IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 20, Issue 12 Ser.10 (December. 2021), PP 13-19
www.iosrjournals.org

In Vitro Study to Evaluate and Compare Internal Adaptation of Provisional Crowns Fabricated With Different CAD/CAM Materials

Dr. Prabhakar Angadi[1], Dr. Girish Sadashiv Nazirkar[2], Dr. Ritika Patel[3]
[1] *(MDS, Professor of Department of Prosthodontics)*
[2]*(MDS, Head of Department of Prosthodontics and Professor)*
[3]*(PG Student, Department of Prosthodontics)*

ABSTRACT:
AIM: *The aim of this study is to evaluate and compare internal adaptation of provisional crowns fabricated with different CAD/CAM materials.*
METHOD: *A dentoform right first mandibular molar was prepared to receive ceramic crown following tooth preparation guidelines and provisional crowns were fabricated. The crowns were divided into two groups, group A: VITA CAD-Temp (n=10), and group B: TELIO CAD-Temp (n=10), each crown was investigated for internal adaptation.*
RESULTS: *Group A (VITA-CAD) had higher internal gap/ discrepancy as compared to Group B (TELIO-CAD).*
CONCLUSION: *Internal adaptation of provisional crowns fabricated from TELIO CAD-Temp is better as compared to VITA CAD-Temp.*
KEY WORDS: *CAD/CAM, provisional crown, internal adaptation*

Date of Submission: 14-12-2021 Date of Acceptance: 28-12-2021

I. Introduction

Fixed Prosthodontic treatment is often incomplete without accurate provisional or interim restorations. The need for provisional restorations has it's roots in esthetic, diagnostic and physiologic factors.[1] Accurate provisional restorations are essential and serve a number of functions including protection of the pulpal tissues, prevent bacterial contamination, and preservation of periodontal tissues. In addition, preventing rotation of the tooth from its normal position in terms of supra or infra occlusion, maintaining esthetics and oral functions, such as mastication and speech, is paramount.[2] It can provide an important tool for the psychological management of patient until the final restorations are cemented.[3]

To meet these goals, special care should be taken to ensure the shape and adaptation of such restorations.[4] Adaptation is an important predictor of the clinical success and longevity of dental restorations.[5] Internal adaptation provides an appropriate and uniform luting space without compromising retention and resistance form during cementation.[6] The fit of restorations depends largely on fabrication methods.[4] The most common materials used for the fabrication of the provisionals are polymethylmethacrylate (PMMA) resins.[7]

Autopolymerizing PMMA resins have several deficiencies. Previous studies have reported polymerization shrinkage and marginal discrepancies with these materials. The danger of pulpal damage because of exothermic reaction of polymerization has been equally well documented, as has sensitivity of the periodontium to the contour and fit of provisional restorations. However, these problems are associated primarily with direct methods of fabrication. It is beneficial to fabricate provisional restorations indirectly on models. The indirect technique has been associated with superior adaptation and pulpal protection.[8]

Innovative materials, such as high-density polymers based on a highly cross-linked polymethyl methacrylate (PMMA) or composite resin for Computer-Aided Design/Computer Aided-Manufacturing (CAD/CAM), have gained interest.[9] Computer-aided design/computer-aided manufacturing (CAD/CAM) is increasingly used to fabricate prosthetic restorations as it reduces laboratory time and material costs while increasing productivity.[10]

But, the importance of the provisional (treatment) restoration among the procedures required for successful completion of a fixed partial denture is often overlooked.[11] A well-made provisional fixed partial denture should provide a preview of the future prosthesis and enhance the health of the abutments and periodontium.[12]

However, limited clinical evidence in terms of internal adaptation is available for CAD/CAM provisional restorations fabricated with newer generation of crown and bridge resins. Hence, this study is planned to comparatively evaluate the internal adaptation of crowns made using commercially available newer generation of CAD/CAM provisional restorative materials.

II. Aim And Objectives

The aim of this study is to evaluate and compare internal adaptation of provisional crowns fabricated with different CAD/CAM materials.

III. Materials And Methodology

Ethical committee approval and study design -

This study was carried out in the Department of Prosthodontics in 2019–2020. Ethics was granted by the Institutional Ethical Committee and research board approval. The study conducted according to the ethical standards given in the 1964 Declaration of Helsinki, as revised in 2013.

The sample size was calculated using the references of related articles, studies, reviews and sample size formula. The power of the study is less; thus, the sample size was taken as 20. The sample was divided into two groups, namely Group A and B. Each group was assigned 10 samples each.

Fabrication of samples-

Samples were made with two different provisional materials (VITA-CAD temp and *TELIO CAD-Temp*) as mentioned above to compare the internal adaptation.

• VITA *CAD-Temp* (VITA Zahnfabrik, India): micro filler reinforced polyacrylic. Group A - 10 samples. (fig. 1)

• Telio *CAD-Temp* (Ivoclar Vivadent Marketing (India) Pvt. Ltd.): cross-linked PMMA blocks. Group B - 10 samples. (fig. 2)

Fig. 1. VITA CAD-Temp (group A) provisional material

Fig. 2. Telio CAD-Temp (group B) provisional material

Fabrication of die model-

A dentoform right first mandibular molar was prepared for a ceramic crown. (fig. 3) The prepared tooth was scanned to fabricate 20 stereolithical resin dies and provisional crowns. (fig. 4 & fig. 5)

Fig. 3. Prepared tooth for ceramic crown

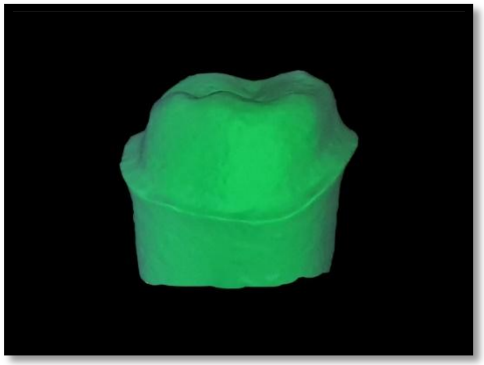


Fig. 4. Scanning of prepared tooth

Fig. 5. Stereolithical resin dies and provisional crowns

Computer-Assisted Designing and Computer-Assisted Milling specimens –

In this study, VITA CAD-Temp (VITA Zahnfabrik, India) AND TELIO CAD-Temp (Ivoclar Vivadent Marketing (India) Pvt. Ltd.) PMMA resin blanks were used to fabricate specimens for group A and group B respectively. The Die model of prepared tooth was scanned with extraoral scanner and virtual image were obtained. Design of prosthesis was done on obtained virtual image. The computer file in STL format was transferred to CAD program, and the specimens were transferred to the milling unit. The specimens were milled in pre polymerized PMMA blanks (VITA CAD, Telio CAD) of the shade A2.

IV. Procedure Of Study

A dentoform right first mandibular molar was prepared to receive ceramic crown with 1.5 mm occlusal reduction, the convergence angle of the wall was prepared to be approximately 6^0 and the round shoulder of 1 mm using a high-speed hand piece operating with water coolant. The preparation was powdered with scan spray using propellent to provide a thin, even layer of powder. The preparation was then scanned. 20 stereolithical resin dies were made. Two CAD/CAM provisional blocks were used: VITA CAD-Temp and TELIO CAD-Temp. Ten provisional crowns were milled for each group. The correlation mode was used with the spacer set at 10 microns for two CAD/CAM groups and the default milling burs (1.2 mm cylinder bur, step bur) were used for the milling of the crowns. Following milling, the crowns were examined for the presence of any cracks or defects.

Crowns were cemented to the resin dies using TempBod NE (kerr, CA, USA) with a standardized time of six minutes to allow for complete setting of the cement. The cement was mixed on a paper pad, following the manufacturer's instructions. The crowns were filled with the cement and seated on its corresponding resin die. The cemented crowns were thermocycled between 5^0C to 55^0C with 30 seconds dwell time to replicate ten weeks intraoral environment, after which the samples will be immersed in 0.5% acid fuschin for 24 hours to evaluate microleakage. Dies along with cemented crowns were embedded in clear resin to prevent dislodging while sectioning the crowns with diamond disk. (fig. 6) The dies were then sectioned into mid bucco-lingual direction to evaluate internal adaptation. (fig. 7)

Fig. 6. Die embedded in acrylic resin.

Fig. 7. Sectioning of samples

Internal adaptation: Internal adaptation was measured using stereomicroscope. (fig. 8 & fig. 9) To evaluate internal adaptation, perpendicular distance from the internal surface of the crown to the external surface of preparation was measured. All measurements were made at the axial, cusp and fossa regions.

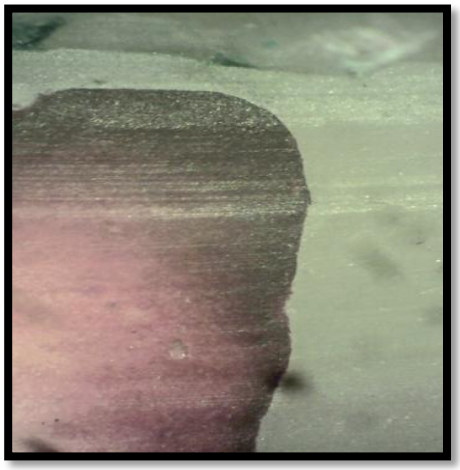


Fig. 8. Measuring internal gap of VITA CAD – Temp (group A) provisional material under stereomicroscope.

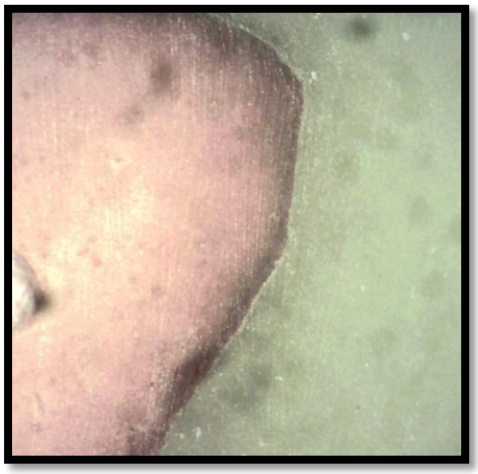


Fig. 9. Measuring internal gap of TELIO CAD- Temp (group B) provisional material under stereomicroscope.

V. Data Analysis

Statistical analysis was performed using Statistical Product and service solution (SPSS) version 16 for Windows (SPCC Inc, Chicago, IL). Descriptive quantitative data was expressed in mean and standard deviation respectively. Data normality was checked by Shapiro--Wilk Test. Inter group comparison of means between two groups of different commercially available PMMA based CAD/CAM provisional restorative materials was done using STUDENT T-TEST. Confidence interval is set at 95% and probability of alpha error set at 5% Power of study set at 80%.

VI. Results

The internal adaptation was recorded for each specimen. This raw data of the values obtained were compiled on MS- Excel sheet to get the mean and SD. The data were then statistically analysed.
Mean values and standard deviations (M±SD) of the internal gap for both groups are graphically shown in Figure. (table 1 & table 2) The average internal gap for each group was: VITA CAD-Temp (122 µm) and TELIO CAD (106.6 µm). On comparative statistics of internal gap between Group A (VITA-CAD) and Group B (TELIO-CAD) respectively, there was found to be statistically significant difference ($p<0.001$) between both groups where Group A (VITA-CAD) had higher internal gap as compared to Group B (TELIO-CAD).

Table 1: Descriptive statistics of internal gap in Group A (VITA-CAD) and Group B (TELIO-CAD) respectively

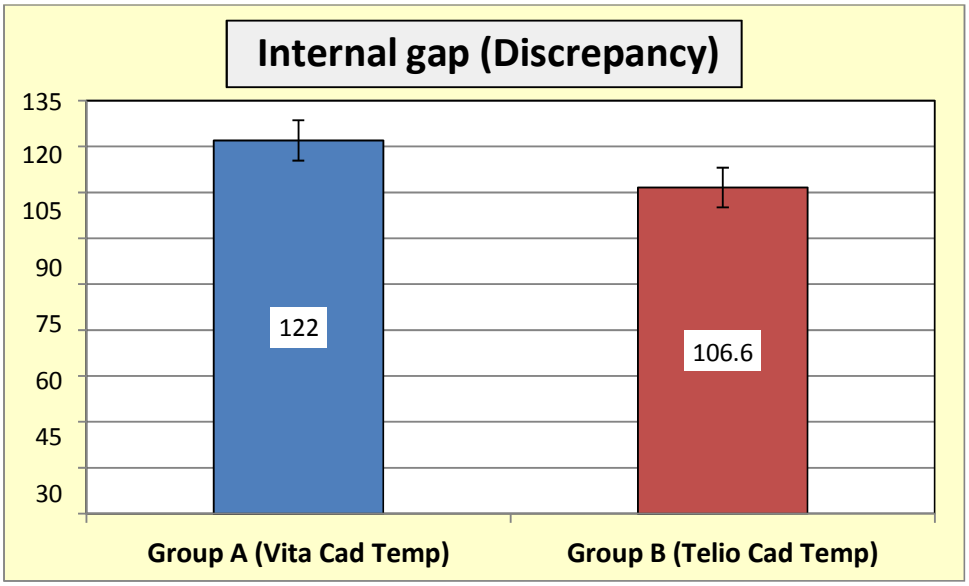
	VITA CAD - Temp	TELIO CAD - Temp
1	127	106
2	129	102
3	116	108
4	113	116
5	118	104
6	119	119
7	129	101
8	126	98
9	129	105
10	114	107
Mean	122.0	106.6
S.D	6.61	6.50
S.E	2.09	2.05
Minimum	113.0	98.0
Maximum	129.0	119.0

On comparative statistics of marginal gap/discrepancy between Group A (VITA-CAD) and Group B (TELIO-CAD) respectively, there was found to be statistical significant difference ($p<0.001$) between both groups where Group A (VITA-CAD) had higher marginal gap/ discrepancy as compared to Group B (TELIO-CAD)

	Mean	S.D	Mean Difference ±S.E	't' test value	p value, Significance
Group A (Vita Cad Temp)	122.0	6.61	15.4 ± 2.93	t = 5.250	p <0.001**
Group B (Telio Cad Temp)	10.6.6	6.50			

*** p<0.05 – significant difference** ****p<0.001 – highly significant difference**

Table 2: Comparative statistics of internal gap between Group A (VITA-CAD Temp) and Group B (TELIO-CAD Temp) respectively



Graph. 1. Comparison of internal gap of VITA CAD Temp (group A) and TELIO CAD Temp (group B)

On comparative statistics of internal gap between Group A (VITA-CAD) and Group B (TELIO-CAD) respectively, there was found to be statistically significant difference (p<0.001) between both groups where Group A (VITA-CAD) had higher internal gap as compared to Group B (TELIO-CAD)

VII. Discussion

In this study, the internal adaptation of the single unit provisional crowns fabricated from two different CAD/CAM provisional materials were evaluated and compared. Tooth was prepared on dentoform lower first molar and then scanned using laboratory scanner. After that stereolithical resin dies were made on which provisional crowns were milled using two different CAD/CAM provisional material i.e. TELIO CAD-TEMP and VITA CAD-TEMP. Aim of the study was to determine internal adaptation of the provisional crowns fabricated by different CAD/CAM provisional crowns. The reason to evaluate internal adaptation is that the adaptation is an important predictor of the clinical success and longevity of dental restorations.[5] Internal adaptation provides an appropriate and uniform luting space without compromising retention and resistance form during cementation.

A restoration, definitive or provisional, is regarded as successful when it exhibits a good adaptation and fit and is strong enough to withstand the oral environment. In literature there are various approaches to measure gap of restorations. Two common techniques to measure the gap are measurement of embedded and sectioned specimens, and measurement of the replica of the gap.[13,14] In this study embedded and sectioned technique was used.

Regarding internal adaptation of restoration, it was found that there was a statistically significant difference between the groups, with the Telio CAD-Temp group demonstrating the lower internal gap. This result was consistent with a previous study.[2,15] and may be due to the machining process of fabricating the crowns and the shape of the milling burs.

Jiajing yao et al [16] studied accuracy of interim material fabricated traditionally and CAD/CAM method before and after thermal cycling 5^{o}C to 55^{o}C, with dwell time of 60- seconds transfer time for 5000 cycles) and found that there is a difference in values before and after thermal cycling. Discrepancy increases after thermal cyclig, so, in present study thermocycling was done to mimic oral environment.

The importance of accurate and well-made provisional restorations in prosthodontic treatment cannot be emphasized enough. This article has reviewed the commercially available CAD/CAM materials used for fabrication of interim restorations, with the goal of familiarizing the clinician with the properties of the materials. The plethora of materials available today requires the clinician to have an in depth understanding of each in order to maximize the benefits and fit the requirements in any given clinical scenario.

VIII. Conclusion

Within the limits of this *In Vitro* study, the following conclusions can be drawn:

- The internal gap size of TELIO-CAD was found to be lesser than VITA-CAD.
- As both the materials (TELIO-CAD & VITA-CAD) showed values under significant range hence, can be used for long term provisional restorations.

References

[1]. Mathur S, Shah A, Makwana R, Shah M, Shah A, Jathal N. Provisional restorative materials in fixed prosthodontics: A comprehensive review. B Bhavnagar University's Journal of Dentistry. 2013;3(3):50-7.

[2]. Abdullah AO, Tsitrou EA, Pollington S. Comparative in vitro evaluation of CAD/CAM vs conventional provisional crowns. Journal of Applied Oral Science. 2016 Jun;24(3):258-63.

[3]. Digholkar S, Madhav VN, Palaskar J. Evaluation of the flexural strength and microhardness of provisional crown and bridge materials fabricated by different methods. The Journal of the Indian Prosthodontic Society. 2016 Oct;16(4):328.

[4]. Mai HN, Lee KB, Lee DH. Fit of interim crowns fabricated using photopolymer-jetting 3D printing. The Journal of prosthetic dentistry. 2017 Aug 1;118(2):208-15.

[5]. Dolev E, Bitterman Y, Meirowitz A. Comparison of marginal fit between CAD-CAM and hot-press lithium disilicate crowns. The Journal of prosthetic dentistry. 2019 Jan 1;121(1):124-8.

[6]. Peng CC, Chung KH, Yau HT. Assessment of the internal fit and marginal integrity of interim crowns made by different manufacturing methods. The Journal of prosthetic dentistry. 2019 Jul 26.

[7]. Al Rifaiy MQ. Evaluation of vertical marginal adaptation of provisional crowns by digital microscope. Nigerian journal of clinical practice. 2017;20(12):1610-7.

[8]. Young HM, Smith CT, Morton D. Comparative in vitro evaluation of two provisional restorative materials. The Journal of prosthetic dentistry. 2001 Feb 1;85(2):129-32.

[9]. Güth JF, e Silva JA, Edelhoff D. Enhancing the predictability of complex rehabilitation with a removable CAD/CAM-fabricated long-term provisional prosthesis: a clinical report. The Journal of prosthetic dentistry. 2012 Jan 1;107(1):1-6.

[10]. Şeker E, Ozcelik TB, Rathi N, Yilmaz B. Evaluation of marginal fit of CAD/CAM restorations fabricated through cone beam computerized tomography and laboratory scanner data. The Journal of prosthetic dentistry. 2016 Jan 1;115(1):47-51.

[11]. Federick DR. The provisional fixed partial denture. The Journal of prosthetic dentistry. 1975 Nov 1;34(5):520-6.

[12]. Regish KM, Sharma D, Prithviraj DR. Techniques of fabrication of provisional restoration: an overview. International journal of dentistry. 2011;2011.

[13]. Beschnidt SM, Strub JR. Evaluation of the marginal accuracy of different all-ceramic crown systems after simulation in the artificial mouth. J Oral Rehabil. 1999;26(7):582-93.

[14]. Holmes JR, Bayne SC, Hollard GA, Sulik WD. Considerations in measurement of marginal fit. J Prosthet Dent.2004;91(3):258-64.

[15]. Tsitrou EA, Northeast SE, van Noort R. Evaluation of the marginal fit of three margin designs of resin composite crowns using CAD/CAM. J Dent.2007;35(1):68-73.

[16]. Yao J, Li J, Wang Y, Huang H. Comparison of the flexural strength and marginal accuracy of traditional and CAD/CAM interim materials before and after thermal cycling. The Journal of prosthetic dentistry. 2014 Sep 1;112(3):649-57.

Dr. Prabhakar Angadi, et. al. "In Vitro Study to Evaluate and Compare Internal Adaptation of Provisional Crowns Fabricated With Different CAD/CAM Materials." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 20(12), 2021, pp. 13-19.