کارگاه های آموزشی مرکز اطلاعات علمی جهاد دانشگاهی

کارگاه آنلاین آشنایی با پایگاه های اطلاعات علمی
بین المللی و
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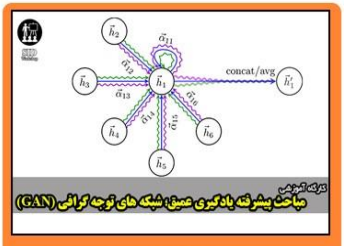

مباحث پیشرفته یادگیری عمیق؛
شبکه های توجه گرافی
(Graph Attention Networks)

کارگاه آنلاین مقاله نویسی IEEE و ISI
ویژه فنی و مهندسی

The evaluation and comparison of marginal adaptation in metal ceramic and all ceramic restorations fabricated by two methods: CAD/CAM and conventional

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Abstract

Introduction: Marginal fit is a key factor for long term clinical success through any dental restorations. Poor marginal adaptation causes cement dissolution. This can lead to dental caries, gingival irritation, periodontal diseases, and finally treatment failure. The aim of this study was measurement and comparison of marginal gap quantities in metal ceramic and all ceramic dental restorations fabricated by various methods. **Methods & Materials:** A total of 60 complete crowns in 6 groups (n=10) were fabricated as. Follows: Group A: Conventional metal-ceramic collarless restorations. Group B: Metal-ceramic collarless restorations with CAD/CAM wax copings and porcelain layering. Group C: Metal-ceramic collarless restorations with Ceramill Sintron metal copings and porcelain layering. Group D: All ceramic e-max. Press (lithium disilicate) restorations. Group E: All ceramic restorations with CAD/CAM zirconia copings and porcelain layering. Group F: All ceramic CAD/CAM translucent zirconia (Zolid). Replica technique and optical microscope (60 x magnifications) used to gap measurement. Mann whitney and kruskal-wallis tests used to analyze the data. **Results:** The lowest mean marginal gap seen in group C (29.12) and the highest mean marginal gap seen in group E(78.19)The mean marginal adaptation was better in metal ceramic restorations than all ceramic restorations and the difference was significant (P<0.001). **Conclusion:** According to our study, marginal gap of metal ceramic and all ceramic restorations was clinically acceptable (less than 120 microns).

Key words: Marginal gap, marginal adaptation, metal ceramic, all ceramic.

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Introduction

Poor marginal adaptation in dental restorations causes cement dissolution. This can lead to plaque accumulation, recurrent caries. Dental pulp inflammation, periodontal disease and finally treatment failure. (1, 2, 3, 4, 5, 8, 13)

Metal ceramic restorations are still the gold standard choice of fixed dental prosthesis. Popularity of metal ceramic restorations is due to their strength and marginal adaptation. Unfortunately, these restorations are like a barrier prevent light transmission through restorations (18, 29)

If esthetic is essential, we should use collarless metal ceramic or all ceramic restorations, Marginal adaptation of these restoration is lower than cast metal ceramic restorations but clinically acceptable.(7)

High strength cores of alumina and zirconia made them as an excellent material in anterior and posterior metal free restorations in all types of occlusions. Marginal adaptation is a normal concern in this restorations (4) CAD/CAM method improved design, fabrication and accuracy of dental restorations. It is faster, accurate and comfortable. Although today chair side in office method of fabrication needs more time and cost, probable errors such as scanning procedure, software designing, milling and distortion during and after sintering can affect marginal adaptation (14-17)

Novel sintron technology introduced by Amman Girrbach company, allowed chrome-cobalt soft milling without cooling agent and difficulties. Advantages are: 1) simpler and comfortable milling
2) No need to wax up, investing, casting steps 3) maximum speed, time saving
4) Accuracy because of digital technology
5) Avoid repeated sending to dental laboratory 6) in office fabrication. (22)

The purpose of this study was evaluation and comparison of marginal adaptation in metal ceramic and all ceramic restorations fabricated by two methods: CAD/CAM and conventional.

Materials and methods

1. Cast and die production

In this in-vitro study, first, one upper jaw and one lower jaw plastic model of dental arches selected and hand articulated for better stability after die preparation. The upper first molar selected and prepared for complete coverage crown with an 1 mm depth round shoulder finishing line manually. Then each die surveyed to avoid undercuts. Afterward, impression done by additional silicone material and after pouring with gypsum, working cast and die were fabricated. (Fig. 1)

2. Restoration fabrication

60 restorations divided into 6 groups (n=10) Groups A, B, C were metal ceramic and groups D, E, F were all ceramic. (Fig. 2)

* Group A: Conventional wax up method used to producing wax copings and then converted to metal copings by lost wax technique. Porcelain layering done and then shoulder porcelain

Added with direct lift technique. (Fig. 3)

Group B: in this group wax copings made from CAD/CAM able wax blocks and converted to metal copings by lost wax technique and then porcelain layering and adding shoulder porcelain done like group A. (Fig. 4)

Group C: in this group sintron technology used. Copings were milled from soft presinterd chrom cobalt alloy by CAD/CAM and then sintered in special oven under pressure of agron gas. Final strength of these copings is comparable with conventional method. Adding porcelain steps are like group A (Figure. 5)

Group D: Restorations of this groups were lithium disilicate (e max-press). First a full contoured wax up performed. After lost wax technique e max ingots pressed to the mold space by special plunger. Finally a full contoured all ceramic restoration produced. (Fig 6)

Group E: Restorations in this group were named zircon. Zircon core milled by CAD/CAM from pre-sintered zirconia blocks. Then sintered and porcelain layering done. (Fig. 7, 8)

Group F: restorations in this group named Zolid. Full contoured restoration milled from pre-sintered zirconia blocks by CAD/CAM and then sintered in special oven. (Fig. 9)

3. Marginal gap measurement

For this purpose, replica technique used. Silicon replica of all restorations sectioned as seen in fig 10. 8 points of each silicon replica measured by optical stereomicroscope under 60X magnification. (Fig. 11)

Statistical analysis

In this in vitro study, at first Shapiro-Wilk test was done for evaluating data normality. It was found that data in some groups have not normal distribution. Kruskal-wallis test used for data analysis and comparison in each 6 groups. Mann-Whitney test used for data comparison between metal ceramic and all ceramic groups.

Figure1.Upper and lower dental arches

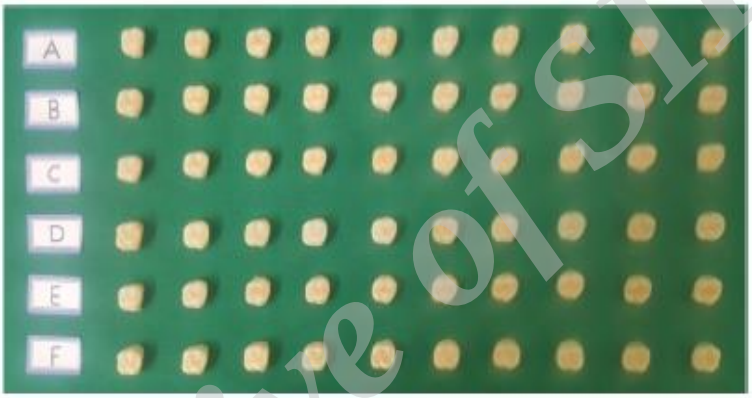

Figure 2.60 fabricated restorations

Fifure 3.Conventional casting metal coping

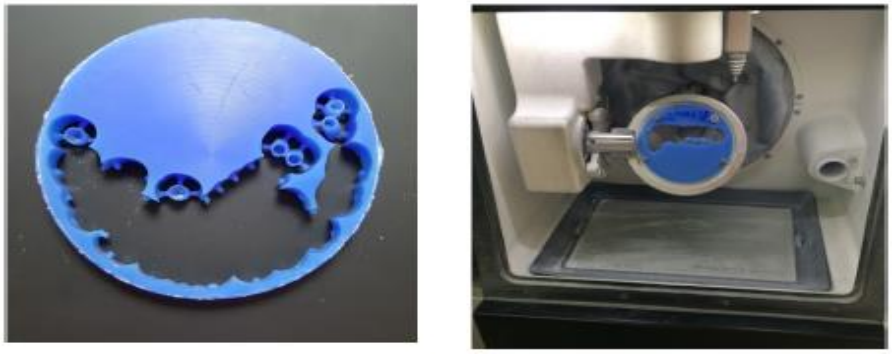

Figure4.CAD/CAMable wax blocks

Figure 5. Presintered soft chrome cobalt blocks

Figure 6.e.max Press ingots and plunger

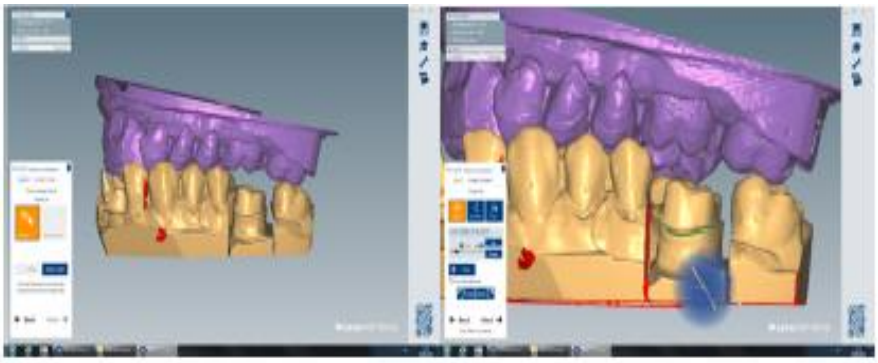

Figure7. CAD/CAM designing

Figure 8. Presintered zircona blocks

Figure 9. Presintered Zolid blocks

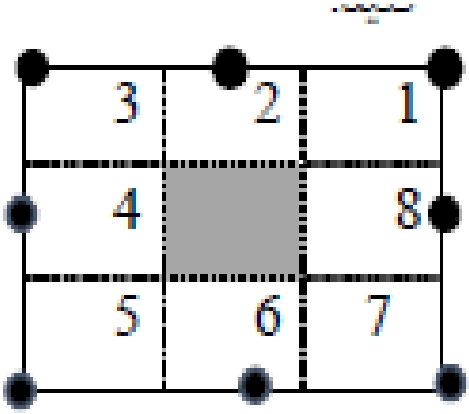

Figure 10.Occlusal view of replica and 8 measurement points

Figure 11. Photographs of cross sections of replica

Results

In this study, marginal gap of two groups of the restorations (metal ceramic and all ceramic) and their subdivisions (A, B, C, D, E, F) measured. As it can be seen in table 1 the lowest mean marginal gap was in group C and the greatest in group E. There was significant difference between 6 groups statistically (p<0,001). In paired comparison between 6 groups, it was found that mean marginal gap in group C was significantly lower than groups A, D, E, F. Also mean marginal gap in group F was lower than groups D and E. Groups F and D also were significantly lower than group E. Between other groups there was no significant difference. (Table 2) Data distribution in 6 groups has shown (Chart 1). As you can see in this chart, there are large gaps in groups 3 and 5.

Regarding the table 3, the lower mean marginal gap existed in metal ceramic restorations and the difference was significant statistically (p<0,001).Data distribution between metal ceramic and all ceramic has shown in chart 2.

Table1. Mean ،Standard of deviation, minimum, maximum and median marginal gap measurement of the study groups

Group	Number	Mean±SD	Min	Max	Median± IQR	Kruskal-Wallis test
A	80	135.4±69.3	49.8	372.3	106.9±86.7	P<0.001
B	80	92.5±54.8	39.1	369.4	72.8±35.7	
C	80	195.2±123.3	54.3	680.3	152.4±142.0	
D	80	155.9±73.7	69.5	607.0	136.7±63.7	
E	80	181.0±85.5	65.2	602.1	176.9±69.07	
F	80	168.7±45.1	87.6	347.7	165.0±56.4	

IQR: Inter Quantile Range , Min: Minimum , Max: Maximum, SD: Standard Deviation

Table 2.Paired comparison of 6 groups of the study

Group1-group2	p-value
C-B	1.000
C-A	.006
C-F	<0.001
C-D	<0.001
C-E	<0.001
B-A	.824
B-F	<0.001
B-D	<0.001
B-E	<0.001
A-F	.001
A-D	<0.001
A-E	<0.001
F-D	1.000
F-E	<0.001
D-E	.001

Table3 .Mean ،Standard of deviation ،Minimum ،maximum .Median Data of marginal gap of metal ceramic and all ceramic restorations and their statistical results

Group	Number	Mean±SD	Min	Max	Median±IQR	Mann Whitney test
Metal ceramic	240	141.0±96.9	39.1	680.3	105.9±99.3	P<0.001
All-ceram	240	168.6±70.7	65.2	607.0	155.5±68.8	

IQR: Inter Quantile Range , Min: Minimum , Max: Maximum, SD: Standard Deviation

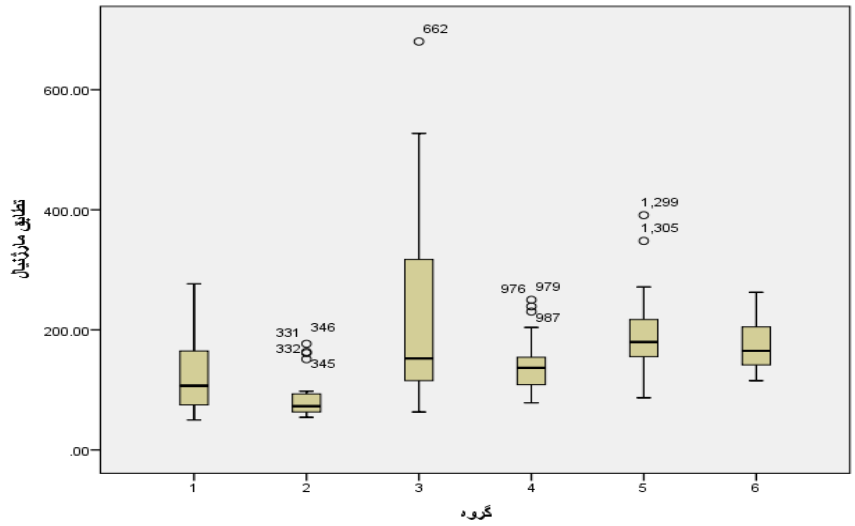

Chart 1. Marginal adaptation data distribution status for all study groups separately

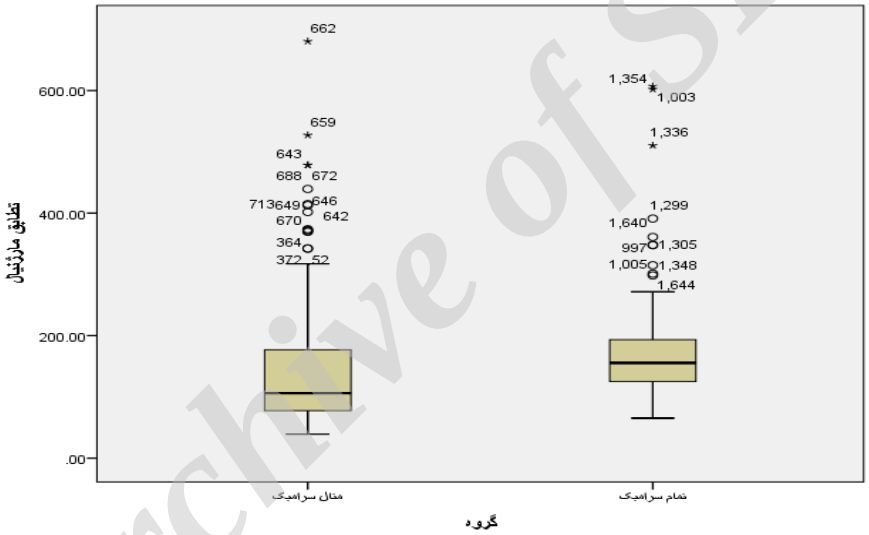

Chart 2. Marginal adaptation data distribution status for metal ceramic and all ceramic groups

Discussion

The marginal gap in all 60 restorations was within acceptable range (<120 microns). It is confirmed that mean marginal gap in collarless metal ceramic restorations is about 50-60 microns and these restorations have better marginal fit than IPS empress and IPS empress CAD so preferred in esthetic zones. Most studies showed that marginal gaps in pressed and CAD/CAM all ceramic restorations (Celay, e.Max, In-ceram, cerec3, Procera, Cercon , lava, Digident, ED-4, Amann Girrbach) are more than that of in metal ceramic restoration but clinically acceptable (1,3,4,12,13,17,26,27). Our study's findings were in agree with them. In contrast, one study reported that marginal gap of zirconia was more than clinical range (28). Another study showed that marginal gap of press and CNC methods was acceptable except zirconia (25). The most important factor for a cast restoration is marginal fit (20). Marginal adaptation is a key factor for clinical success of restorations (1-4). Good marginal adaptation can lead to decrease gingival irritation and periodontal disease (5), cement

dissolution and secondary caries (6). However, there is an agreement between studies and clinicians that marginal gap lower than 120 microns is clinically acceptable (8-12). Probable errors of CAD/CAM method such as scanning, software designing, milling procedure and contraction during sintering can affects marginal fit (14-17).

Also, there are several methods for gap measurement. We used replica technique and volume of silicon and its contraction can affect measurements. Another problem is that this technique is 2-dimentional. (23) On the other hand, there are several methods for adding shoulder porcelain. The best method is platinum foil. Other methods are refractory die, direct lift and porcelain wax. Direct lift is the simplest method and we used this method but it has greater marginal discrepancy (21).

Variation in different studies may also be related to in-vitro vs in-vivo study, single unit vs multiunit restorations, laboratory equipment and material and method of gap measurement.

Conclusion

According to our study all restorations in all groups have clinically acceptable marginal gap, however metal ceramic restorations showed better marginal adaptation than all ceramic ones.

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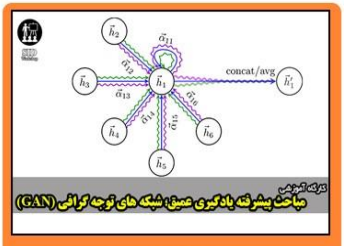

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