ISSN: 2581 – 3633
PubMed - National Library of Medicine - ID: 101745081

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at:www.ijmacr.com

Volume – 6, Issue – 2, March - 2023, Page No. : 611 - 617

Effect of different sterilization methods and sterilization cycles on the scanning accuracy of the scan bodies.

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How to citation this article: Priyanka Pawar, Nikhil Chawla, Smita Khalikar, Shankar P. Dange, Kishor Mahale, Sonali Mahajan, "Effect of different sterilization methods and sterilization cycles on the scanning accuracy of the scan bodies", IJMACR- March - 2023, Volume – 6, Issue - 2, P. No. 611 – 617.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Purpose of this study: is to determine whether there is change in the scanning accuracy of the scan bodies when they are subjected to two different sterilization method and sterilization cycles.

Materials and method: Cast was obtained after recording a conventional an open tray implant im pression for implant placed in 46 regions. The cast was used for measurement of the accuracy of the implant scan body. Measurements were done after 0,15,20,25,30 cycles of steam sterilization and chemical sterilization followed by steam sterilization using Autodesk mesh mixer software from six different points created on adjacent teeth.

Results: were analyzed using ANOVA test and unpaired t test it was found that there was no statically significant difference between the method of sterilization but results

were statistically significant when only autoclaving was performed without the use of chemical sterilization.

Conclusion: difference in the accuracy of the scan when scan body were subjected to different sterilization method but the accuracy of the scan decreased after 20 cycles of sterilization. After repeated cycles of steam sterilization the accuracy of the scan bodies changed progressively.

Keywords: scan body, implant scan body, digital impression, implant impression, scanning abutment, sterilization, scanning accuracy.

Introduction

Since we all are aware of the fact that digitization is the present and future of worlds development and so in the dentistry as well. Digital dentistry is evolving rapidly since the introduction of the computer-aided design and computer-aided manufacturing (CAD-CAM) software in the 1970s.

It consists of 3 main units: data acquisition unit, data processing unit and manufacturing unit. Recording a dental impression is a crucial step in implant dentistry. [4] Inaccurate transfer of the implant position can lead to an ill-fitting prosthesis, which causes both biological and mechanical complications which will ultimately result in failure of implant treatment. [5]

With the advancement of CAD-CAM technology, it is now possible to use a digital workflow when fabricating implant-supported restorations.[6] which can be either direct or indirect in nature. [7,8]

The indirect work flow involves making a conventional implant impression which is then digitized in the laboratory by using an optical benchtop scanner and laboratory scan bodies (ISBs).

All the leading implant system manufactures scannable abutment. Commercial intraoral scan body (ISB) design is highly variable with regard to material, shape, size, surface, connection, reusability, software/ scanner compatibility, and cost etc.1-10 Scan body consist of three parts 1) scan region 2) body and 3) base. scan region may contain 1 or multiple scan areas. Scan region is the region which may improve the accuracy of the digital impression. This portion is usually made up of a variety of materials including Polye there ther Ket one (PEEK), titanium alloy, aluminum alloy, and various resins. Wear of this component through repeated use and sterilization may cause changes in positioning over time, which may degrade the overall accuracy of the scan.[16]

As implant scan body is very expensive tool in implantology, if it is made with single use material its affordability will be questionable both for the dentist and for the patient. So, it should be made with material that can be sterilized multiple times to prevent cross infection without compromising its accuracy with each use in different patients.

The purpose of this study is to determine whether there is change in the scanning accuracy of the scan bodies when they are subjected to two different sterilization methods and multiple sterilization cycles. Materials and method A 29 y/o male patient visited the department of prosthodontics of Government Dental College and Hospital, Aurangabad with chief complain of missing 46 tooth was planned for Adin implant (dimensions 5*11.5) in the 46 regions.

After surgery, the patient was advised to wait for 3 to 4 months for complete implant osseointegration. After the waiting period of 4 months a conventional open tray implant impression of the implant using addition silicone (Dentsply aqusil soft putty and xlv light body) was recorded (fig.1). The cast was poured using type 4 dental

stone (pearl stone, Asian chemicals) with lab analog in place (Adin RS Internal Hex Implant Analog).

After retrieval of the cast, one of the scan bodies (RS 7 ADIN IMPLANT) was attached to the cast using hex driver following which Orientation lines were marked on adjacent teeth to reposition the scan bodies for subsequent scans(fig.2) and also 6 points were marked on the adjacent premolar and molar for measurements.

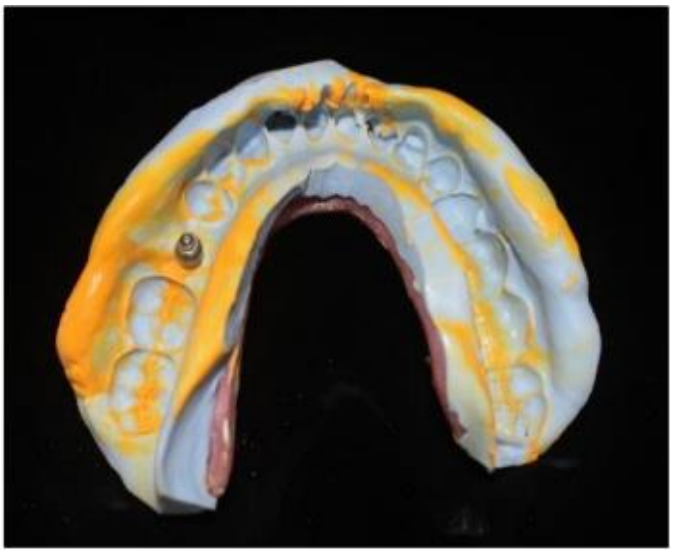


Fig.1: Open tray implant impression.

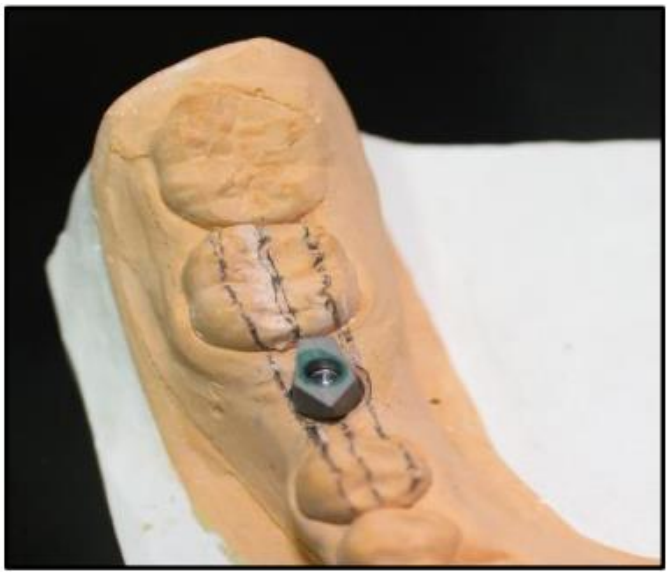
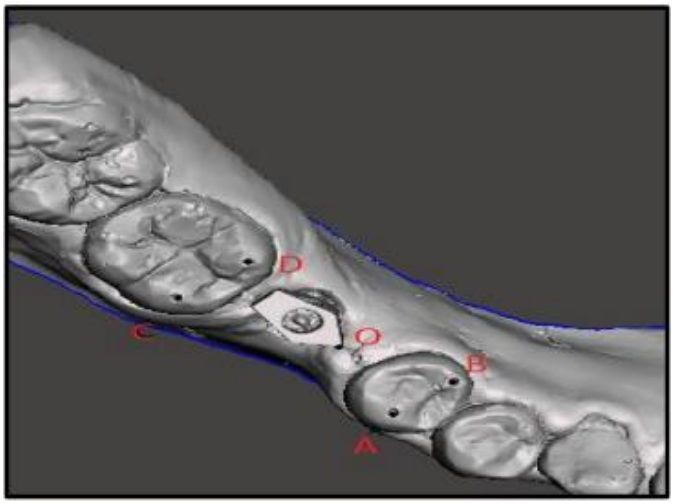


Fig.2: Scan body attached to the cast using Orientation lines

The cast was scanned using extraoral scanner (fig.3) (Dentsply Sirona in Eos X5). The scanned file was exported to in lab software, where the digitalization of the images was done (fig.4 and 5) and the file was converted to STL file.

Fig 3: Scanning of the cast with scan body



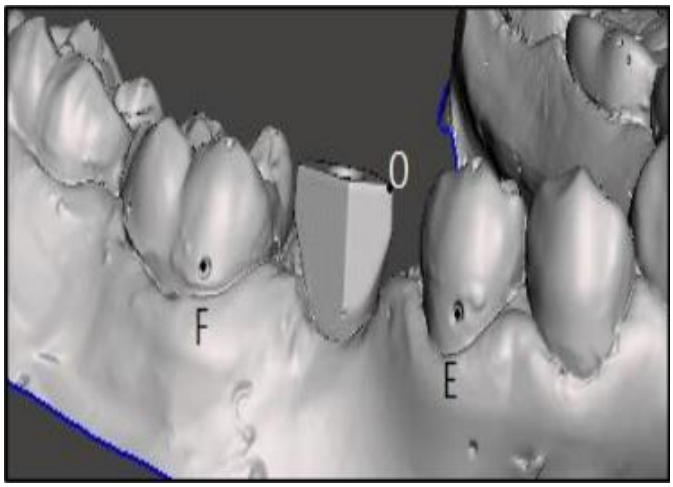


Fig. 4 and 5 points marked for measurement

This STL file was exported to Autodesk MESHMIXER software where digital measurement were done of the points given below.

- Point A: Represents buccal cusp tip of adjacent premolar
- Point B: Represents lingual cusp tip of adjacent premolar
- Point C: Represents mesiobuccal cusp tip of adjacent molar.
- Point D: Represents mesiolingual cusp tip of adjacent molar.
- Point E: Represents buccal surface of adjacent premolar.
- Point F: Represents buccal surface of adjacent molar.
- Point O: Represents apex of the scan body.

Line OA, OB, OC, OD, OE and OF were measured and values were recorded.

The scan bodies were removed from the cast and were placed in artificial saliva for 10 min. Following this, one of the scan body was placed in glutaraldehyde solution for 10 min and then was autoclaved for 15 min at 121degree.Other scan body was simply autoclaved for 15 min at 121 degree.

This Process was repeated up to 15 cycles then again, the scan bodies were attached to the cast using previous orientation lines, scanning and measurements were done using previous method. This step was (i. e. scanning and measurement of the scan) repeated after 20,25 and 30 cycles. To avoid human error three different measure ment were noted which is given in the table.

Results

Inter group and intra group comparison was done using one way ANOVA and unpaired t test respectively. Results obtained were tabulated. Mean reading obtained

Table 1: autoclaving (mean reading after 3 repeated measurements)

	0	15	20	25	30
OA(m)	7.1347	6.8913	7.1705	7.086	7.1118
OB(m)	7.6833	7.9408	7.7705	7.8952	7.8523
OC(m)	11.009	10.757	10.768	10.872	10.667
OD(m)	9.8812	9.9631	9.8266	9.7519	9.6289
OE(m)	8.2858	7.9976	8.1455	8.1584	8.2675
OF(m)	12.6940	12.254	12.482	12.471	12.415

Table 2: chemical sterilization followed by autoclaving

	0	15	20	25	30
OA	7.1256	7.0639	7.0645	7.0484	7.1173
OB	7.6785	7.8293	7.9018	7..6737	7.7876
OC	11.0458	10.699	10.616	11.039	10.770
OD	9.7845	9.8266	9.8656	9.7546	9.8105
OE	8.1245	8.1479	8.2960	8.3307	8.3292
OF	12.2212	12.2180	12.385	12.432	12.543

- there was no statistically significant difference ($p>0.05$) between both sterilization methods at each cycle.
- In group A (only autoclave) there was statistically significant difference ($p<0.05$) in measurements when subjected to different sterilization cycles.
- There was no statistically significant change ($p>0.05$) in Group B (chemical + autoclave) at different sterilization cycles as measurements were almost stable.

Table 3: ANOVA test results

POINTS	AUTOCLAVING	CHEMICLAVING +AUTOCLAVING
OA	F=3.44 P=0.049*	F=1.71 P=0.223
OB	F=1.2 P=0.351	F=2.93 P=0.076
OC	F=16.65 P=0.001*	F=3.764 P=0.041*
OD	F=3.60 P=0.045*	F=3.14 P=0.064
OE	F=0.934 P=0.482	F=0.858 P=0.521
OF	F=8.87 P=0.003*	F=1.10 P=0.405

Table 4: Unpaired t test result

	OA	OB	OC	OD	OE	OF
0	T=1.090 p=0.337	T=1.137 p=0.319	T=1.23 p=0.28	T=-0.41 p=0.698	T=0.381 p=0.508	T=0.381 p=0.722
15	T=0.79 p=0.472	T=0.474 p=0.660	T=2.28 p=0.08	T=0.376 p=0.726	T=0.726 p=0508	T=0.726 p=0.508
20	T=3.414 p=0.27	T=-052 p=0.62	T=0.45 p=0.67	T=-1.47 p=0.21	T=0.005 p=0.99	T=0.005 p=0.99
25	T=1.828 P=0.142	T=0.97 p=0.385	T=0.19 p=0.85	T=0.41 p=0.699	T=0.66 p=0.545	T=0.660 p=0.545
30	T=1.918 p=0.128	T=0.418 p=0.69	T=0.61 p=0.57	T=-0.18 p=0.86	T=0.253 p=0.81	T=0.253 p=0.81

Discussion

Scan bodies are device made up of different materials. Scan region is the region which may improve the accuracy of the digital impression. This portion is usually made up of a variety of materials including Polye there ther Ket one (PEEK), titanium alloy, aluminum alloy, and various resins. They can be used multiple times in different patients for which they should be sterilized after each use to prevent cross infection. Different manufactures recommend different sterilization method and have set a limit for number of sterilization cycles that can be done without reducing the accuracy of the scan body.[17] This study attempts to show that whether there is difference in the accuracy of scan body when it is subjected to different sterilization methods and different cycles of sterilization.

The scan body contain 1 or multiple scan areas, which may improve the accuracy of the digital impression.[8] This portion is usually made up of the same material as the body but usually has a different shape.

The machinability of these materials and the Manu facturing tolerances may be an important consideration in the accuracy of scan bodies. Wear of this component through repeated use and sterilization may decrease the accuracy of transfer of the implant position and in clination to the cad software.[16]

Results showed that the autoclaving alone can decrease the scanning accuracy of the scan bodies but chemical sterilization does not cause any change in accuracy after different cycles of sterilization. There was no significant change in accuracy of the scan with different sterilization methods. The results obtained were not consistent as the software used for measurements, measures values in mm so, more precise software that

measures values in microns can provide more ap pro priate results.

As samples obtained were recorded by three different operators, more precise values have to obtained by increasing the sample size and number of observations.

Clinical significance

Scan bodies can be steam sterilized and reused up to 20 times in patients without compromising the accuracy of scan. After 20 cycles of steam sterilization the accuracy changes.

Conclusion

• There was no difference in the accuracy of the scan when scan body were subjected to different sterilization methods i.e., chemical and steam sterilization.

• After 20 cycles of autoclaving the accuracy of the scan decreased gradually. The same trend was seen when scan bodies were subjected to chemical sterilization followed by steam sterilization.

• So, it can be concluded that after repeated cycles of steam sterilization the accuracy of the scan bodies changed progressively.

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