The Marginal Fitness of CAD/CAM All Ceramic Crowns Constructed by Two Types of Direct Digitization Techniques (An *In Vitro* Study)

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ABSTRACT

Background: In capturing a negative image, the digital impression secures a digital record for the purposeof designing and creating restorations. The introduction of scanning system presents a paradigm shift in the way of the dental impression procedure and encourages the accuracy of obtained restoration especially in the marginal area as a result of producing accurate final impression The digital system offers many advantages over the Conventional method.. The objective of this present in vitro study was to evaluate the marginal fitness of all ceramic crowns fabricated by direct digital scanning of the prepared tooth using two types of intra-oral cameras (Bluecam camera with strip light projection technique and Omnicam camera with video sampling technique).

Materials and Methods: Sixteen sound upper first premolar teeth of comparable size were collected. Standardized preparation of all teeth samples were carried out to receive all ceramic crown restoration with deep chamfer finishing line (1mm), axial length (4mm) and convergence angle (6◦). The specimens divided in to two groups according to the type of digital impression technique: Group A, eight prepared teeth scanned directly by Bluecam camera; Group B, eight prepared teeth scanned directly by Omnicam camera. Then CAD/CAM all ceramic crowns constructed for each tooth sample.

Marginal discrepancy was measured at Sixteen points per tooth using digital microscope at (120X) magnification.

Results: Independent sample t-test was used to identify and localize the source of difference among the groups. It was found that there is statistically non- significant difference in the marginal gap mean values between (group A and group B).

Conclusions: From the above result we can conclude that the two types of direct digitization techniques have the same accuracy.

Key words: Marginal fitness, CAD/CAM system, Digital impression. (J Bagh Coll Dentistry 2016; 28(2):30-33).

INTRODUCTION

The conventional impression technique for construction of the indirect dental restoration include many steps; preparation of the abutment teeth, impression making, pouring procedure to form master model, wax up and finally casting**,** so there are several factors could effect on the accuracy of the traditional impression-making.

The introduction of CAD/CAM systems in 1980s to dental field resolved a wide range of these limitations found in the conventional impression techniques since they provide speed, property of storing captured images indefinitely with no distortion [(1)].

The early systems of CAD/CAM using extra-oral scanners that enable scanning the stone models after taking impressions or the impression itself were scanned[(2)]. Nowadays many companies developed an in-office scanners that enhance capturing of three dimensional virtual images of the prepared teeth intra-orally without needing to conventional impression making, then the restorations were designed on a computer using CAD software relies on the captured data that acts as a virtual wax-up.

The introduction of scanning system presents a paradigm shift in the way of the dental impression procedure and encourages the accuracy of obtained restoration especially in the marginal area as a result of producing accurate final impression because any inaccuracy in impression results in crown restoration having marginal discrepancy that compromises preexisting periodontal diseases, secondary caries and eventually crown failure [(3,4)].

MATERIALSAND METHODS

Sixteen sound recently extracted maxillary 1st premolar were collected, the root of each tooth were embedded in an individual block of acrylic to about (3mm) by the aid of surveyor. Each specimen was prepared to receive all ceramic crown with flat occlusal surface, (1mm) deep chamfer finishing line, 6 degree axial tapering and (4mm) axial length (fig. 1).

Prior to scanning,each specimen with its acrylic base was reseated in its corresponding place inside a modified mannequin to replicate natural dental arch, so each tooth sample will have adjacent and opposing teeth which was needed in the scanning procedure (Fig. 2)

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Figure 1: The final preparation of the tooth sample.

Figure 2: The modified custom made model

The teeth samples in (group A) were scanned using intra-oral digital scanning by Bluecam camera (Fig. 3), and (group B) were scanned using intra-oral digital scanning by Omnicam camera (Fig:4), all the scanning procedure were done according to the manufacturer's instructions.

The ceramic Vita Mark II CAD /CAM crowns were then constructed for all teeth samples.The crowns for all groups were designed using the biogeneric software according to the recommended parameters, all the information were then sent to the milling machine CEREC MC XL.

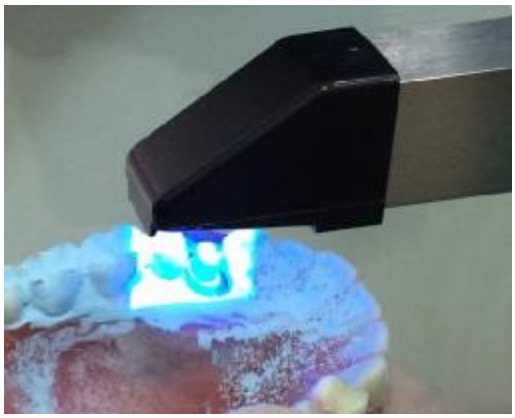

Figure 3: Scanning with Bluecam camera.

Figure 4: Scanning with Omnicam camera

The marginal fitness of the crowns were calculated by measuring the vertical gap between the margin of tooth and that of the ceramic crown, no any type of cement or luting agent was used to affixthe crown onto the specimenbecause when specimens are cemented, they may lose the precision of the primary adaptation by the effect of cement type, cement viscosity and cementation technique which influence the results [(5)], but the specimens fixed in place with a specially designed holding device to apply a constant seating of the tested crowns to ensure the accuracy of their examination [(6)].

The area of (mid-buccal, mid-lingual, mid-mesial, mid-distal) was selected to measure the space between the margin of the tooth and that of the crown during marginal fitness measurement [(7,8)]. The measuring was done by the digital microscope at magnification 120X (figure 5). the digital imageswere captured and measured utilized IMAGE J software (Image J 1.32, U.S. National Institutes of Health, Bethesda, MA, USA)[(9,10)] that calculate the value in pixel. The samples were observed and photographed at 120X magnification and calibrated using a photograph of a (1mm) increment take at the same focal lengthand input into (IMAGE J) by the option of

set scale [11] that converted all calculated readings from pixel to (μm) (Fig:6 A and B).

Figure 5:Digital image captured by Dino-Lite digital microscope.

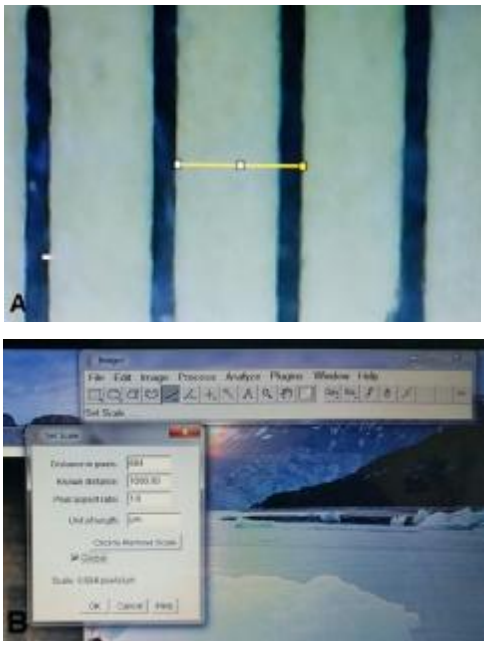

Figure 6 A and B: Calibration the measurements by set scale option.

Statistical analysis

Data were collected and analyzed using SPSS (statistical package of social science) software version 15 for windows XP Chicago, USA.

The following statistics were used:

A- Descriptive statistic: including mean, standard deviation, statistical tables and graphical presentation by bar charts.

B- Inferential statistics: including t-test to see if there were any significant differences between the means of groups.

P value of more than 0.05 was regarded as statistically insignificant as follows:

$p \geq 0.05$ NS Non-significant

$0.05 \geq p > 0.01$ * Significant

$0.01 \geq p > 0.001$ ** highly significant

RESULTS

Table 1 showed the descriptive statistics and groups' comparison of vertical marginal gap measured in μm. The results revealed non-significant difference between the two groups.

Table 1: Descriptive statistics and comparison of vertical marginal gap for the two groups in (μm).

Groups	Descriptive statistics					Comparison (d.f.=14)	
	N	Mean	S.D.	Min.	Max.	t-test	p-value
A	8	36.688	2.018	34.799	40.864	-1.796	0.484 (NS)
B	8	34.892	3.723	28.713	39.576		

DISCUSSION

In the present study, all the evaluated values obtained were clinically acceptable[12-14] who concluded that marginal discrepancy in the range of (100 um) being clinically acceptable.

The results of our study showed that the accuracy difference between the two types of cameras (Bluecam camera continuous images techniques and Omnicam camera video sampling technique) was statistically non-significant, which is in agreement with the results of previous studies that showed no statistically significant differences between the technique of video sampling and that of stripe- light projection [15-17]. On the other hand our results reflect a small degree of difference between (Bluecam camera 36.688) and (Omnicam camera 34.892) which in total agreement with a recent laboratory research which concluded that powder-free and powder-based systems can achieve comparable results [16].

The explanation of that difference might be due to the fact that the layer of powder used in scanning procedure of Bluecam camera, which is necessary to applied to prevent reflections of glossy surfaces, could lead to inaccurate measurements. This comes

in total agreement with other findings [1,17,18] who stated that powdering may adversely affect the marginal fitness instead of improving it even if the scanners' program capable of taking the powder layer into account in the algorithm.

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