, while final setting took about 4 days)

A total number of fourteen bridges will be constructed using two different types scanning technique;

Group A: A total number of seven bridges will be constructed using an intra-oral scanner Trios 3*(direct technique) which scans the abutments of the implants.

Group B: A total number of seven bridges will be constructed using an indirect scanning technique (Identica blue **), which scans a cast obtained from conventional impression of the implants' abutments.

Impression will be taken to the implants' abutments using addition silicon impression material in a putty and light consistencies using single step impression technique.

EXO CAD software was used for designing a 3 unite bridge over the scanned data. VHF 5 axis milling machine was used for milling of zirconia bridges (Bruxzir)***. The zirconia bridges were sintered in a sintering furnace for 7 hours under 1500oC.

All bridges seated on the model and marginal adaptation of the superstructure evaluated using stereomicroscope. Shots of the margins were taken for each retainer using digital camera fitted on the microscope using a fixed magnification of 40X.

Then morphometric measurements were done on an IBM compatible personal computer equipped with the Image-tool software (Image J 1.43U, National Institute of Health, USA). which was used for image analysis. Within the Image J software, all limits, sizes, frames and measured parameters are expressed in pixels. Therefore, system calibration was done to convert the pixels into absolute real world units. Calibration was made by comparing an object of known size (a ruler in this study) with a scale generated by the Image J software. The vertical gap distance was measured for each shot 5 equidistant landmarks along the cervical circumference for each surface of the bridge.

* 3 shape, Denmark.

** Medit, Korea
*** Glidwell laboratories, USA

Fig. (1) Trios scanner.

Fig. (2) Identica blue scanner

Fig. (1) Trios scanner. Fig. (2) Identica blue scanner

III. RESULTS

TABLE: Shows mean, standard deviation & p- value of paired t test of the marginal gap of fixed bridges fabricated by Direct intra oral scanning and indirect beach top scanning .

Direct intraoral scanning		Indirect desktop scanning		
Mean	SD	Mean	SD	P value
49.158 um	5.488	54.318 um	6.517	0.5 <

Mean and standard deviation for the marginal gap (um) for the three units implant retained fixed bridge were presented in the previous table. Direct intra oral scanning showed marginal gap mean 49.158 ± 5.488 S.D which is less than indirect desktop scanning that showed mean54.318± 6.517 SD.
However by using paired T test this difference was statistically insignificant

IV. DISCUSSION

The reconstruction of partially edentulous jaws by implant-supported FPDs has been shown to be a successful therapy. [9,10]

One of the advantages of carrying out an in-vitro study rather than a clinical study is the possibility of practicing greater standardization and control. In-vitro studies do not show the multiple individual variability of clinical studies.

Attempts to fabricate perfectly fitting superstructure are affected by a number of factors, such as fabricating techniques,(11,12) increasing the number of implants and different angulations of the implant axes.(13)

Osseointegrated implants show little mobility; hence, in contrast to the situation on abutment teeth, where a certain degree of misfit of a superstructure may be compensated by the resilience of the periodontium, misfit of FPDs seated on implant may cause a certain stress that is directly transmitted to the surrounding bone. (14) Before performing in vivo studies or applying materials for clinical use, in vitro tests should be undertaken to prove the materials' applicability and performance. In vitro tests can performed in a short period of time and have the advantages of reproducibility and the possibility of standardizing a test parameter (15)

In this study the clinical situation was simulated through several ways. The models used were constructed from epoxy resin which has a modulus of elasticity similar to that of jaw bone.(16,17) The use of the dental surveyor was a must in order to keep the implants parallel to each other. The model material (epoxy resin) was poured around the implant fixtures before setting rather than drilling and insertion, so that the relation of the epoxy resin to the fixture surfaces would simulate osseointegration. Two implants were used to replace three (The Model) adjacent missing teeth (more common due to being more economic yet indicated) rather than

using an implant per missing tooth. The implants were of two diameters 3.7 mm for replacing the premolar and 4.2mm for replacing the molar as the latter is at greater risk of overloading in the molar region so it's recommended to use larger diameter implant. The second implant was seated 11mm apart from the first one to assemble the real distance between lower first premolar and lower first molar measured on a natural teeth model.

The vertical cervical marginal gap measurement was selected as the most frequently used to quantify the accuracy of fit of a restoration. (18)

The assessment of the marginal adaptation of the crowns was performed using stereomicroscope; all measurements were made by the same operator to avoid errors as much as possible.

The data obtained in this study support rejection of the null hypothesis that no differences would be found in fit discrepancy among the crowns fabricated by the two different impression techniques. The mean marginal gap size was 49.1 mm for the intraoral digital impression and 54.3 mm for the desktop PVS impression.

The mean marginal gap widths of CAD/CAM- fabricated zirconia restorations in this study were matching with the reported literature results at the marginal site. This could be due to our specimens being finished monolithic bridges without veneered porcelain, as Syrek et al. (19) and Scotti et al.(20) whom only used the copings to measure the fit. Adding porcelain to copings can cause distortion and lead to an inadequate fit according to Pak et al., (21) whose results of two different zirconia systems with a presintered milling and totally sintered milling showed significant differences when analyzing the marginal gaps before and after porcelain veneering within each group.

There are some more in vitro studies comparing the conventional and the digital impression. Some showed no difference in marginal accuracy (22-25) others favoured the digital intraoral impression: Tidehag et al. (26) reported a better marginal fit of crowns produced on the basis of an intraoral scan with iTero and Lava C.O.S. compared to crowns resulting from a conventional impression and the Empress workflow.

Another current in vitro study by Ng et al. (27) also noticed that crowns based on the intraoral scan of the Lava C.O.S. were statistically significantly better than conventionally made crowns. Most of the in vitro studies on intraoral digital impressions report values of about 50 µm for the marginal gap or better (22,24&25) Two current in vitro studies with two and four different intraoral scanners reveal values around 120 µm, which is comparable to the measurements in this study(4,26&27)

V. CONCLUSIONS

Intraoral scanners can be used successively for restorations production with high precision.

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Hend Ali El kawash, et. al. "Intra Oral Versus Desktop Scanners Effect On Adaptation Of Three Unites Implant Supported Zirconia Bridge." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 22(1), 2023, pp. 42-46.