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Research article

Examination of the effect of aging process on marginal fit and fractute strength of temporary crowns prepared from different materials

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ABSTRACT

Aim: The aim of this study is to investigate the effect of the aging process on the marginal fit and fracture resistance of temporary crowns prepared using different materials.
Materials and method: The steel die to represent the maxillary first premolar used in this study was produced on a CNC turning machine to include an anatomical occlusal surface. A total of 160 epoxy resin dies were obtained by taking impressions with conventional impression methods on the metal die. Epoxy resin dies were randomly divided into four groups. Temporary crowns were prepared for each group from poly acrylic resin (Vita CADTemp®), bis-acryl composite resin (Protemp 4), poly methyl methacrylate (PMMA; Imident) and poly ethyl methacrylate (PEMA; Dentalon Plus) restorative materials. Half of the specimens (n = 20) in each group (n = 40) were randomly separated and the aging process was applied 5000 times in the device. Marginal gap measurements on epoxy resin dies were made using a stereomicroscope. The fracture strength test of the specimens was performed by using the Instron Universal Test Device. Jamovi 2.2.5 statistical program was used for statistical analysis.
Results: When compared to temporary crowns prepared from all other materials, poly acrylic resin (Vita CADTemp ®) temporary crowns observed significantly lower marginal gap values (59,05 μm) regardless of the aging process, and a significantly higher fracture resistance (478,44 N) in the presence of aging process ($p < .05$ for each). While the highest marginal gap value was detected in PMMA (Imident) (120.36 μm) temporary crowns with aging process, the lowest marginal gap value was observed in poly acrylic resin (Vita CADTemp®) (59.05 μm) crowns without non-aging process. The marginal fit and fracture resistance of all temporary crowns were negatively affected by the aging process.
Conclusion: Our findings revealed the superiority of poly acrylic resin (Vita CADTemp®) crowns to the temporary crowns prepared from all other materials in terms of the significantly lower marginal gap in the absence of aging process, and the significantly higher fracture resistance in the presence of aging process. Marginal fit and fracture resistance values for all materials were found to be within clinically acceptable limits.

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1. Introduction

Temporary restorations refer to short- or long-term intermediate stage placements applied during the fabrication process of the fixed prosthetic treatments (crowns or bridges), from the tooth preparation to the placement of permanent indirect restorations [1,2].

Temporary restorations are used for multiple purposes such as the maintenance of oral functions, phonation and aesthetics until the fabrication and placement of definitive fixed prostheses, as well as the recreation of the occlusal relationship, and the changing the gingival contour or localization before prosthetic treatments where vertical dimension change is planned [3,4].

Temporary restorations with a good marginal fit help to provide the continuity of gingival tissues and to accelerate the healing of gingival tissues damaged during tooth preparation [5,6].

Although none is considered an ideal temporary restoration material suitable for all clinical procedures, there are many materials that largely supply the temporary crown-bridge requirement. Selection should be made considering the mechanical and physical properties of the fixed temporary restoration material [7].

Ideally, the temporary prosthesis should be able to protect the pulp from thermal changes and to have a low exothermic reaction during hardening [8,9].

CAD/CAM temporary materials are prefabricated from the industrially polymerized blocks under optimum conditions enabling homogeneous and standard quality restorations, which prevents the heat of polymerization and shrinkage as well as the porosity formation [10–14].

Marginal fit is considered one of the main determining criteria in assessment of the quality and clinical success of restorations. Presence of a good marginal fit is of critical importance in achieving the long-term clinical success of restorations, the integrity of dental and periodontal tissues, the fracture resistance of the restorations and the survival of the adhesive cement [15].

There are different methods for assessing the marginal gap of a restoration in the clinic, such as probing, radiographic examination with bite-wing films, and use of an impression material according to the Cardash method. In in vitro studies, the edge compliance of restorations can be examined under electron microscopy and stereomicroscope [16].

This study aimed to compare the marginal fit and fracture resistance properties of the crowns prepared using different temporary restorative materials and the impact of aging process on these properties. The null hypothesis tested was twofold: the CAD/CAM temporary crowns will have a better marginal fit and fracture resistance than the counterparts (H0 hypothesis) and marginal fit and fracture resistance will be negatively affected by the aging process (hypothesis H1).

2. Material and method

A total of 160 temporary crowns, in four groups (n = 40 for each) based on the type of material used in their preparation, including those prepared from poly acrylic resin (Vita CADTemp®)($(C_3H_4O_2)_n$), from bis-acryl composite resin (Protemp 4) ($C_{19}H_{20}O_6$), from poly methyl methacrylate (PMMA; Imident)($[CH_2C(CH_3)(CO_2CH_3)]_n$) and from poly ethyl methacrylate (PEMA; Dentalon Plus)($[CH_2C(CH_3)(CO_2C_2H_5)]_n$)were evaluated in terms of their marginal fit and fracture resistance properties.

The dies representing the prepared maxillary first premolar tooth, through which samples would be obtained, were prepared on a C turning machine (Space Turn LB2000, Okuma Corp, Japan) with 5 mm crown length and 6° taper angle with 1 mm chamfer finish line with anatomical occlusal surface in order to ensure standardization (Fig. 1).

The impressions were taken from the prepared metal die by the same researcher using double mixing impression technique and silicone based impression material (Elite HD + Heavy Body and Elite HD + Light Body; Zhermack, Italy), and 160 epoxy dies were obtained from epoxy resin (Armor Chemical, AC520, Istanbul) using a precision balance in accordance with the recommendations of the manufacturer (resin and hardener components are 5:2 by weight).

The numbered dies were randomly divided into four groups (n = 40) and temporary crowns were obtained using four different materials (Table 1).

The epoxy resin dies obtained during the preparation of poly acrylic temporary crowns were scanned with a laboratory scanner (Shinning ds200+). From the scanned data, an anatomical maxillary first premolar temporary crown restoration was designed in the Exocad 3.0 Galway design program, with a material thickness of 1.5 mm on the occlusal surface and 1 mm on other surfaces (buccal,

Fig. 1. Steel die used in the study.

lingual, mesial, distal) (Fig. 2).

Among the designed temporary crown restorations, 40 maxillary first premolar temporary crowns were prepared by milling from poly acrylic resin block (Vita CADTemp®) in the Yena d15 milling unit (Yenadent, Istanbul, Turkey). Compatibility of the obtained temporary crowns on epoxy resin dies was checked. Inappropriate temporary crowns were reproduced. While temporary crowns were produced from Poly methyl methacrylate, Poly ethyl methacrylate, Bis-acryl composite resin, measurements were taken with a silicone-based impression material placed on one of the temporary crown restorations produced by CAD/CAM method to enable the same dimensions in these crowns with those prepared with the CAD/CAM method. The silicone index model was obtained from the measurements taken from the temporary crowns prepared with the CAD/CAM method (Fig. 3). Conventional temporary crowns were made using this silicone index.

In accordance with the manufacturer's recommendations; poly methyl methacrylate (PMMA), poly ethyl methacrylate (PEMA) and bis-composite resin was placed in the obtained silicone index and 40 temporary crowns were prepared for each group. All of the crowns ($n = 160$) prepared from four different temporary restorative crowns were cemented by applying finger pressure with temporary cement (Temp-Bond™ NE, Kerr, Salerno, Italy) prepared in accordance with the manufacturer's recommendations. After the cement hardened, the overflowing parts were carefully cleaned. All cemented temporary crowns were kept in distilled water at 37 °C for 24 h. Then, aging process (5000 times) was applied to the half ($n = 20$) of the temporary crowns randomly selected in each group ($n = 40$), while the remaining crowns in each group ($n = 20$) did not undergo aging process ($n = 20$).

In order to keep the samples in the same position during the evaluation of their marginal fit, a carrier was prepared from auto-polymerized acrylic resin (Fig. 4).

The marginal gap of the crowns placed in the mechanism prepared from autopolymerized acrylic resin was made by rotating the samples clockwise from the regions where the guide points were located, and 20 measurements for each sample were made using a stereomicroscope (Carl Zeiss AG, Oberkochen, Germany) under ×40 magnification(Fig. 5). All measurements were calculated in micrometers (μm). The average of the measurements for each crown was then taken and recorded as the marginal gap value of the relevant sample.

Evaluation of fracture resistance was performed using Instron Universal tester (Instron Corp, USA) (Fig. 6). Temporary crowns were placed at a right angle on the tray designed to remain immobile during force application. Speed of Instron header was set at 1.5 mm/min and force was applied to the palatal tubercle of the crowns in a continuously increasing manner until the first fracture occurred. The data obtained were recorded in Newton (N) to the device's own software and data were statistically analyzed using Jamovi 2,2,5 statistical program (Sydney, Australia).

The Kolmogorov-Smirnov test and the Q-Q plot were used to evaluate the conformity of the variables to the normal distribution. A normal distribution was observed in both the marginal fit and fracture resistance dependent variables. Covariance analysis was performed to determine the relationship between normally distributed variables. Tukey's multiple comparison test was used for multiple comparisons. $p < .05$ was considered statistically significant.

3. Results

3.1. Marginal gap values

The Q-Q plot showing the distribution of marginal gap gave a straight line (Fig. 7). In addition, marginal gap values were considered to be normally distributed (Kolmogorov-Smirnov test, $p = .063$).

The covariance analysis for marginal gap measurements revealed significance for the materials used and the aging process ($p < 0.001$ for each), while the material-aging process interaction was not significant ($p = .58$) (Table 2).

Comparison of marginal gap values between four types temporary crowns prepared with non-aging process revealed the association of the poly acrylic resin (Vita CADTemp®) temporary crowns prepared by CAD/CAM method with the best marginal gap values compared to the crowns prepared by other materials ($p < 0.001$). The marginal gap values were als significantly better for the bisacryl composite resin (Protemp 4) temporary crowns compared to the poly methyl methacrylate (Imident) crowns (Fig. 8, Table 3).

3.2. Impact of aging process on marginal gap - overall

Regardless of the used materials, temporary crowns with aging process showed significantly ($p < 0.001$) higher marginal gap values than temporary crowns without aging process (Fig. 9, Table 4).

Table 1
Temporary crown materials used in the study.

Material Type	Trade Name	Manufacturer
Poly acrylic resin	Vita CADTemp®	Vita Zahnfabrik, Germany
Bis-acryl composite resin	Protemp 4	3 M ESPE, Neuss, Germany
Poly methyl methacrylate (PMMA)	Imident	Imicryl, Konya, Turkey
Poly ethyl methacrylate (PEMA)	Dentalon Plus	Heraeus Kulzer, Hanau, Germany

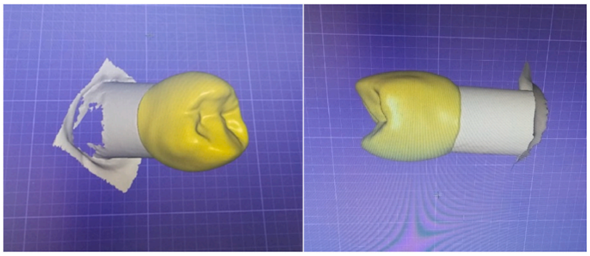

Fig. 2. The designed crown.

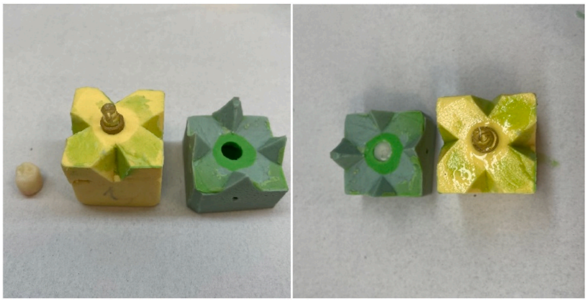

Fig. 3. Silicone index obtained from temporary crowns prepared by CAD-CAM method.

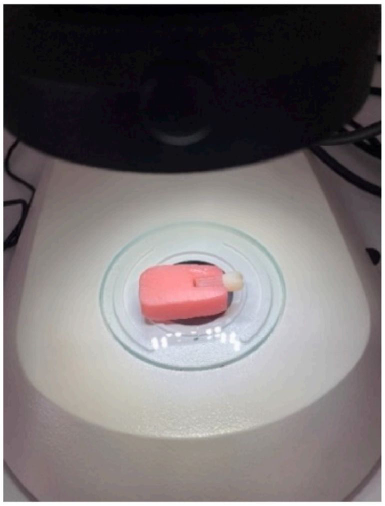

Fig. 4. Carrier mechanism prepared from autopolymerized acrylic resin.

3.3. Impact of aging process on marginal gap - by types of temporary crowns

In the absence of aging process, the marginal gap values were significantly lower in the poly acrylic resin (Vita CADTemp®) group (59.05 ± 6.86 μm) compared to other three groups of temporary crowns including bis-acryl composite resin (Protemp 4; 86.79 ± 10.04 μm), poly methyl methacrylate (Imident; 96.21 ± 11.16 μm) and poly ethyl methacrylate (Dentalon Plus; 93.68 ± 11.78 μm) ($p < 0.05$ for each) (Table 5).

In the presence of aging process, the marginal gap values were significantly lower in the poly acrylic resin (Vita CADTemp®) group (89.23 ± 12.47 μm) compared to other three groups of temporary crowns including bis-acryl composite resin (Protemp 4; 112.60 ± 13.02 μm), poly methyl methacrylate (Imident; 120.36 ± 14.13 μm) and poly ethyl methacrylate (Dentalon Plus; 116.82 ± 15.45 μm) ($p < 0.05$ for each) (Table 5).

While the maximum marginal gap value (120.36 μm) was observed in the aged poly methyl methacrylate (Imident) temporary crowns, the least marginal gap value (59.05 μm) was detected in non-aged poly acrylic resin (Vita CADTemp®) temporary crowns

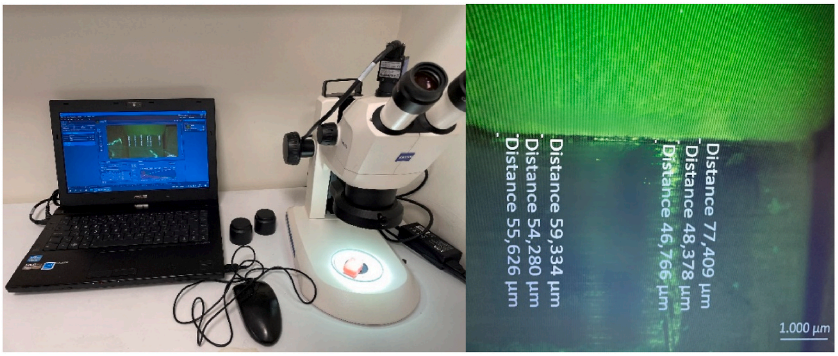

Fig. 5. Stereomicroscope to measure marginal gap.

Fig. 6. Instron Universal tester.

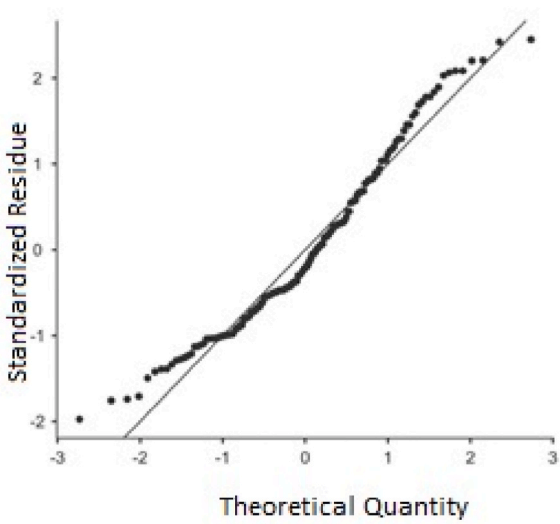

Fig. 7. Q-Q plot showing the distribution of marginal gap values.

prepared by CAD/CAM method (Table 5).

For each type of temporary crown, marginal gap values obtained without application of aging process were significantly lower than those obtained in the setting of aging process ($p < 0.001$ for each) (Table 5, Fig. 10).

Table 2
Covariance analysis results of marginal gap values.

	Sum of squares	df	Mean of squares	F	p value
Material	29004.75	3	9668.25	65.83	**<0.001**
Aging process	26672.54	1	26672.54	181.62	**<0.001**
Materiel x Aging process	289.83	3	96.61	0.65	0.58
Residual value	22321.81	152	146.85		

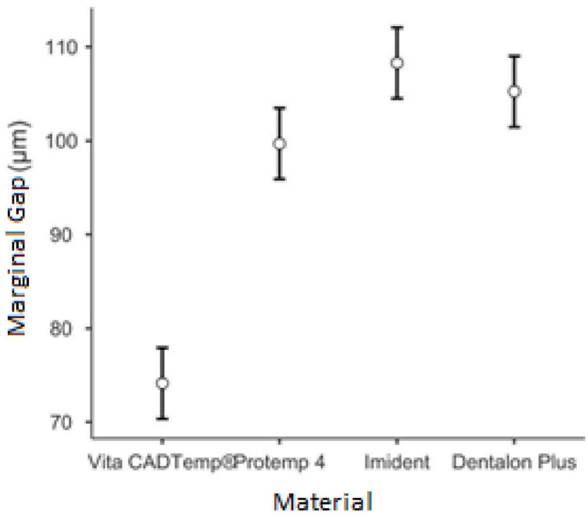

Fig. 8. Graphical representation of marginal gap values of temporary crowns without aging process (95% confidence interval).

Table 3
Tukey multiple comparison test results of marginal gap values of non-aging process temporary crowns.

Compared groups	Difference between means	Standard error	df	t	p value
Vita CADTemp® vs. Protemp 4	−25.55	2.70	152	−9.43	**< 0.001**
Vita CADTemp® vs. Imident	−34.14	2.70	152	−12.60	**< 0.001**
Vita CADTemp® vs. Dentalon Plus	−31.10	2.70	152	−11.48	**< 0.001**
Protemp 4 vs. Imident	−8.59	2.70	152	−3.17	**< 0.01**
Protemp 4 vs. Dentalon Plus	−5.55	2.70	152	−2.05	0.17
Imident vs. Dentalon Plus	−3.03	2.70	152	−1.12	0.67

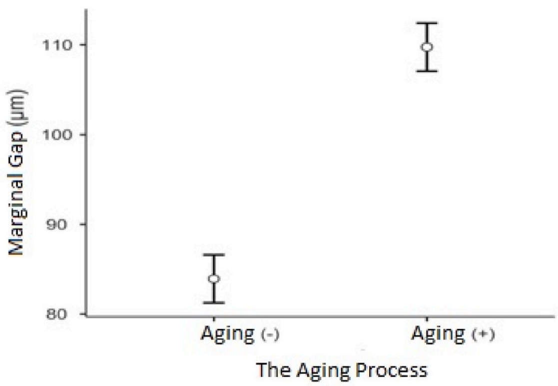

Fig. 9. Graphical representation of the effect of aging on the marginal gap values of temporary crowns regardless of material type (95% confidence interval).

Table 4
Tukey multiple comparison test results of the effect of aging process on marginal gap values of temporary crowns regardless of material type.

Aging process	Difference between means	Standard error	df	t	p value
No vs. Yes	−25.82	1.91	152	13.47	**<0.001**

Table 5
Tukey multiple comparison test results of marginal gap values of aging process and non-aging process temporary crowns (μm).

	Marginal gap values (μm), mean ± SD		
Temporary crowns by material	Non-aging process	Aging process	p value
Poly acrylic resin (Vita CADTemp®)	59.05 ± 6.86^{a}	89.23 ± 12.47^{a}	**< 0.001**
Bis-acryl composite resin (Protemp 4)	86.79 ± 10.04^{b}	112.60 ± 13.02^{b}	**< 0.001**
Poly methyl methacrylate (Imident)	96.21 ± 11.16^{b}	120.36 ± 14.13^{b}	**< 0.001**
Poly ethyl methacrylate (Dentalon Plus)	93.68 ± 11.78^{b}	116.82 ± 15.45^{b}	**< 0.001**
p value	**< 0.001**	**< 0.001**	

Different letters indicate statistically significant difference ($p < 0.05$).

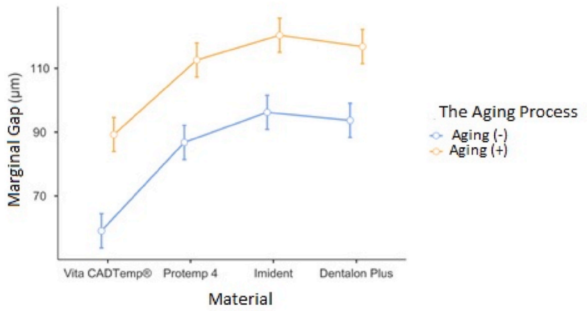

Fig. 10. Graphical representation of marginal gap values of temporary crowns made of different materials according to the aging process (95% confidence interval).

Scanning Electron Microscopy (SEM) images showing the marginal fit of temporary crowns prepared from different materials are shown in Figs. 11–14. The assessment of SEM images of temporary crowns prepared using different materials also revealed that the poly acrylic resin (Vita CADTemp®) temporary crowns showed less marginal gap value than those prepared from other materials, in both the aged and non-aged settings.

3.4. Fracture resistance data

The Q-Q plot showing the distribution of fracture resistance gave a straight line (Fig. 15). In addition, fracture resistance values were considered to be normally distributed (Kolmogorov-Smirnov test, $p = .063$).

The covariance analysis for fracture resistance measurements revealed significance for the materials used, the aging process and the interaction between the materials and the aging process ($p < 0.001$ for each) (Table 6).

For the non-aged temporary crowns, poly acrylic resin (Vita CADTemp®) temporary crowns prepared using CAD/CAM method showed significantly ($p < 0.001$) higher fracture resistance values than temporary crowns prepared using all other materials (Protemp 4, Imident and Dentalon Plus). Also, temporary crowns prepared using PMMA (Imident) showed significantly ($p < 0.001$) higher fracture resistance values than temporary crowns prepared using PEMA (Dentalon Plus) (Fig. 16, Table 7).

3.5. Impact of aging process on fracture resistance - overall

Regardless of the materials used, aged temporary crowns showed significantly ($p < 0.001$) lower fracture resistance values compared to non-aged temporary crowns (Fig. 17, Table 8).

3.6. Impact of aging process on fracture resistance – by temporary crown types

In the absence of aging process, no significant ($p > 0.05$) difference was noted between poly acrylic resin (Vita CADTemp®; 478.44

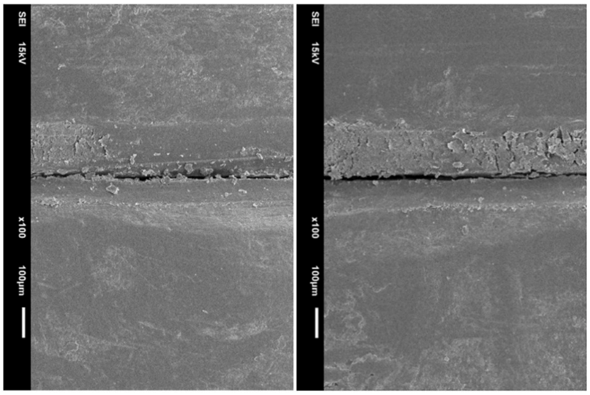

Fig. 11. SEM images of marginal gaps of Vita CADTemp® temporary crowns without aging process (a) and with aging process (b).

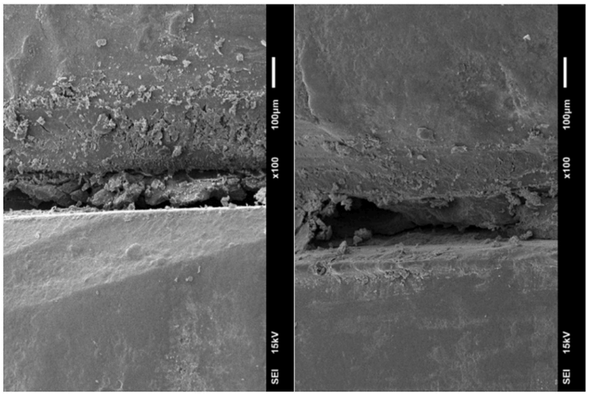

Fig. 12. SEM images of marginal gaps of Imident temporary crowns without aging process (a) and with aging process (b).

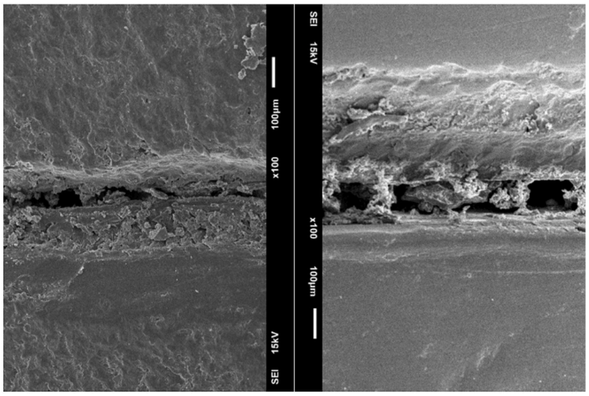

Fig. 13. SEM images of marginal gaps of Dentalon Plus temporary crowns without aging process (a) and with aging process (b).

± 34.01 N) and bis acryl composite resin (Protemp 4; 472.6 ± 29.91 N) groups in terms of the fracture resistance, whereas both groups had significantly higher fracture resistance values than PPMA (Imident; 323.57 ± 28.65 N) and PEMA (Dentalon Plus; 283.02 ± 30.94 N) groups ($p < 0.05$ for each). PMMA (Imident) temporary crowns also showed significantly higher fracture resistance than the PEMA (Dentalon Plus) group ($p < 0.05$) (Table 9).

In the presence of aging process, fracture resistance was highest in the poly acrylic resin (Vita CADTemp®; 355.14 ± 15.58 N) group compared to bis-acryl composite resin (Protemp 4; 315.36 ± 20.83), PPMA (Imident; 240,0.82 ± 14.60) and PEMA (Dentalon Plus; 213.80 ± 10.26) groups ($p < 0.05$ for each). PMMA (Imident) temporary crowns also showed significantly higher fracture resistance than the PEMA (Dentalon Plus) group ($p < 0.05$) (Table 8).

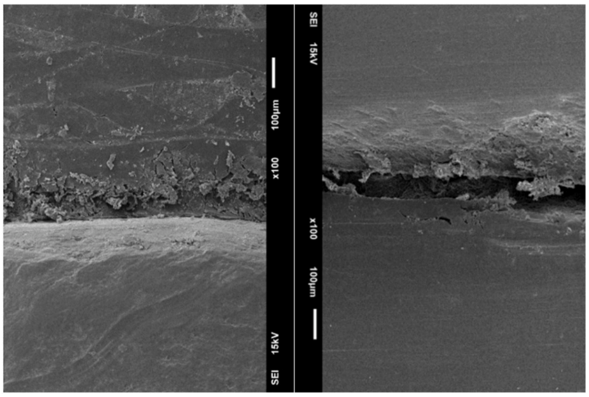

Fig. 14. SEM images of marginal gaps of Protemp 4 temporary crowns without aging process (a) and with aging process (b).

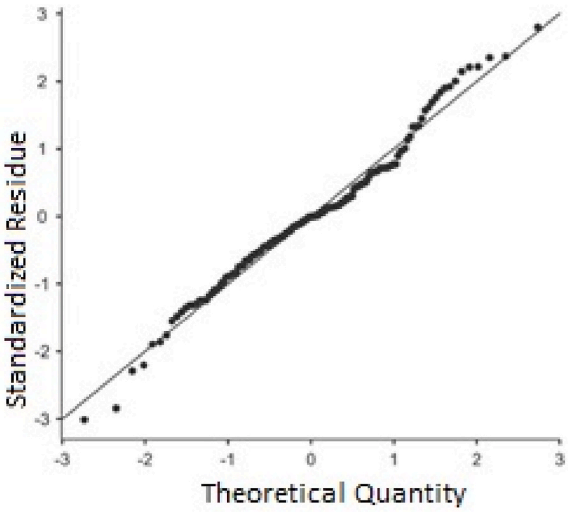

Fig. 15. Q-Q plot showing the distribution of fracture resistance values.

Table 6
Covariance analysis results of fracture resistance values.

	Sum of squares	df	Mean of squares	F	p value
Material	818158.71	3	272719.57	452.04	**<,001**
Aging Process	467619.00	1	467619.00	775.09	**<0.001**
Materiel x Aging process	48000.53	3	16000.17	26.52	**<0.001**
Residual value	91702.44	52	603.30		

The highest fracture resistance (478.44 N) was determined for the non-aged poly acrylic resin (Vita CADTemp®) temporary crowns prepared by CAD/CAM method, while the lowest fracture resistance (213.80 N) was determined for the aged PEMA (Dentalon Plus) temporary crowns (Table 9).

For each type of temporary crown, fracture resistance values obtained without application of aging process were significantly higher than those obtained in the setting of aging process ($p < 0.001$ for each) (Table 9, Fig. 18).

4. Discussion

This study was conducted to investigate the effect of the aging process on the marginal fit and fracture resistance of crowns prepared using different temporary restorative materials. Our findings revealed that the marginal fit and fracture resistance of the temporary crowns prepared with CAD/CAM were better, confirming the H0 hypothesis. Also, the aging process negatively affected the marginal fit and fracture resistance, confirming the H1 hypothesis.

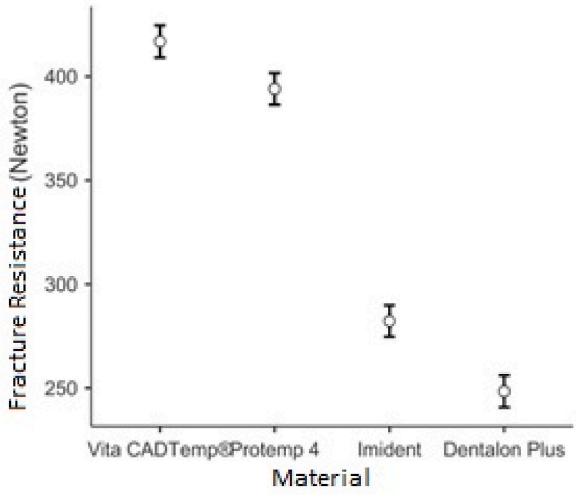

Fig. 16. Graphical representation of fracture resistance values of non-aging process temporary crowns (95% confidence interval).

Table 7
Tukey multiple comparison test results of fracture resistance values of non-aged temporary crowns.

Compared groups	Difference between means	Standard error	f	t	p value
Vita CADTemp® vs. Protemp 4	22.81	5.49	52	4.15	**<0.001**
Vita CADTemp® vs. Imident	134.59	5.49	52	24.50	**<0.001**
Vita CADTemp® vs. Dentalon Plus	168.38	5.49	52	30.65	**<0.001**
Protemp 4 vs. Imident	111.78	5.49	52	20.35	**<0.001**
Protemp 4 vs. Dentalon Plus	145.57	5.49	52	26.50	**<0.001**
Imident vs. Dentalon Plus	33.78	5.49	52	6.15	**<0.001**

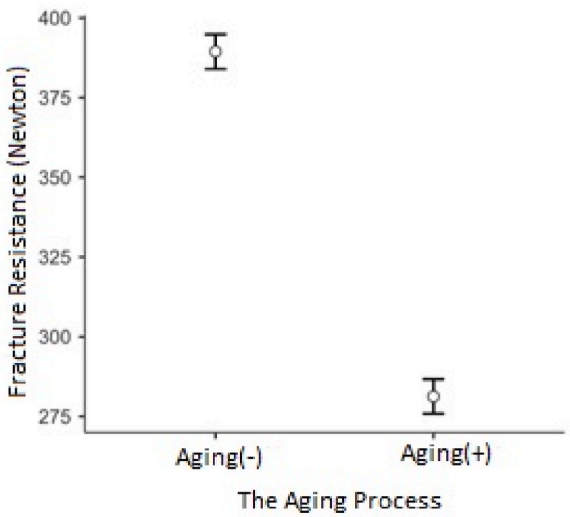

Fig. 17. Graphical representation of the fracture resistance values of aging and non-aging process temporary crowns, regardless of material type (95% confidence interval).

The finish line design of the preparations determines the cervical shape and thickness of the material in the collar part of the restorations, and affects the marginal harmony and seating angle [17]. In this study, a die representing the prepared maxillary first premolar tooth prepared with chamfer steps was used.

The spacing and protruding marginal measurements at the crown edge are clinically important evaluations. Currently no standard

Table 8
Tukey's multiple comparison test results of the effect of aging process on the fracture resistance of temporary crowns regardless of material type.

Aging Process	Difference between means	Standard Error	f	t	p value
No vs. Yes	108.12	3.88	152	27.84	**<0.001**

Table 9
Tukey multiple comparison test results of fracture resistance values of aged and non-aged temporary crowns (N).

	Fracture resistance (N), mean ± SD		
Material	Non-aging process	Aging process	p value
Poly acrylic resin (Vita CADTemp®)	478.44 ± 34.01[a]	355.14 ± 15.58[a]	**< 0.001**
Bis-acryl composite resin (Protemp 4)	472.6 ± 29.91[a]	315.36 ± 20.83[b]	**< 0.001**
Poly methyl methacrylate (Imident)	323.57 ± 28.65[b]	240.82 ± 14.60[c]	**< 0.001**
Poly ethyl methacrylate (Dentalon Plus)	283.02 ± 30.94[c]	213.80 ± 10.26[d]	**< 0.001**
p-value	**< 0.001**	**< 0.001**	

Different letters indicate statistically significant difference ($p < 0.05$).

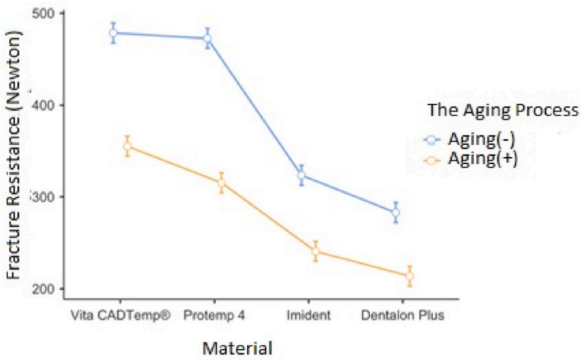

Fig. 18. Graphical representation of fracture resistance values of temporary crowns prepared from different materials according to the aging process (95% confidence interval).

method is available for the measurement and evaluation of the edge spacing. In particular, there is no consensus among researchers regarding measurement points. In order to make precise measurements, numerically measurable methods should be used. The microscope is the most commonly used instrument for the evaluation of measurements made through the direct method. The high image magnification feature of the microscope enables precise measurements to be made [18–23].

The marginal fit of the temporary crowns prepared in this study was evaluated with a stereomicroscope using the direct method, which is one of the frequently techniques in the research field, which allows the repeated measurement as well as the highest accuracy.

Holmes et al. [24] reported that the incompatibility between the crown and the tooth can be determined by measuring from different points.

Gavelis et al. [25] stated that many factors can affect the marginal fit of restorations, such as the materials used, type of preparation, the impression materials and methods used, laboratory procedures, and the viscosity of the cement. In this study, the maximum marginal gap value (96.21 μm) was determined in temporary crowns prepared from PMMA (Imident), while the minimum marginal gap value (59.05 μm) was determined in temporary crowns prepared from poly acrylic resin (Vita CADTemp®), supporting the views of Gavelis et al. [25]. We think that the better marginal fit of the temporary crowns prepared from poly acrylic resin is due to the fact that they were prepared by the CAD/CAM method and therefore there is no shrinkage due to the polymerization process.

Ehrenberg and Weiner [26] prepared temporary crowns from four different materials on a metal die produced from a low melting point alloy (Cerroblend) in their study where they analyzed the marginal gap changes due to the aging process and occlusal loading. The prepared crowns underwent occlusal loading (50,000 cycles, 40 N, 4 Hz) and aging (8000 cycles, 5 °C–60 °C). They observed an increase in mean marginal gap in all temporary crowns.

Reeponmaha et al. [27] evaluated the fracture strength and fracture patterns of temporary crowns prepared with different materials and techniques, and determined that the temporary crowns prepared with CAD/CAM exhibited significantly higher fracture strength than the others.

Abdullah et al. [28] prepared the maxillary first premolar phantom tooth and determined the marginal spacing, internal fit, fracture strength and fracture mode of the temporary crowns (VITA CAD-Temp®, Polyetheretherketone "PEEK", Telio CAD-Temp) prepared with CAD/CAM direct technique, in comparison to conventionally produced temporary crowns (Protemp 4). It was determined that the temporary crowns produced via CAD/CAM showed better marginal fit and greater durability than the conventionally produced temporary crowns.

In this study, temporary crowns were prepared on epoxy resin dies with CAD/CAM (VITA CAD Temp®) and traditional method (Imident, Dentalon Plus, Protemp 4). Temporary crowns prepared with CAD/CAM were found to have better marginal fit and greater durability than those prepared conventionally.

This study is an in vitro study. The limitations of this study are that situations that may arise from the patient during the impression process, such as the presence of blood and saliva, are not reflected in the study environment. In addition, the aging process cannot adequately imitate the oral environment and the study is limited to single member crowns. Work can be done by including more than one member crown.

5. Conclusion and recommendations

The current results revealed the superiority of temporary crowns prepared by poly acrylic resin (Vita CADTemp®) via the CAD/CAM method to the temporary crowns prepared from all other materials in terms of the significantly lower marginal gap in the absence of aging process, and the significantly higher fracture resistance in the presence of aging process. Regardless of the material type, all temporary crowns showed lower marginal gap values and higher fracture resistance in the absence vs. presence of aging process.

The temporary crowns that prepared from CAD/CAM and Bisacryl composisite resin have higher resistance. Therefore, it was concluded that they can be used as long term temporary restorations.

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author: The data are not publicly due to privacy or ethical restrictions.

CRediT authorship contribution statement

Bahriye Bahar Tüfekçi: Writing – review & editing, Writing – original draft. **Zeynep Yeşil:** Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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