Introduction

In the last years, CAD/CAM technology improved greatly and has provided several applications in dentistry. A variety of drillable materials are available in CAD/CAM for virtually all restoration indications. This technology allows accurate, standardized and fast prosthetic results. One of the main factors for the success of a restoration is marginal adaptation. A large disadaptation between tooth and cement might cause the dissolution of cement, resulting in biofilm accumulation and possibly the occurrence of cavities and/or periodontal disease. Vertical discrepancy at the edge of the restoration is acceptable up to 120µm because it causes smaller cement dissolution. The replica and microscopic techniques have been effectively used to assess crown marginal discrepancy. Ceramic restorations have been widely used in dentistry. Several materials are available in the market, such as lithium disilicate and nanoceramic resin. Lithium disilicate is more resistant and present longer lifespan in clinical use. The nanoceramic resin is a hybrid material that unites the properties of both ceramic and resin. Also, materials with different resistances have different abilities to promote adaptation when machined. This study compares the marginal adaptation of nanoceramic resin crowns (3M ESPE, Lava Ultimate, USA) and lithium disilicate (IpsE.maxCad, IvoclarVivadent, Liechtenstein, Germany) crowns, machined in a CAD/CAM system, after the assessment of the replica technique using optical microscopy.

Proposition

The aim of this study is to compare the marginal adaptation of lithium disilicate (IpsE.maxCad, IvoclarVivadent, Liechtenstein, Germany) and nanoceramic resin (3M ESPE, Lava Ultimate, USA) crowns, machined in a CAD/CAM system, after the assessment of the replica technique using optical microscopy.
The replica technique was used to measure the marginal disadaptation.\textsuperscript{4,5}

The assembly abutment-analog was attached to a liner Bioart B2, (Bioart Equipamentos Odontológicos Ltda, São Carlos; Brazil) and inserted into a bipartite acrylic box measuring 2.5cm of width and 2.5cm of height containing, in one half, heavy addition silicone Take 1 Advanced (Kerr Dental, Munich, Germany) for the conformation of the spatial positioning mold.

The crown was cemented to the abutment with light silicone Take 1 Advance (Kerr Dental, Munich, Germany) and repositioned on the heavy silicone mold with a 2kg load on the liner for 2 minutes for the silicone polymerization (Figure 2). The abutment was then removed and the gap created was filled with extra light silicone Take 1 AdvanceMonophase (Kerr Dental, Munich, Germany). The other half of the box was filled with the same heavy silicone and repositioned for the shaping of the abutment replica in fluid silicone.

The replica was covered with medium addition silicone Take 1 Advanced mono/medium (Kerr Dental, Munich, Germany). Following polymerization, it was covered with heavy silicone, forming a replica of the abutment-cement-crown complex. This replica was split in 4 equal parts, and the silicone layer relative to the cementation line was measured in 4 points - mesial, distal, vestibular, and lingual - using a Mitutoyo TM500 (Mitutoyo, Tokyo, Japan) microscope with 30x of magnification (Figure 3). The measurements were submitted to statistical analysis.

**Results**

The mean values of marginal disadaptation are shown in Tables 1–3.

Student’s t-test showed that the groups differ with level of significance of 0.05.

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**Table 1** Mean marginal disadaptation of the test specimens (CP) in micrometers obtained from nanoceramic resin blocks

| Nanoceramic resin | Vestibular | Lingual | Mesial | Distal | Mean   | Standard deviation |
|-------------------|------------|---------|--------|--------|--------|--------------------|
| CP1               | 42         | 43      | 56     | 41     | 45.50  | 7.05               |
| CP2               | 62         | 50      | 41     | 43     | 49.00  | 9.49               |
| CP3               | 89         | 68      | 43     | 74     | 68.50  | 19.16              |
| CP4               | 95         | 80      | 83     | 74     | 83.00  | 8.83               |
| CP5               | 63         | 71      | 65     | 56     | 63.75  | 6.18               |
| CP6               | 87         | 65      | 67     | 63     | 70.50  | 11.12              |
| CP7               | 56         | 65      | 82     | 67     | 67.50  | 10.79              |
| CP8               | 87         | 73      | 72     | 84     | 79.00  | 7.62               |
| CP9               | 56         | 77      | 76     | 45     | 63.50  | 15.67              |
| CP10              | 43         | 34      | 45     | 43     | 41.25  | 4.92               |

Mean 63.15

Standard deviation 13.9
Assessment of marginal adaptation of lithium disilicate and nanoceramic resin crowns using CAD/CAM system

Table 2 Mean marginal disadaptation of the test specimens (CP) in micrometers obtained from lithium disilicate blocks

| Lithium disilicate | Vestibular | Lingual | Mesial | Distal | Mean | Standard deviation |
|--------------------|------------|---------|--------|--------|------|--------------------|
| CP1                | 90         | 76      | 83     | 64     | 78.25 | 11.09              |
| CP2                | 73         | 66      | 54     | 77     | 67.50 | 10.08              |
| CP3                | 76         | 67      | 73     | 84     | 75.00 | 7.07               |
| CP4                | 56         | 71      | 73     | 79     | 69.75 | 9.78               |
| CP5                | 116        | 98      | 99     | 87     | 100.00| 11.97              |
| CP6                | 89         | 84      | 83     | 88     | 86.00 | 2.94               |
| CP7                | 15         | 116     | 95     | 87     | 78.25 | 43.90              |
| CP8                | 87         | 98      | 78     | 71     | 83.50 | 11.68              |
| CP9                | 77         | 73      | 71     | 69     | 72.50 | 3.42               |
| CP10               | 66         | 56      | 88     | 92     | 75.50 | 17.31              |
| Mean               | 78.63      |         |        |        | 9.42  |                    |

Table 3 Standard deviation per group

| Group             | Mean  | Standard deviation | p-value* |
|-------------------|-------|--------------------|----------|
| Nanoceramic resin | 63.15 | 13.9               |          |
| Lithium Dissilicate| 78.63 | 9.42               | 0.009    |

*Student’s t-test for homogeneous variances

Shapiro Wilk’s test confirmed normal distribution and Levene’s confirmed homogeneity of variances. All statistical tests were conducted on SPSS version 20.0.

Discussion

With the latest technological development, digital solutions have progressively replaced manual processes in all contexts. Dentistry is one of them. New systems and software are routinely being developed and it is up to science to investigate their efficacy. With this in mind, this study aims to contribute to the understanding of CAD/CAM systems application in dentistry.

Restorations with poor marginal adaptation are subjected to cement dissolution and early failure. A marginal disadaptation of more than 120µm show high rate of cement dissolution, thus defining its acceptable limit.1

The use of CAD/CAM technology for the manufacture of indirect restorations has been questioned in terms of its ability to promote good marginal adaptation. Some authors have compared conventional with digital methods.2–3,10–12 Most of these studies failed to find significant differences between the two approaches. However, Colpani et al.,1 found better results using the conventional method of manufacturing of prostheses, and Zarauz et al.1 found the opposite. Nonetheless, both techniques showed satisfactory results. Only a few studies show clinically unacceptable results when using CAD/CAM systems to produce the restorations. One such example is the study by Vojdani et al.,2 that used a combination of conventional and digital methods.

Having established that CAD/CAM systems are capable to promote good marginal adaptation, some studies have engaged in studying the factors influencing the good adaptation of prostheses within the digital workflow.13–15

Some authors (Camargo et al. (2004), Ribeiro et al.,13 Jalali et al.14) found no differences in terms of marginal adaptation when comparing different preparations. On the other hand, Ates & Yesil15 compared shoulder and chamfer finish lines and found better results with the latter. This is the finish line used here.

Some studies compare marginal adaptation of different CAD/CAM systems. They conclude that CAD/CAM systems, software and parameters within given software may interfere in marginal adaptation.15 Hamza et al.16 used the same CAD/CAM system used here and all results were clinically acceptable.

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Some other studies assessed only the system’s milling machine.7 They show significant differences in marginal adaptation depending on the type of milling machines, due mainly to the number of axes and thickness of burs. All the authors used, in at least one group, the same milling machine used here and obtained clinically acceptable results.

This study aimed at comparing the marginal adaptation of different materials. This was already done by some authors, with different methodologies.6,7,10,16–20 There is a consensus among them that different materials present different marginal adaptation results, which is in agreement with the results of the present study.

Marginal adaptation is directly linked to the resistance of the material, which interferes in its machinability. Less resistant materials are less machinable.6,7,20 This is also in agreement with this study’s findings of a marginal adaptation of 63.15µm of the nanoceramic resin group, significantly smaller than the one found for the lithium disilicate group, of 78.63µm. Despite this difference, based on the literature limits, the lithium disilicate group presented an acceptable result.4,5,17,20–23

Conclusion

Based on the results presented here, it is possible to conclude that:

1. Nanoceramic resin crowns present better marginal adaptation than lithium disilicate ones.
2. The materials tested here promote a clinically acceptable marginal adaptation.

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Conflict of interest

The authors declare that there is no conflict of interest.

References

1. Jacobs MS, Windeler AS. An investigation of dental luting cement solubility as a function of the marginal gap. J Prostheth Dent. 1991;65(3):436–442.
2. Trifkovic B, Badak I, Todorovic A, et al. Application of Replica Technique and SEM in Accuracy Measurement of Ceramic Crowns. Measurement Science Review. 2012;12(3):90–97.
3. Colpani JT, Borba M, Della Bona A. Evaluation of marginal and internal fit of ceramic crown copings. Dent Mater. 2013;29(2):174–180.
4. Berrendero S, Salido MP, Valverde A, et al. Influence of conventional and digital intraoral impressions on the fit of CAD/CAM-fabricated all-ceramic crowns. Clin Oral Investig. 2016;20(9):2403–2410.
5. Zarauz C, Valverde A, Martinez-Rus F, et al. Clinical evaluation comparing the fit of all-ceramic crowns obtained from silicone and digital intraoral impressions. Clin Oral Investig. 2016;20(4):799–806.
6. Ruse ND, Sadoun MJ. Resin-composite blocks for dental CAD/CAM applications. J Dent Res. 2014;93(12):1232–1234.
7. Lebon N, Tapie L, Vennut E, et al. Influence of CAD/CAM tool and material on tool wear and roughness of dental prostheses after milling. J Prostheth Dent. 2015;114(2):236–247.
8. Ardekani KT, Ahangari AH, Farahi L. Marginal and internal fit of CAD/CAM and slip-cast made zirconia copings. J Dent Res Dent Clin Dent Prospects. 2012 Spring;6(2):42–48.
9. Vojdani M, Torabi K, Farjood E, et al. Comparison the Marginal and Internal Fit of Metal Copings Cast from Wax Patterns Fabricated by CAD/CAM and Conventional Wax up Techniques. J Dent (Shiraz). 2013;14(3):118–129.
10. Neves FD, Prado CJ, Prudente MS, et al. Micro-computed tomography evaluation of marginal fit of lithium disilicate crowns fabricated by using chairside CAD/CAM systems or the heat-pressing technique. J Prostheth Dent. 2014;112(5):1134–1140.
11. Kim JH, Jeong JH, Lee JH, et al. Fit of lithium disilicate crowns fabricated from conventional and digital impressions assessed with micro-CT. J Prostheth Dent. 2016;116(4):551–557.
12. Memari Y, Mohajerifar M, Armin A, et al. Marginal Adaptation of CAD/ CAM All-Ceramic Crowns Made by Different Impression Methods: A Literature Review. J Prosthodont. 2018;28(2):1–9.
13. Ribeiro VAQ, Sousa RC, Paiva AEM, et al. Evaluation of the marginal fit in copings for full metaloceramic crown with chamfer and beveled shoulder finish line 45°. RFO UPF. 2010;15(3):281–285.
14. Jalali H, Sadighpour L, Mini A, et al. Comparison of Marginal Fit and Fracture Strength of a CAD/CAM Zirconia Crown with Two Preparation Designs. J Dent (Tehran). 2015;12(12):874–81.
15. Ates SM, Yesil Duymus Z. Influence of Tooth Preparation Design on Fitting Accuracy of CAD-CAM Based Restorations. J Esthet Restor Dent. 2016;28(4):238–246.
16. Hamza TA, Ezzat HA, El-Hossary MM, et al. Accuracy of ceramic restorations made with two CAD/CAM systems. J Prosthet Dent. 2013;109(2):83–87.
17. Shim JS, Lee JS, Lee JY, et al. Effect of software version and parameter settings on the marginal and internal adaptation of crown fabricated with the CAD/CAM system. J Prosthet Dent. 2015;114(2):515–522.
18. Della Bona A, Corazza PH, Zhang Y. Characterization of a polymer-infiltrated ceramic-network material. Dent Mater. 2014;30(5):564–569.
19. De Paula Silveira AC, Chaves SB, Hilgert LA, et al. Marginal and internal fit of CAD-CAM-fabricated composite resin and ceramic crowns scanned by 2 intraoral cameras. J Prostheth Dent. 2017;117(3):386–392.
20. Chavali R, Nejat AH, Lawson NC. Machinability of CAD/CAM materials. J Prosthet Dent. 2017;118(2):194–199.
21. Park SH, Yoo YJ, Shin YJ, et al. Marginal and internal fit of nano-composite CAD/CAM restorations. Restor Dent Endod. 2016;41(1):37–43.
22. Bosch G, Ender A, Mehli A. A 3-dimensional accuracy analysis of chairside CAD/CAM milling procedures. J Prostheth Dent. 2014;112(6):1425–1431.
23. Kirsch C, Ender A, Attin T, et al. Trueness of four different milling procedures used in dental CAD/CAM systems. Clin Oral Invest. 2017;21(2):551–558.