Volume-9 | Issue-4 | April-2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

# COMPARISON OF MARGINAL FIT OF LITHIUM DISILICATE CROWNS FABRICATED FROM CONVENTIONAL AND DIGITAL IMPRESSION TECHNIQUES-A SEM ANALYSIS

**Prosthodontics**

**Dr. Aushili Mahule** Postgraduate student, Department of Prosthodontics, Crown and Bridge and Oral Implantology,Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, Maharashtra, India

**Dr. Jaykumar Gade** MDS, HOD & Professor, Department of Prosthodontics, Crown and Bridge and Oral Implantology, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, Maharashtra, India

**Dr. Vandana Gade** MDS, Professor, Department of Conservative Dentistry and Endodontics, Swargiya Dadasaheb Kalmegh Smruti College and Hospital, Nagpur, Maharashtra, India

## ABSTRACT

**Background:** A properly fitting crown margin is a key for successful fixed prosthodontic treatment. The present study aimed to compare and evaluate the marginal fit of lithium disilicate crowns fabricated from digital and conventional impression techniques.

**Materials and method:** A typhodont mandibular first molar was prepared for receiving an all ceramic lithium disilicate crown. Four groups each containing 5 crowns were created. The marginal fit was measured using SEM.

**Result:** Marginal fit obtained using intraoral digital impression technique was found to be minimum (39.43 µm).

**Conclusion:** Ceramic crowns fabricated by using fully digital impressions technique provided a better marginal fit than those created from extraoral scanning and conventional techniques.

## KEYWORDS

Marginal fit, Digital Impression, Lithium Disilicate, CAD/CAM

## INTRODUCTION:

Due to the most esthetically pleasing appearance, high bio compatibility and a very close resemblance to the natural tooth structures, there is a high demand for all-ceramic restorations in everyday dental practices.[1]

The capture of an accurate impression is a pre-requisite for the prosthesis fabrication.[2] Inaccuracies in the impression can affect the fabrication of the final prosthesis. In earlier days clinicians recorded the negative replica of the prepared tooth structures by using physical impression materials and techniques. Though the conventional impression process has been well documented and is inexpensive, it is associated with a numbers of inadequacies which can affect the fabrication of final prosthesis such as storage condition of the impression, changes associated with transportation of the impression to a commercial dental laboratory, the length of time between securing an impression and the pouring of the stone cast, the surface wettability of the gypsum product, disinfectant used; and lab errors associated with manual fabrication procedures. Also, the quality, type of impression material and technique used, and operator's experience play an important role. Conventional impressions techniques is frequently described as uncomfortable by the patients as they may produce objectionable taste and odour. It is also difficult to record impressions by this technique in patients having increased gag reflex and in patients with microstomia.[2,3]

To overcome certain disadvantages associated with the conventional procedures newer techniques were instigated for capturing the oral tissues and fabrication of the prosthesis. The digital impression technique and the computer aided design computer aided manufacturing (CAD/CAM) have now became an inherent part in the field of dentistry. CAD/CAM systems can design and fabricate prostheses using stone casts made from conventional impressions. With the digital designing and fabrication of the prosthesis, manual procedures like manipulation of the wax pattern and investing and casting procedures have been eliminated. Prosthesis fabricated in this manner have shown optimum results both esthetically as well as functionally.[4,5] However, the inadequacies from the conventional impression technique such as air bubbles and deformation of impression material which can affect the accuracy of the stone cast and thus the final prosthesis remain unchanged. So, intraoral scanners have been developed to enhance the accuracy of the definitive prostheses by direct acquisition of the data from the oral cavity. Direct CAD/CAM procedures using intraoral scanners involve less steps in the impression-making process, thus reducing possible error sources. Additional benefits of intraoral digital impressions include speed, increased patient acceptance and comfort; no requirement of disinfection; ability to make immediate corrections during preparation; digital scans can be stored on a computer thus freeing the space in the dental office.[2] However, the amortization of the cost of the equipment and dexterity and expertise required for using the technology cannot be overlooked.

Marginal fit is regarded as one of the most crucial factors for the success of the fixed dental prosthesis.[5-8] Poor marginal fit can lead to the accumulation of dental plaque, secondary dental caries, inflammation of the periodontium, bone loss, dissolution of luting material and ultimately the failure of prosthesis.[6]

Existence of availability of multiple techniques for recording impression and fabricating crowns created a dilemma regarding which technique is better. Few studies state that digital technique provided a better marginal fit,[5-10] some state that conventional technique provided a better marginal fit,[2] while few stated that no difference exists between the two techniques.[11,12] Thus the present study was undertaken to compare marginal fit of lithium disilicate crowns fabricated using extraoral, intra-oral digital impression techniques as well as the conventional impression technique. The null hypothesis was that no difference would be found in the marginal fit of lithium disilicate crowns fabricated using either of the impression technique.

## Materials and method:

A typodont mandibular right first molar (Trulon, Zahnsply) was prepared to receive a lithium disilicate complete coverage crown with medium grit diamond points (Ex-12, Sf-11, Tf-21, Tf-12ef; Ex-21ef, Mani Inc, Japan) using a high speed handpiece (High Speed Air Turbine Handpiece, Nsk, Japan); having a circumferential shoulder finish line of 0.6mm; functional cusp reduction of 2mm; non-functional cusp reduction- 1.5 mm and a 6 degree angle of convergence.5 Four groups consisting of 5 LDS crowns each were made. The groups were: intraoral scanning group (CS 3600 carestream) (n=5), extraoral scanning group In EOS X5 (Dentsply Sirona) (n=5), extraoral scanning group Identica Hybrid blue ray technology optical scanner (Medit) (n=5) and conventional heat press (n=5) (Table 1). From the prepared master die, 20 duplicate dies were produced using poly methyl methacrylate resin. The resin dies served as an individual master dies over which respected crowns from each group were cemented.

PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

**Table 1: Impression techniques and materials used for crown fabrication**

| Group | Impression Method | Scanner (Manufacturer) | Restoration Material | Fabrication Method |
|---|---|---|---|---|
| Group A | Intraoral digital | Cs3600 Carestream Dental) | e.max CAD | CAD/CAM |
| Group B | Extraoral digital | In EOS X5 (Dentsply sirona) | e.max CAD | CAD/CAM |
| Group C | Extraoral digital | Identica Hybrid optical scanner (Medit) | e.max CAD | CAD/CAM |
| Group D | Conventional PVS | - | e.max Press | Lost-wax |

For the group A crowns, intra-oral (IDI) digital scanning was performed using CS 3600 carestream scanner. The occlusal surface was scan first followed by buccal and lingual surface scanning at an angle of 45 degrees approximately. Separate STL files were made for each specimen which were used for crown milling.

Fifteen conventional impression were made from the resin dies using light-body and heavy-body polyvinyl siloxane material (Aquasil Soft Putty/Regular Set, Dentsply, Germany) in a complete arch perforated stock metal tray. The impressions were removed and evaluated for the intactness of the preparation margins and 15 stone casts were poured in type IV stone (Ultrarock, Kalabhai, Mumbai, India).

Out of the fifteen stone dies, 10 dies were scanned using extraoral scanners. Out of the 10 dies, 5 stones dies were scanned using extraoral scanner In EOS X5 (Dentsply Sirona) (Group B) and other 5 dies were scanned using extraoral scanner Identica Hybrid blue ray technology optical scanner (Medit) (Group C). All the IPS e.max CAD/CAM crowns were designed using exocad software and were milled using a 5-axis milling machine (Arum 5x-400, Milling Machine, Germany). The crowns were finished, polished and glazed.

**Fig 1: Jeol SEM (6380 A)**

The 5 remaining stone dies were used for fabrication of lithium disilicate crowns with the conventional heat press technique. Wax patterns were made, invested and pressed following the manufacturer's instructions.

All the fabricated LDS crowns were cemented to their respected resin dies with resin cement (Multilink N, Ivoclar Vivadent) using finger pressure. All the samples were ensured to be dried; coated with platinum-palladium alloy and were analysed using SEM (Jeol 6380 A) (Fig 1). The marginal discrepancies were measured at 4 predetermined sites: mesiobuccal, midbuccal, distobuccal and lingual.

The descriptive statistics like mean, standard deviation, median and range were obtained for the marginal gap measurements by four different techniques. The comparison of means across techniques was performed using one-way analysis of variance (ANOVA). The pair-wise comparison between group means was carried out using Tukey's post-hoc test. All the analyses were performed using SPSS ver 20.0 (IBM Corp USA) and the statistical significance was tested at 5% level.

**Results:**

The descriptive statistics for marginal gaps for four different impression techniques are given in Table 2. The mean for group A ie Intra-oral scan CS 3600 care stream was the minimum i.e. 39.43 µm (SD: 8.82 µm), followed by In EOS X5 with mean of 44.81 µm (SD: 4.97 µm), Identica hybrid Medit with mean of 45.89 µm (SD: 9.53 µm) and maximum for conventional heat press i.e. 49.75 µm (SD: 8.41 µm) (Fig 2-5). The comparison of means across four groups was performed using one-way analysis of variance. The between group analysis resulted into a p-value of 0.002 indicating statistically significant difference of means across four groups (Table 2).

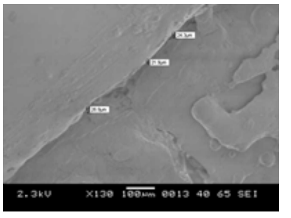

**Fig 2: SEM image Group A**

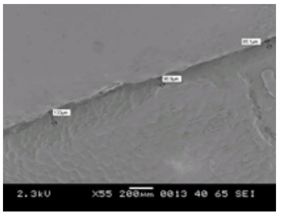

**Fig 3: SEM image group B**

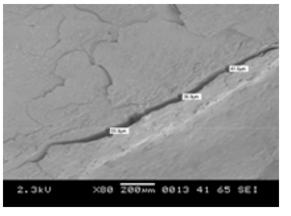

**Fig 4: SEM image Group C**

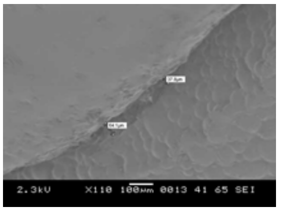

**Fig 5: SEM image group D**

**Table 2: Descriptive statistics for marginal gap obtained by using different impression techniques**

| Measuring techniques | Marginal gap (µm) | | | | |
|---|---|---|---|---|---|
| | Mean* | Median | SD | Minimum | Maximum |
| A) Intra-oral scan CS 3600 care stream | 39.43 | 39.25 | 8.82 | 22.70 | 58.10 |
| B) In EOS X5 (Dentsply Sirona) | 44.81 | 45.90 | 4.97 | 31.60 | 51.20 |
| C) Identica hybrid (Medit) | 45.89 | 42.35 | 9.53 | 31.30 | 64.00 |
| D) Conventional heat press | 49.75 | 51.20 | 8.41 | 38.10 | 64.60 |

*Significantly different across techniques ($p = 0.002$) using one-way ANOVA

In order to determine which group means differ significantly, a pair-wise analysis was performed using Tukey's post-hoc test. The analysis revealed that the difference between the means of group A and group D was statistically significant with a p-value of 0.001, while all other paired differences were statistically insignificant ($p > 0.05$).

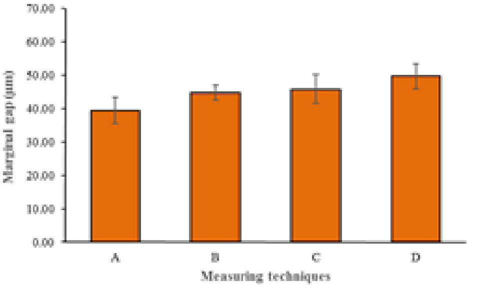


**Figure 6: Column chart showing mean marginal gaps for four different impression techniques**

**DISCUSSION:**

In the present study two extraoral scanners, one intraoral scanner and conventional impression techniques were compared. The marginal fit obtained from the intra oral digital impression (IDI) group was found to be minimum (39.43 µm) when compared to the extraoral and conventional impression techniques. Significant differences were found between IPS e.max CAD crowns produced using intraoral digital impressions (group A) and IPS e.max press crowns produced using heat press technique (group D). Thus, the null hypothesis of this study was rejected. However, no statistically significant differences were found between any other groups (Table 2 and Fig 6).

Various studies have shown that digital impression techniques can offer better results than conventional technique which is in accordance with the result of this study.[5-10] Kim et al compared the marginal of lithium disilicate crowns fabricated from digital and conventional impressions and stated that the marginal discrepancy was least with the intra oral scanning CS3500 compared to the other 3 groups which was in accordance with the result of the present study.[5]

Ng et al compared the marginal fit of lithium disilicate crowns fabricated with digital LAVA C.O.S scanner and conventional methods. Marginal gap measurements were made using digital photography at x40 magnification. They concluded that, the digitally made crowns produced significantly smaller (48±25 µm) marginal discrepancy than the conventionally made crowns (74±47 µm).[6]

A study by Azim et al[11] stated that no significant differences occur between the marginal discrepancies of the crowns fabricated from conventional and digital workflows. This was not in accordance with the present study. Another study by An et al has evaluated the marginal fit of zirconia copings using light microscopy at x50 magnification stated that the marginal gap was greater in the groups that used the digital impression method than in the groups that used conventional impressions.[2] This was also in controversy with the results obtained from the present study.

A wide range of values has been reported for the marginal discrepancies of the crown in the literature. The marginal fit of cemented restorations can lie between 25 to 40 µm, while most of the literature suggesting that a marginal opening of less than 120 µm is clinically acceptable.[11,13] In the present study, the marginal gaps obtained from all the groups were within the clinically acceptable limits.

The lowest marginal discrepancy obtained with the intra oral scanning in this study may be attributed to the fact that the fully digital fabrication system involves less steps, obtain data directly from the object and thus decreases the chances of error. On the other hand, the manual fabrication processes consists of multiple steps like physical impression making, pouring the casts, manual application of die hardener and spacer, manual fabrication of the wax pattern, investing, casting and producing the crowns that increases the chances of errors and decreases the quality of final restoration. Also, irreversible hydrocolloid which is the most commonly used impression material may produce dimensional changes ranging from 0.33% to -2.8%.[14] PVS impression after 24 hours are known to exhibit 0.14% to 0.17% linear contraction, and the linear expansion of gypsum Type IV dental stone lies between 0.06% and 0.5%.[5,15]

The limitations of this study are: Finger pressure was used for cementation of the lithium disilicate crowns and no loading of the crowns by e.g., chewing or clenching took place. All the specimens were prepared using the standard model. Also, the findings of the present study, for clinical use, may be somehow limited by the in vitro design of the study. Factors such as presence of saliva, blood, humidity, adjacent teeth, patient movement while scanning, and the effect of powder coating which can all alter the intraoral impression-making procedure were not taken into the consideration.

## CONCLUSION:

Ceramic crowns fabricated by using intra oral digital impression technique provided a better marginal fit than those created from extra oral scanning and conventional techniques. However, the marginal discrepancies obtained from all the groups were within the clinically acceptable limits.

## REFERENCES:

1. Beier US, Kapferer I, Dumfahrt H. (2012): Clinical long-term evaluation and failure characteristics of 1,335 all-ceramic restorations. International Journal of Prosthodontics.;25(1):70-78.
2. An S, Kim S, Choi H, Lee JH, Moon HS. (2014): Evaluating the marginal fit of zirconia copings with digital impressions with an intraoral digital scanner. The Journal of prosthetic dentistry. 112(5):1171-5.
3. Nagarkar SR, Perdigao J, Seong WJ, Theis-Mahon N. (2018): Digital versus conventional impressions for full-coverage restorations: A systematic review and meta-analysis. The Journal of the American Dental Association., 149(2):139-47.
4. Alqahtani F. (2017): Marginal fit of all-ceramic crowns fabricated using two extraoral CAD/CAM systems in comparison with the conventional technique. Clinical, cosmetic and investigational dentistry., 9:13-8.
5. Kim JH, Jeong JH, Lee JH, Cho HW. (2016): Fit of lithium disilicate crowns fabricated from conventional and digital impressions assessed with micro-CT. The Journal of prosthetic dentistry., 116(4):551-7.
6. Ng J, Ruse D, Wyatt C. (2018): A comparison of the marginal fit of crowns fabricated with digital and conventional methods. The Journal of prosthetic dentistry., 112(3):555-60.
7. Lee B, Oh KC, Haam D, Lee JH, Moon HS. (2018): Evaluation of the fit of zirconia copings fabricated by direct and indirect digital scanning procedures. The Journal of prosthetic dentistry., 120(2):225-31.
8. Kocaağaoğlu H, Kılınç HI, Albayrak H. (2017): Effect of digital impressions and production protocols on the adaptation of zirconia copings. The Journal of prosthetic dentistry., 117(1):102-8.
9. Su TS, Sun J. (2016): Comparison of marginal and internal fit of 3-unit ceramic fixed dental prostheses made with either a conventional or digital impression. The Journal of prosthetic dentistry., 116(3):362-7.
10. Chochlidakis KM, Papaspyridakos P, Geminiani A, Chen CJ, Feng IJ, Ercoli C. (2016): Digital versus conventional impressions for fixed prosthodontics: A systematic review and meta-analysis. The Journal of prosthetic dentistry., 116(2):184-90.
11. Abdel-Azim T, Rogers K, Elathamna E, Zandinejad A, Metz M, Morton D. (2015): Comparison of the marginal fit of lithium disilicate crowns fabricated with CAD/CAM technology by using conventional impressions and two intraoral digital scanners. The Journal of prosthetic dentistry., 114(4):554-9.
12. Zeltner M, Sailer I, Mühlemann S, Özcan M, Hämmerle CH, Benic GI. (2017): Randomized controlled within-subject evaluation of digital and conventional workflows for the fabrication of lithium disilicate single crowns. Part III: marginal and internal fit. The Journal of prosthetic dentistry., 117(3):354-62.
13. May KB, Russell MM, Razzoog ME, Lang BR. (1998): Precision of fit: the Procera AllCeram crown. The Journal of prosthetic dentistry., 80(4):394-404.
14. Erbe C, Ruf S, Wöstmann B, Balkenhol M. (2012): Dimensional stability of contemporary irreversible hydrocolloids: humidor versus wet tissue storage. The Journal of prosthetic dentistry., 108(2):114-22.
15. Kenyon BJ, Hagge MS, Leknius C, Daniels WC, Weed ST. (2005): Dimensional accuracy of 7 die materials. Journal of Prosthodontics: Implant, Esthetic and Reconstructive Dentistry., 14(1):25-31.