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ORIGINAL RESEARCH ARTICLE

Comparison Of Adaptation And Microleakage Of Cad/Cam Restorations To Inlay Cavities Prepared By Using Different Finishing Methods

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Abstract

Purpose: To compare the adaptation and microleakage of CAD/CAM inlay restorations using conventional or ultrasonic finishing equipment and their combinations.
Materials and Methods: Inlay cavities were prepared on 66 extracted human lower first molar teeth using one of the following finishing methods: Group I: straight fissure diamond bur; Group II: fissure diamond bur and ultrasonic tip; Group III: 6° tapered conical diamond bur; Group IV: 6° tapered conical diamond bur and ultrasonic tip. Inlay restorations milled from feldspathic ceramic blocks were cemented with resin cement. Adaptation and microleakage of the restorations were evaluated by micro-CT. The adaptation of the restorations was evaluated in four areas and at five determined points. The differences between the finishing methods were statistically evaluated at each measurement point.
Results: The adaptation of the restorations range from 1.07 and 330.71 µm. Statistical differences were observed in the marginal and internal adaptation of ceramic inlay restorations due to the finishing method used at some points of the ceramic and cavity interface. Group IV exhibited superior adaptation with significantly lower marginal gaps at points A, C, and E compared to Groups I, II, and III (($p<0.05$). However, the microleakage values between the finishing methods did not show a statistical difference ($p>0.05$).
Conclusions: According to the study findings, microleakage of inlay restorations was not affected by the finishing method. However, both marginal and internal adaptation were influenced by the finishing method, with Group IV (conical diamond burs + ultrasonic tip) demonstrating superior results.

Key words: Ceramic Inlays; Microleakage; Ultrasonic Instruments; Inlay Preparation; Micro-CT

Introduction

Developments in dental bonding technology paved the way for the widespread use of indirect adhesive restorations for posterior teeth.[1] The most common indirect adhesive restorations used in the posterior area are inlays, onlays, and overlays.[1,2]

Inlay restorations are indirect restorations that involve occlusal and proximal tooth surfaces.[3] They are known as being more of a conservative restorations compared to complete coverage crowns.[4] The current materials used to fabricate CAD/CAM inlay restorations are glass ceramic and composite resin blocks.[1,4] Ceramic restorations provide high clinical success, good esthetics, and natural tooth morphology.[5] A higher success rate is reported for ceramic inlays than composite resin inlays.[4,6] They show better physical properties and lower polymerization shrinkage than composite resins.[7] Ceramic inlays are also known to demonstrate higher wear resistance and compressive force.[1,8,9]

Many variables affect the longevity of ceramic inlay restorations, such as the quality of the remaining tooth structure to which the restoration is bonded, oral hygiene, and applied load.[7] The clinician can control the tooth preparation design, choice of the restoration material, and bonding method used.[7] The factors associated with preparation design that could affect the longevity of the inlay/tooth

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complex are; cavity depth, preparation taper, cavity/isthmus width, and the morphology of internal line angles. [10]

Poor marginal adaptation of the restoration can result in microleakage, luting cement dissolution, the formation of secondary caries, and gingival inflammation. [4,11,12] Poor internal adaptation can reduce retention, increase cement thickness, alter occlusion, and lead to exchanged marginal adaptation. [4] With the developments in CAD/CAM systems, the internal and marginal adaptation of the milled restorations is improving. [7]

The preparation design of inlay restorations must be compatible with the specific properties of the ceramic material used. [10] The brittle structure of ceramics is a limiting factor; however, this limitation could be minimized through proper preparation design. [7] Avoiding internal stress concentration, providing adequate restoration thickness, and creating a passive insertion axis are essential for ceramic inlay tooth preparation. [3] The retention form is not needed for ceramic inlays as long as the restoration is bonded. The formation of bevels should be avoided since it reduces ceramic thickness. [3,7]

Additionally, the equipment used for the preparation process can affect the cavity geometry and the marginal and internal adaptation between the cavity and ceramic restoration. In inlay restorations where the preparation surface is very important, the choice of preparation instruments should also be made carefully. As an alternative to conventional preparation, different hand, rotary, and oscillating (ultrasonic) instruments have been developed to improve the preparation surface. [13] Rotary instruments work with rotational movements. Rotary instruments have a short working time, thus increasing patient comfort and efficiency for dentists. However, they cause the preparation surface to be rougher. On the other hand, ultrasonic instruments work with oscillatory movements and providing a smooth finishing line. [14]

Ultrasonic instruments are widely used in dentistry due to their operative ease, better efficiency, precise cutting ability, visualization, and success in accessing difficult areas at the margin of preparation. [15] There are studies indicating that preparation with ultrasonic instruments provides less surface roughness than rotary instruments. [16] Although there was a difference in surface roughness between rotary and ultrasonic preparation, some studies have also shown that this did not result in differences in microleakage or gaps between the restoration and tooth. [17]

The clinical significance of this research is that restoration fit is one of the most vital determinants of survival in the oral environment. Different cavity preparation techniques could influence the adaptation and microleakage of inlay restorations. This study aims to compare the effects of four different preparation finishing methods (straight diamond bur, straight fissure diamond bur, ultrasonic and ultrasonic tip, 6º tapered conical diamond bur, 6º tapered conical diamond bur, and ultrasonic tip) on the marginal and internal adaptation and microleakage of ceramic inlay restorations. The null hypotheses are: (H1) the use of a straight fissure diamond bur or a 6º tapered conical diamond bur would not bring about any difference in the restoration adaptation and microleakage of ceramic inlays, and (H2) finishing the proximal margins with an ultrasonic tip would not improve the adaptation and microleakage of the ceramic inlays.

Material and Methods

Preparation of the Specimens

A total of 66 extracted caries-free human lower first molar teeth were collected for this study. Based on calculations using a type I error rate (α) of 0.05, effect size (f) of 0.4, and test power (1-β) of 0.80, the sample size necessary to achieve a test power of 0.80 was determined to be 66. Teeth collection was approved by the Ethical Committee of Ankara University Faculty of Dentistry (22.07.2020 Date, 08/6 Issue). The utilization of extracted teeth in this study aimed to assess adhesive bonding under conditions that closely simulate real-world clinical scenarios. The teeth were randomly divided into four groups (n=14) and embedded in plaster up to the level of the collar for easy and precise inlay preparation.

The inlay cavities were prepared according to specific criteria for standardization. The following geometrical parameters for the inlay cavity were kept: 1.5 mm axial depth, 2 mm occlusal depth, 1 mm rounded shoulder margin in the axio-gingival angle, and a 12-degree tapered angle. To ensure standardization of the preparations, all inlay cavities were prepared by the same operator using different instruments for each group. The groups are as follows: The specimens in Group I underwent cavity preparation using a straight fissure diamond bur (Intensiv 8526). The specimens in Group II were prepared using a combination of fissure diamond bur (Intensiv 8526) and ultrasonic tip (SONICflex CAD-CAM mesial Nr. 34 Ref: 1.002.1984, Katenbach & Voigt GmbH (KaVo), Biberach, Germany). Group III specimens were prepared using 6º tapered conical diamond burs (Intensiv 3026SLC, Intensiv 3029SEC). Lastly, the specimens in Group IV were prepared using both 6º tapered conical diamond burs (Intensiv 3026SLC, Intensiv 3029SEC) and ultrasonic tips (SONICflex CAD-CAM mesial Nr. 34 Ref: 1.002.1984, Katenbach & Voigt GmbH (KaVo), Biberach, Germany).

The digital impressions of the inlay cavities were obtained with an intraoral scanner (Cerec Omnicam system, Sirona Dental Systems GmbH, Bensheim, Germany). Inlay restorations for each preparation were designed using the CAD program (Cerec CAD System Sirona Dental Systems GmbH, Bensheim, Germany). Both the scanning and designing procedures were performed by the same clinician. Sixty-six ceramic inlay restorations were milled from feldspathic ceramic blocks using the CEREC InLab MC XL (Sirona Dental Systems) and CEREC Blocs (Sirona Dental Systems GmbH, Bensheim, Germany). The fit of the inlay restorations before cementation was visually checked; reproduction was performed for incompatible restorations.

The ceramic inlay restorations were cemented onto the prepared teeth using resin cement (Panavia SA Cement Plus A2 Automix, Kuraray Noritake Dental Inc., Okayama, Japan, Lot: 1N0298). The cavity surfaces were etched with 37% phosphoric acid (i-GEL, i-dental, Šiauliai, Lithuania, Lot: 050154), while the cementation surfaces of the ceramic inlay restorations were treated with 4% buffered hydrofluoric acid gel (Porcelain Etchant Gel, Bisco Inc., USA). The restorations were then adapted using SONICflex CEM (KaVo, Biberach, Germany).

Micro-CT Analyses

For micro-CT analyses, a high-resolution scanning device, the Skyscan 1275 (Skycan, Kontich, Belgium), was used. The scanning parameters were set to a 0.2 rotation step, 125 kVp, 80 mA, and a 24 μm pixel size. To prevent radiological artifacts during scanning, a 1-mm thick aluminum filter was used. Each scanned specimen was reconstructed separately using NRecon software (version 1.6.4.8 Skycan, Kontich, Belgium). The software was also used to correct other radiological artifacts that may have occurred during the scanning. The two-dimensional axial projections of the reconstructed samples were obtained and then transferred to CTan software (version 1.14.4.1 Skycan, Kontich, Belgium) for quantitative analysis.

Linear Measurements

The Dataviewer software (version 1.5.6.2, Skycan, Kontich, Belgium) was used for two-dimensional measurements. Axially reconstructed images were examined in coronal planes using this software, and mid-coronal section images were obtained for the samples. These images were then imported into the CTan software, where two-dimensional linear measurements were performed to evaluate both the marginal and internal fit of the restorations. For

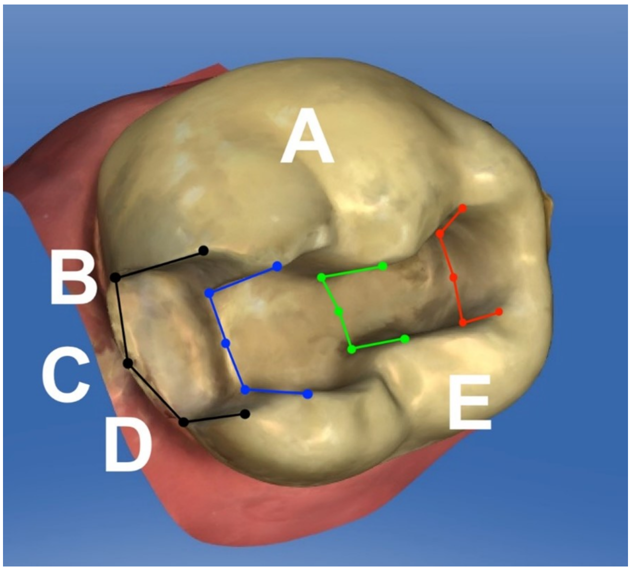

Figure 1. Measurement points. Black: Gingival circumferential tie margin and proximal flare margin, Blue: Isthmus, Green: Middle area of the occlusal box cavity, and Red: Occlusal box margin finish area. A: Buccal, B: Bucco-occlusal, C: Occlusal, D: Linguo-occlusal, E: Lingual.

the all-ceramic inlay preparations, five reference measurement points were used to determine the gap in micrometers for each localization (Fig. 1). These reference points were determined by modifying the measurement points used in the study by Ekici et al.[18] Each measurement point is described as follows:

- A: Buccal cavity margin
- B: Buccal intersection between cavity wall and floor
- C: Midpoint of the cavity preparation floor
- D: Lingual intersection between cavity wall and floor
- E: Lingual cavity margin

Volumetric Measurements

After the aging procedures, the inlay restorations were coated with two layers of nail varnish, except for a 1 mm thick area around the restoration margin and allowed to dry for 10 minutes. Next, all the restorations were immersed in a freshly prepared aqueous solution of 50 wt% ammoniacal silver nitrate (pH value = 9.5) for 24 hours (50% $AgNO_3$, Sinopharm, Beijing, China). They were then rinsed with running water for 2 minutes, immersed in a photo-developing solution (RPXOMAT, Kodak China, Shanghai, China), and exposed to light for 8 hours. Afterward, each specimen was ultrasonically cleaned for 1 minute with a toothbrush to eliminate any silver deposits on the surface. Each restoration was then individually scanned using micro-CT after being placed and fixed into the specimen holder.

Statistical analysis

The obtained data were analyzed using the IBM SPSS Statistics V25 software package (SPSS Inc, Chicago, IL, USA). Hypothesis tests were conducted at a significance level of α=0.05. One-way analysis of variance (ANOVA) was used to statistically compare the data, and the least significant difference (LSD) comparison test was used for inhomogeneous values and multiple comparisons of the averages.

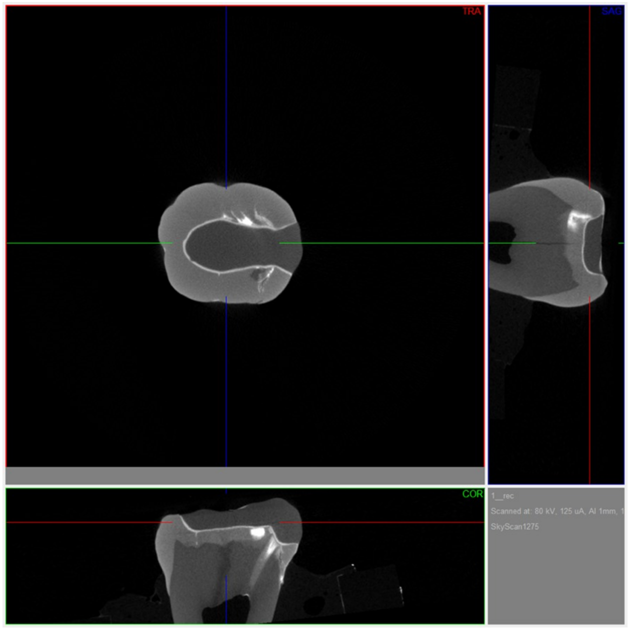

Figure 2. The two-dimensional image(Micro-CT Scans)

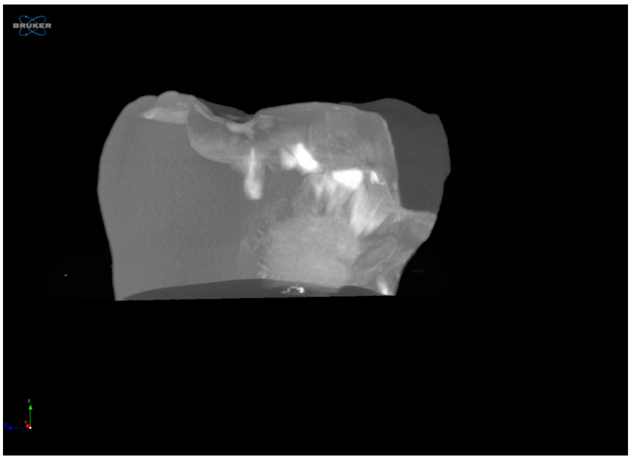

Figure 3. The three-dimensional image(Micro-CT Scans)

Results

The two-dimensional and three-dimensional micro CT images are shown in Fig. 2 and Fig. 3. Statistical comparisons of marginal or internal adaptation for each group are presented in Table 1,2,3 and 4. The statistical evaluation of marginal gap values at the circumferential gingival margin and proximal flare margin is as follows (Table 1). In the tables, groups sharing the same superscript letters do not exhibit statistically significant differences, whereas groups with different superscript letters show statistically significant differences. The marginal gap exhibited similar results across all groups at B, D, and E points ($p>0.05$); Group IV (205.52±23 µm) demonstrated a lower marginal gap compared to Group I (224.64±19 µm) and II (223.64±15 µm) at point A; and Group IV (1.64±3.97 µm) exhibited a lower marginal gap compared to Group I (6.36±7.01 µm) at point C ($p<0.05$).

The table 2 shows the fit of the isthmus (in µm) across five different regions (A, B, C, D, E) for four groups (Group I, II, III, IV) (Table 2). Each region presents mean (Mean), standard deviation (SD), and median (Median) values. In the tables, groups sharing the same superscript letters do not exhibit statistically significant differences, whereas groups with different superscript letters show

Table 1. Fit of gingival circumferential tie margin and proximal flare margin (μm)

	Group I		Group II		Group III		Group IV	
	Mean±SD^X	Median	Mean±SD^X	Median	Mean±SD^X	Median	Mean±SD^X	Median
A	224.64±19.47a	230.50	223.64±15.43a	226.50	209.86±23.66a,b	210.50	205.57±23.98b	199.00
B	192.57±17.34a	193.00	190.57±16.27a	191.50	190.36±19.10a	195.50	184.50±17.73a	184.00
C	6.36±7.01a	4.50	4.86±5.61a,b	4.00	4.64±4.27a,b	4.00	1.64±3.97b	0.00
D	156.50±12.09a	154.50	154.50±17.72a	154.50	149.86±10.26a	148.50	148.93±14.20a	148.00
E	123.57±17.26a	123.00	123.43±20.68a	118.50	117.57±17.13a	117.00	115.71±20.66a	114.00

Groups with the same superscript letters did not exhibit a statistical significance. Different superscript letters exhibit a statistical significance. The significance level is set at p=0.05. A: Buccal cavity margin B: Buccal intersection between cavity wall and floor C: Midpoint of the cavity preparation floor D: Lingual intersection between cavity wall and floor E: Lingual cavity margin * Each line was statistically compared within itself.

Table 2. Fit of Isthmus (μm)

	Group I		Group II		Group III		Group IV	
	Mean±SD^X	Median	Mean±SD^X	Median	Mean±SD^X	Median	Mean±SD^X	Median
A	330.71±30.38a	324.50	325.79±25.88a	328.50	317.86±28.72a	324.00	315.14±17.88a	318.50
B	177.14±16.34a	178.00	170.71±15.25a	168.50	169.79±16.55a	173.50	168.00±16.40a	163.00
C	5.00±5.50a	4.50	2.50±3.61a,b	0.00	2.86±3.57a,b	1.00	1.07±2.56b	0.00
D	163.50±22.51a	166.00	150.29±22.07a,b	151.50	147.50±18.63a,b	157.50	139.57±24.60b	145.00
E	120.36±8.45a	122.50	117.57±9.87a	120.00	117.36±11.72a	118.50	115.14±9.77a	115.00

Groups with the same superscript letters did not exhibit a statistical significance. Different superscript letters exhibit a statistical significance. The significance level is set at p=0.05. A: Buccal cavity margin B: Buccal intersection between cavity wall and floor C: Midpoint of the cavity preparation floor D: Lingual intersection between cavity wall and floor E: Lingual cavity margin * Each line was statistically compared within itself.

statistically significant differences. Group IV demonstrated a lower marginal gap compared to Group I at C (Group IV (1.07±2.56 μm; Group I (5.00±5.50 μm), and D (Group I: 163.50±22.51 μm, Group IV: 139.57±24.60 μm) points C ($p<0.05$). Other regions (A, B, E) did not exhibit statistically significant differences among the groups ($p>0.05$).

Table 3 presents the fit of the middle area of the occlusal box cavity (in μm) across four different groups (Group I, Group II, Group III, Group IV). Mean and standard deviation (SD) values, along with medians, are provided for each group. Comparisons between groups are indicated by the same superscript letters, indicating no statistical significance, while different superscript letters denote statistically significant differences (Table 3). Marginal gap displayed similar results across all groups at B, C, D, and E points ($p>0.05$); Group IV (186.93±14.54 μm) demonstrated a lower marginal gap compared to Group I (200.50±14.05 μm) at point A ($p<0.05$).

Table 4 presents the fit of the occlusal box margin finish area (in μm) among four distinct groups (Group I, Group II, Group III, Group IV). For each group, mean values with standard deviations (SD) and medians are provided. Comparisons between groups are indicated by the same superscript letters; identical letters denote no statistical significance, whereas different letters indicate statistically significant differences (Table 4). The marginal gap displayed similar results across all groups at A, C, and D points ($p>0.05$); Group IV (229.71±17.07 μm) demonstrated a lower marginal gap compared to Group I (245.93±15.59 μm) and III (244.36±20.76 μm) at point B; Group IV (103.79±7.95 μm) exhibited a lower marginal gap compared to Group I (109.93±7.20 μm) at point E ($p<0.05$).

Table 5 presents the volumetric microleakage of ceramic inlay restorations (in mm3) for four different groups (Group I, Group II, Group III, Group IV). Mean values with standard deviations (SD) and medians are provided for each group (Table 5). Statistical comparisons of the mean microleakage values among the groups revealed similar results ($p>0.05$).

Discussion

The null hypotheses of the study were partially confirmed. Micro-CT evaluation indicated that there was a statistical difference in the marginal and internal adaptation of ceramic inlay restorations due to the finishing method used at some points of the ceramic and cavity interface. However, this difference did not affect the microleakage of the restorations. Inlay/onlay restorations have a more complex geometry than crown restorations, which could explain variations in the adaptation of the restoration in some areas.[4]

The conventional method for determining microleakage is to evaluate the penetration of a specific tracer, such as organic dyes or silver nitrate (AgNO3), microscopically on sectioned specimens. AgNO3 is an electron-dense and radiopaque material that can be used with correlated microscopy techniques, such as scanning or transmission electron microscopy. Additionally, AgNO3 can be used with X-ray microcomputed tomography (micro-CT). However, a disadvantage of conventional microleakage tests is that the three-dimensional microleakage factor is assessed in only two dimensions. Furthermore, these tests are invasive, and the results are semiquantitative.[19]

In recent years, micro-CT has increasingly been used to evaluate the adaptation of restorations. Although it is more expensive than conventional methods, micro-CT is a non-destructive and reproducible technique.[20] It can achieve potential resolutions in the submicron range, depending on the computer's hardware capabilities and X-ray source characteristics.[19] Its superior feature compared to other methods is that it provides quantitative analysis and examination of the internal space of the restoration.[20,21] Furthermore, it is possible to perform multiple point measurements using the micro-CT method.[4,22]

The marginal seal is a crucial factor for the longevity of a restoration.[23,24] Several factors, such as restoration type, preparation design, restoration material, and cementation procedure, can affect the adaptation of the restoration. Poor marginal adaptation can result in luting cement degradation, microleakage, caries, periodontal disease, and marginal discoloration.[22] For ceramic inlay restorations, uniform internal adaptation is desired, and poor adaptation of the restoration can result in the cement being supported by the primer instead of the tooth structure.[21] Poor internal adaptation can increase cement thickness, reduce retention and restoration resistance, affect occlusion, and lead to poor marginal adaptation.[4]

There is no consensus on the marginal and internal gap for fixed restorations.[4,24] Some studies report an acceptable marginal range for adaptation as lower than 120 μm[4,11,25,26], while others report it as lower than 100 μm.[4,21,27,28] The acceptable marginal gap for CAD/CAM restorations is reportedly 58–200 μm.[21] Cement thickness below 200 μm is more resistant to wear at restoration

Table 3. The fit of the middle area of the occlusal box cavity (μm)

	Group I		Group II		Group III		Group IV	
	Mean±SD^X	Median	Mean±SD^X	Median	Mean±SD^X	Median	Mean±SD^X	Median
A	200.50±14.05a	200.00	197.50±19.10a,b	200.50	194.93±16.41a,b	199.00	186.93±14.54b	187.00
B	247.43±18.39a	242.50	245.64±17.53a	246.00	239.07±19.64a	237.50	234.57±12.52a	237.00
C	54.29±7.75a	56.00	53.14±5.48a	54.00	53.50±5.88a	54.50	52.57±5.15a	54.00
D	194.93±8.86a	195.50	192.57±12.83a	192.00	190.14±10.86a	190.00	188.79±10.71a	188.00
E	163.07±8.82a	163.00	162.21±11.83a	163.00	157.86±9.03a	157.00	157.50±10.68a	160.50

Groups with the same superscript letters did not exhibit a statistical significance. Different superscript letters exhibit a statistical significance. The significance level is set at p=0.05. A: Buccal cavity margin B: Buccal intersection between cavity wall and floor C: Midpoint of the cavity preparation floor D: Lingual intersection between cavity wall and floor E: Lingual cavity margin * Each line was statistically compared within itself.

Table 4. Fit of the occlusal box margin finish area (μm)

	Group I		Group II		Group III		Group IV	
	Mean±SD^X	Median	Mean±SD^X	Median	Mean±SD^X	Median	Mean±SD^X	Median
A	296.00±29.36a	289.50	292.71±19.39a	294.50	290.43±24.71a	295.50	283.86±28.36a	290.50
B	245.93±15.59a	244.00	235.43±15.67a,b	237.50	244.36±20.76a	238.00	229.71±17.07b	229.00
C	164.50±9.35a	161.50	163.43±9.70a	165.00	163.64±13.18a	161.00	161.79±12.88a	163.00
D	247.29±23.79a	249.00	245.64±24.25a	242.50	240.21±26.19a	243.00	230.79±14.99a	235.00
E	109.93±7.20a	109.00	105.50±8.87a,b	105.50	105.07±4.76a,b	104.00	103.79±7.95b	105.50

Groups with the same superscript letters did not exhibit a statistical significance. Different superscript letters exhibit a statistical significance. The significance level is set at p=0.05. A: Buccal cavity margin B: Buccal intersection between cavity wall and floor C: Midpoint of the cavity preparation floor D: Lingual intersection between cavity wall and floor E: Lingual cavity margin * Each line was statistically compared within itself.

Table 5. Volumetric microleakage of the ceramic inlay restorations (mm3)

	Mean±SD^a	Median
Group I	2.44±1.24a	2.90
Group II	2.38±0.91a	2.18
Group III	2.21±1.05a	2.22
Group IV	2.11±0.75a	2.27

*The mean difference is significant at the 0.05 level.

margins.[24]

In this study, marginal and internal gap values exceeded the acceptable values at some points. This could be due to several factors, such as the restoration material used, the sensitivity of the milling device, restoration adjustments after fabrication, and the cementation procedure used, among others. Increased internal space of the restoration can result in higher polymerization shrinkage of the luting cement and poor support of the restoration.[22]

The longevity of dental restorations is influenced by key factors such as restoration geometry, preparation methods, and loading conditions. Various instrumental methods for cavity preparation are available, including conventional rotating, sonic, ultrasonic, or laser methods. However, rotating instruments seem to cause more damage to the teeth.[29] Ultrasonic instruments have a vibrating motion, which makes them more effective and easier to use than conventional rotating instruments.[17] They are especially useful for beveling the enamel and dentin margins in difficult areas and can provide extremely precise finishing lines, which allows for better impressions and more adapted restorations with less microleakage.[30] Sonic and ultrasonic instruments have grainless tips, reducing the risk of damaging neighboring teeth and causing minimal trauma to the gingival attachment and pulp.[17,29] However, they can lead to more surface irregularities and border defects and can also cause iatrogenic damage to neighboring teeth.[17] Özcan et al.[31] reported acceptable marginal quality using ultrasonic tips and ceramic inserts.

CAD/CAM inlay restorations are vulnerable to imperfect preparation geometry.[30] Kim et al.[22] reported that the preparation design affects the adaptation of indirect partial ceramic crowns. It has been reported that a non-retentive cavity preparation exhibits higher adaptation than a retentive cavity preparation.[4] However, another study found similar marginal adaptation between minimally invasive cavity preparations with proximal undercuts and conventional divergent preparations.[32] Additionally, a study found that higher margin positioning results in less interfacial gap volume.[30]

Naumova et al.[17] evaluated the effect of different preparation methods (rotating, sonic, and ultrasonic) on the marginal quality of ceramic inlays using scanning electron microscopy (SEM). They reported that ultrasonic instruments led to increased surface roughness compared to rotating instruments. They also found no statistically significant differences between the groups' proximal microleakage, proximal marginal gap, and proximal margin quality. In this study, the microleakage values between the groups were similar; however, marginal gap values showed statistical differences at some points. This difference could be explained by the use of micro-CT analysis in this study instead of SEM.

Ellis et al.[29] compared two ultrasonic finishing protocols on the quality of the preparation margins and reported that the ultrasonic finishing protocol affected the results. However, in this study, only one type of ultrasonic finishing protocol was used, which is one of the study's limitations.

It has been reported that the marginal and internal adaptation of CAD/CAM restorations is affected by the type of restorative material used.[4,23] Restorative materials with a low elastic modulus and hardness can result in the removal of a greater amount of material during grinding.[4,33] However, less brittle materials are reported to show lower edge chipping, better machinability, and adaptation.[4,23,34] This study used only one type of restorative material, which can be considered a limitation. Studies including several types of materials are needed for more accurate results.

Conclusion

Within the limitations of this study, it can be concluded that using a special tapered bur and ultrasonic tip together for preparation provides better adaptation for inlay restorations. Furthermore, the tapered bur is more efficient than the straight bur and ultrasonic tip regarding preparation fit. However, recent literature on this topic is limited, and further studies are needed to validate these findings.

Author Contributions

Conceive and Design : A.S. , M.A.K.
Complete the Experiment : E.S. , M.C.T. , M.O , I.B.B
Write and Review : A.S. , M.C.T. , M.O.
Editing : M.A.K. , I.B.B.
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Conflict of Interest

None.

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