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# Evaluation of Marginal and Internal Fit of CAD/CAM- Fabricated Poly-Ether-Ether-Ketone (PEEK) and Ceramic Endocrown Restorations

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**Conflicts of Interest:** Nil

## Abstract

**Introduction**: Endocrown restoration has been introduced as a relatively new technique in recent years and studies on its disadvantages and benefits are limited. Poor marginal and internal fit in dental restorations can lead to dental caries and periodontal diseases. So, in the present study, we compared the marginal and internal fit of CAD/CAM-fabricated Poly-Ether-Ether-Ketone (PEEK) and ceramic Endocrown restorations.

**Materials and Methods**: In vitro study, 30 mandibular first molar specimens were divided into two groups. Group A consisted of 15 specimens with E. max single-unit restoration and Group B consisted of 15 specimens with PEEK single-unit restoration. Marginal and internal fit of the specimens were assessed using a replica technique and stereomicroscope at magnification of × 50. Statistical analysis was accomplished with Independent Samples T-test and significance was predetermined at $p<0.05$.

**Results**: The results of this study showed that the mean marginal fit in PEEK group was 105.73 ± 8.32 and in E. max group were 68.60 ± 12.09 microns. The difference between the two groups was statistically significant ($p <0.001$). Also, the mean internal fit in PEEK group was 129.13 ± 8.52 and in E. max group was 103.93 ± 11.97 microns. The difference between the two groups was statistically significant ($p <0.001$).

**Conclusion**: Marginal and internal fit of PEEK Endocrown restorations were weaker than Marginal and internal fit of E. max restorations. It is recommended to consider other features of PEEK Endocrown restorations in future research.

**Keywords**: Restoration, Endocrown, PEEK, E. max, Marginal fit, Internal fit, CAD / CAM Technique.

**Introduction**

Clinical experiences in order to preserve the remaining dental structure suggest that the restoration of endodontically treated teeth that have been severely damaged be performed with gamel restoration. If the extracorporeal tissue is severely damaged or has a short available length. It cannot provide enough grip for gamel restoration, so to restore severely lost structures, grip from inside the root is needed (1). Endo-crown is a type of restoration that consists of a crown structure and a central structure that is placed inside the pulp chamber (2). This type of restoration was first described as the monoblock technique by Pissis in 1995 for broken teeth (3). In 1990, the trading company Ivoclar Vivadent produced and marketed the first generation of castable porcelain under the brand name IPS-Empress (4). In the next step, lithium di-silicate crystals were used to further enhance the physical properties of the ceramic restorations. (5) IPS E-max press is a ceramic grade reinforced with lithium di silicate that has high flexural strength and fracture toughness. The advantage of this new ceramic, in addition to greater strength, is the great variety in color, translucency and different manufacturing methods, which covers a variety of uses. (6)

In the last few years, a high-performance polymer called PEET (polyetheretherketone) has been introduced in dentistry, which is used to make implant fixtures, fixed and removable dentures, and dental restorations. (7)

In general, an ideal restoration should have strength-enhancing properties High failure resistance High bonding Suitable cheap, easy to use and acceptable beauty that not all of these features are present in ceramic restorations. In addition to these disadvantages in all-ceramic restorations, marginal fit restoration is also a key factor for restorative success and several attempts have been made to minimize the amount of restraint gaps (8). In fact, the optimal marginal fit is one of the most important technical factors predicting the long-term success of crowns (9).

fit and interior Endocrown restorations made with PEEK have rarely been done, and most studies have focused on Marginal fit and ceramic endocrine restorations (10,11) by Dicker on the principle that marginal fit and internal restoration In ceramic restorations; In the present study, we decided to investigate the marginal and internal endocrine restorations made by CAD / CAM method with emic heads and PEEK materials in order to better understand the properties of endocrine restorations made with PEEK, especially Marginal fit. And reach inside them and take a small step to improve the marginal fit and inside of endocrine restorations.

**materials and methods**

This study is laboratory and includes mandibular first molar teeth cut by a prosthetist. Samples were selected as available and randomly divided between the two study groups.

Figure 1: Examples of study.

Figure 2: Incremental silicon molding material.

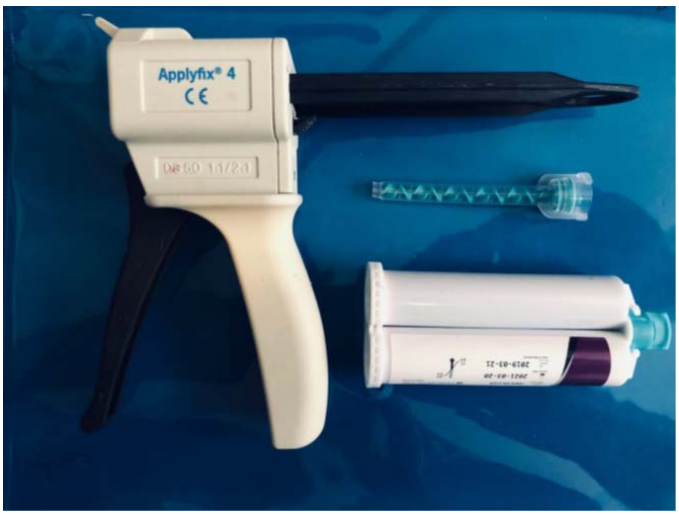



Figure 3: Final molding.

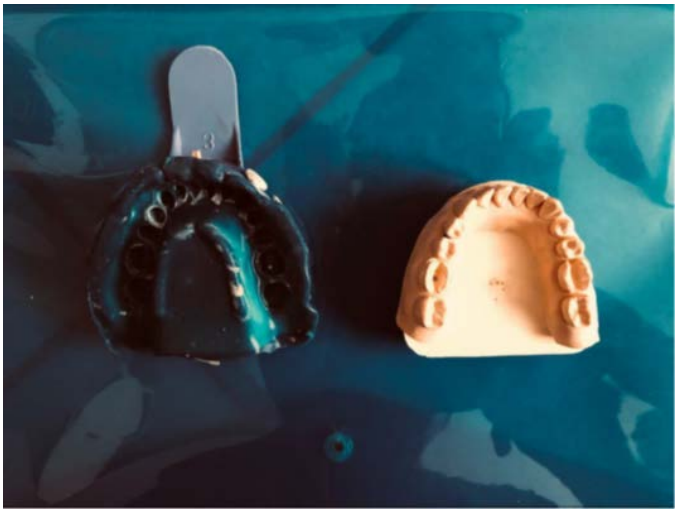
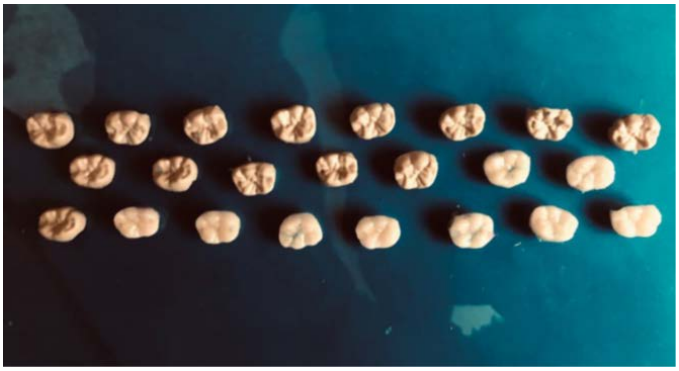


Figure 4: Prepared examples.



According to the random allocation method, after determining 30 mandibular first mandibular abutment teeth, the teeth were cut by a prosthetic specialist. The primary teeth were studied in one of the two study groups based on the type of restoration. The Endocrown preparation consists of a global margin 1-1.2 mm deep and a central grip from inside the chamber pulp. Occlusal reduction was performed at a rate of 2 mm. The thickness of the ceramic was between 3 and 7 mm.

The blind and crown structures were constructed as a unit without receiving receivers from inside the canal. After occlusal preparation, the undercuts were removed in the access path to the cavity and the axial walls were trimmed with a tip of 8 to 10 degrees by a trend milling tape cutter. To do this, the milling cutter was kept parallel to the crown and additional pressure was avoided. The depth of the hole was 3 mm and it was shaved at the rate of 3 mm. The depth of the hole was carefully measured with the help of a probe and the depth of the hole was the same in all samples and in both groups. All the necessary treatment procedures for the veneers were performed by a prosthetist. After finishing the preparation, the teeth were washed and cleaned of debris and an entire jaw mold was taken using polyvinyl siloxane material and the final cast was poured using type IV gypsum and sent to the laboratory to make veneers.

Figure 5: Prepared casts.

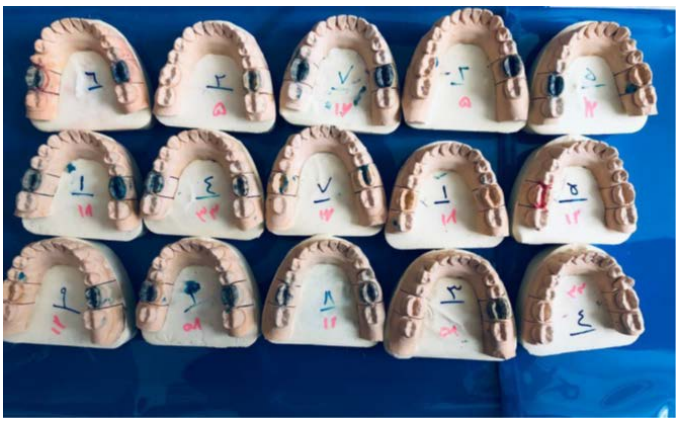
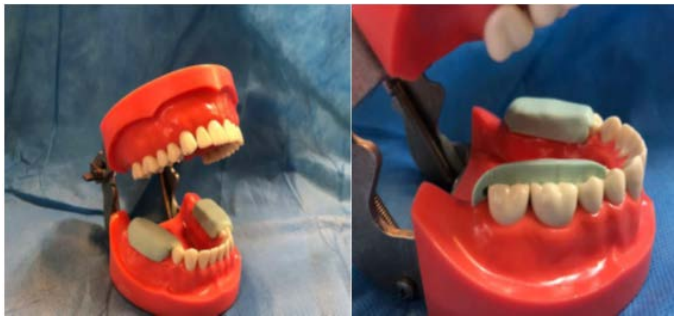


Figure 6: Index to investigate occlusal reduction.



After preparing the restorations, the silicone replica method was used to evaluate the marginal and internal gaps. (12) Finally, the extent of marginal disturbance and internal gaps of the restorations were statistically examined using SPSS software version 18.

**Results**

Kolmogorf test showed that marginal and internal adaptation variables had normal distribution (6: 0: 0).

Table 1: Comparison of marginal matching between two study groups

| | | marginalfit | | | | | P-value† |
|---|---|---|---|---|---|---|---|
| | | Count | Mean | SD | Minimum | Maximum | |
| type | IPS e.max | 15 | 68.600 | 12.088 | 42.000 | 83.000 | <0.001 |
| | PEEK | 15 | 105.733 | 8.319 | 87.000 | 116.000 | |

† Independent Samples T-Test

There was a statistically significant difference in marginal compatibility between the two types of PEEC and E. max Endocrone coatings. The mean of marginal matching in E. max ceramic group was lower than PEEK group (Table 1)

Table 2: Comparison of internal compatibility between the two study groups.

| | | internalfit | | | | | P-value† |
|---|---|---|---|---|---|---|---|
| | | Count | Mean | SD | Minimum | Maximum | |
| type | IPS e.max | 15 | 103.933 | 11.973 | 75.000 | 119.000 | <0.001 |
| | PEEK | 15 | 129.133 | 8.526 | 118.000 | 145.000 | |

† Independent Samples T-Test

There was a statistically significant difference in internal consistency between the two types of PEEK endocrone veneer and E.max ceramic. The mean of internal consistency in E.max ceramic group was lower than PEEK group (Table 2)

**Discussion**

Endo crowns have emerged as a relatively new technique in recent years, and studies on the clinical successes, disadvantages, and advantages of this method have been limited (13,14). And have considered it necessary to pay attention to this factor (15). He also considered the sex of the material used in the endocron as one of the factors affecting the marginal compliance and recommended that the marginal compliance of the endocrons with different sexes be examined (15); This issue has been considered in the present study.

Also, according to the available evidence, in addition to the material of the endocrine material, the method of construction, the method of measuring compliance, the depth of the cavity and the details of the method performed in the laboratory were among the factors affecting the final results of marginal and internal compliance in endo cron samples. Sakrana et al. Have shown the effect of marginal and internal compliance measurement method on significant final findings (16). Vojdani et al. (2013) showed that differences in crown fabrication method (manual method or CAD / CAM) of any of the same alloy's lead to differences in marginal and internal compatibility (17). Shin et al. (2017) in a laboratory study examined the differences in the marginal and internal compatibility of endocrons made by CAD / CAM method by considering different cavity depths. In his study, the results showed that with increasing the depth of the cavity, marginal and internal gaps are added and this relationship does not depend on the type of endocron material and its thickness (18). The result was only due to differences in the material of the endocrine material.

**Conclusions**

In the present study, the findings showed a statistically significant difference in marginal and internal matching between the endo cron group PEEK and E.max, so that marginal and internal gap in E.max samples was less than PEEK samples; Therefore, it can be said that the marginal and internal compatibility of PEEK Endo crowns was weaker than E. max ceramic Endo crowns. Of course, although the results showed a marginal and internal consistency in the PEEK's bath compared to the E.max ceramic bath, but considering some errors and acceptable experimental and limitations of 120 microns, it is thought that by conducting more research with Different fabrication methods and more sample sizes can be expected to bring the marginal and internal compatibility of samples made with PEEK material into a clinically acceptable range.

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