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INFLUENCE OF CERVICAL MARGIN RELOCATION ON MARGINAL INTEGRITY OF RESIN COMPOSITE RESTORATION AFTER THERMO MECHANICAL LOADING

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ABSTRACT

Objectives: The aim of the study was to assess the influence of cervical margin relocation (CMR) with two different materials (flowable resin composite and light cure resin modified glass ionomer) on marginal integrity of resin nano ceramic composite restoration after thermo mechanical loading (TML). **Materials and Method:** A total number of (24) standardized MOD cavities with one proximal box (mesial) with cervical margin located one mm beneath the cement- enamel junction (CEJ) were prepared while keeping the distal box supragingival. The division of teeth into two equal main groups (n=12) based on the kind of restorative materials used for (CMR); group (A):- nanohybrid flowable resin composite (Dyract flow) and group (B):- resin modified glass ionomer (Riva). Both groups were restored with direct nanoceramic resin composite (Zenit). After that, each group was split into two equal subgroups (n=6) based on (TML) was done or not. **Result**: No statistically significant difference in marginal integrity before and after the (TML) regardless of (CMR) was recorded and the flowable resin group showed higher marginal leakage than the mesial resin modified glass ionomer group after the (TML). **Conclusions**: (CMR) technique seems to promising acceptable technique without compensatory the marginal integrity, marginal integrity in (CMR) was a material-dependent and the (TML) had no significant effect on marginal integrity regardless of (CMR).

KEYWORDS: Cervical margin relocation, Marginal integrity, Thermo mechanical loading .

INTRODUCTION

Clinical success in restorative dentistry might depend on a variety of technical factors, including aesthetics, margin accuracy, correct occlusion and vitality preservation [1,2]. Modern composite resin materials and adhesive technology have made it possible to use direct composite resin materials to restore badly damaged teeth [3].

Biological and technical operative difficulties may be found when restoring cavities beneath the cemento-enamel junction (CEJ). To overcome these challenges; cervical margin relocation was developed to reposition the cervical margin supra gingivally [4,5].

Surgical crown lengthening can be replaced by cervical margin relocation (CMR) for the progressive movement of deep proximal margins to relocate cavity margins for direct or indirect restorations. Application of a flowable base is the first step in raising the margin above the CEJ. Under more favorable clinical circumstances, the second

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step enables the practitioner to choose whether to put in a direct or indirect restoration[3,6].

Since bonding to dentin is less robust than enamel and is linked with more liability to micro leakage, bacterial invasion and recurrent caries, maintaining the best possible margin integrity is crucial especially in deep cavities [7].

From the previous review, it was assumed that it would be of importance to investigate the Influence of cervical margin relocation (CMR) on marginal integrity of nano ceramic resin composite restoration after (TML).

The null hypothesis is that will be there is no significant difference in marginal integrity whether the (CMR) was used or not before and after the (TML).

MATERIALS AND METHOD

Materials which were used in the current study as following:

1. Nano ceramic resin composite.
2. Nano hybrid flowable resin composite.
3. Resin modified glass ionomer (RMGI).
4. Two step self-etch adhesive.

Study setting

The study was carried out on sound permanent molar teeth in the Faculty of Dental Medicine, Cairo, Al-Azhar University, Egypt.

The study was approved by Research Ethics Committee of the Faculty of Dental Medicine, Cairo, Al-Azhar University with approval number (157/167/08/06/19).

Study design

An In vitro laboratory**,** non-controlled, non-randomized clinical trial study.

Eligibility criteria

The eligibility criteria of the selected teeth were set as follows.

Inclusion criteria

1. Human permanent molar teeth extracted for pathologic reasons devoid of decay, restoration, and attrition.
2. Teeth with average occluso-gingival height of the crown of 7mm.
3. Teeth Free of cracks and any developmental defects [8].

Exclusion criteria

1. Teeth with developmental defects, caries, fractures and any restoration.
2. Teeth with average occluso- gingival height of the crown less than 7mm [8].

Sample size calculation

The sample size of [6] in each group, depending on prior research by Koken [5], has a 90% power to determine a difference between means of 0.89 with an alpha level of 0.05 (two-tailed), and 95% confidence intervals. The findings will be regarded as "statistically significant" if the P value is lower than 0.05 (two-tailed) in 90% (the power) of those experiments. The difference in means in the remaining 10% of the studies will be labeled as "not statistically significant." Graph Pad Stat Mate 2.00 generated the report.

Preparation of selected teeth

Twenty four teeth were used in this research. The teeth were cleaned to remove any calculus, blood and debris and polished [5].

Fabrication of the molds

A specially fabricated circle plastic mold of internal diameter 3 cm and 3cm in height was fabricated. A separating medium was used to coat the internal surface of the mold Fig (1).

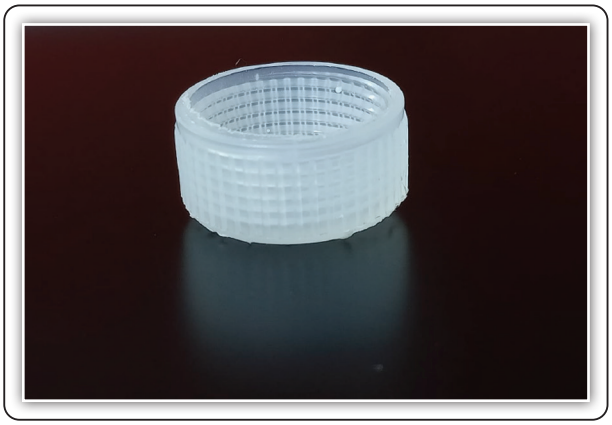

FIG (1) The mold

FIG (3) MOD cavity preparation

The mold was filled with self-curing acrylic resin, the base of the mold was rested on a glass slab to obtain a flat smooth surface base. Each root was embedded vertically in the middle of the mold while leaving 4mm below cemento - enamel junction projecting above the surface of the mold using caliber Fig. (2).

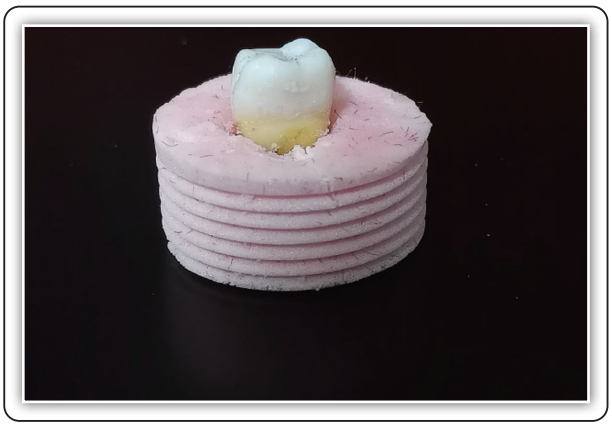

FIG (2) Tooth in mold

MOD cavity preparation

A total number of (24) standardized MOD cavities (Fig.3) with one proximal box (mesial) with a gingival margin located one mm beneath the (CEJ) were prepared while keeping the distal box supragingival [8].

Grouping of teeth

Twenty four teeth were split into two equal main groups (n=12) depend on the kind of restorative materials was used for (CMR); group (A): nanohybrid flowable composite (Dyract flow, Presidential Germany) and group (B):- RMGI (Riva, SDI, Victoria, Australia) Both groups were restored with direct nanoceramic resin composite (Zenit, Presidential, Germany.). After that, each group was split into two equal subgroups (n=6) based on (TML) was done or not

Cervical margin relocation with (dynamic flow)

The tooth structure was accommodated by the circumferential matrix. The adhesive (Clearfil SE Bond) was applied. Polymerization then was carried out for 40s by using an LED apparatus which produces a narrow spectrum of blue light in the 400- to 500-nm range with (a peak wavelength of about 460nm, LED blue light - Carlo De Giorgi – woodpecker medical instrument Co. Italy). After polymerization, the mesial proximal cervical boxes were raised one millimeter to the level of the (CEJ) by applying (dynamic flow).Then it was cured for 20 seconds [9,10].

Cervical margin relocation using (Riva light cure glass ionomer)

The mesial proximal boxes were elevated with (RMGI) to the level of (CEJ). The Riva

was introduced into the cavity and cured for 20 seconds[9,11].

Final restoration procedure

Both groups (A and B) were finally restored with (Zenit) composite final direct restoration [12].

Finishing and polishing procedure

Final finishing was achieved by Dura white stone Shofu abrasives (Dental abrasives, Japan)[12,13].

Thermal and mechanical loading of restorations

A total of 12 specimens (including 6 specimens of group A & 6 specimens of group B) were subjected to TML.

Thermal cycling

A total of 12 specimens were subjected to thermao cycling using a thermal machine (ROBOTA chewing simulator, Model ACH-09075DC-T, Japan) the number of cycles used was 600 cycles representing nearly 6 months under clinical condition[14].

Mechanical Loading

A total of 12 specimens were subjected to mechanical cycling using (ROBOTA chewing simulator) [15]. A weight of 5 kg, which is comparable to 49 N of chewing force was used. The test was repeated 75000 times to clinically simulate the 6 months chewing condition.

SEM evaluation of marginal quality

Preparation the teeth for micro leakage assessment:

A soft brush was used to coat the crown and the root of each tooth with varnish of the nail leaving 1mm all around the margins [5,7].

Each tooth›s crown and root were coated with clear nail polish using a gentle brush, with the exception of the restoration and one millimeter all around the cavity›s edges.

Dye preparation

One to four percent of ammoniacal silver nitrate and distilled water was organized in the Faculty of science, Analytical Chemistry Department, Al-Azhar University, Cairo[5].

Dye immersion

A tube for testing which contained ammonium silver nitrate including one tooth per tube was used . Specimens were repeatedly washed in water for 10 minutes after 24 hours. Acetone was used to remove the nail polish. After eight hours, teeth were washed three times for ten minutes [5,7].

Sectioning of teeth

The teeth were cut into 5 to 6 one millimeter slices perpendicular to the proximal surfaces by (Isomet) [5] .

Scanning of the specimens

The scoring of penetration of the dye at the tooth restoration interface was graded for the microleakage by the following criteria ;- [5,7,16]

Score 0:- No leakage,

Score 1:- Slight leakage,

Score 2: Distinctive leakage.

At 7 KV, the specimen surfaces were inspected using the scanning electron microscope. Photomicrographs of the tooth/restoration interface were taken at magnifications of 1500 X Fig. (4)**.**

Data Analysis

For pairwise comparisons between groups, the Kruskal-Wallis and Mann-Whitney tests were used in the statistical analysis of the results. P-values below 0.05 were deemed statistically significant at the 95% level of significance, and P-values over 0.001 were deemed extremely significant at the 99% level. The normality of the data was examined using the Shapiro Wilk test. Statistical software called SPSS was used to evaluate the data (version 23, IBM Co. USA).

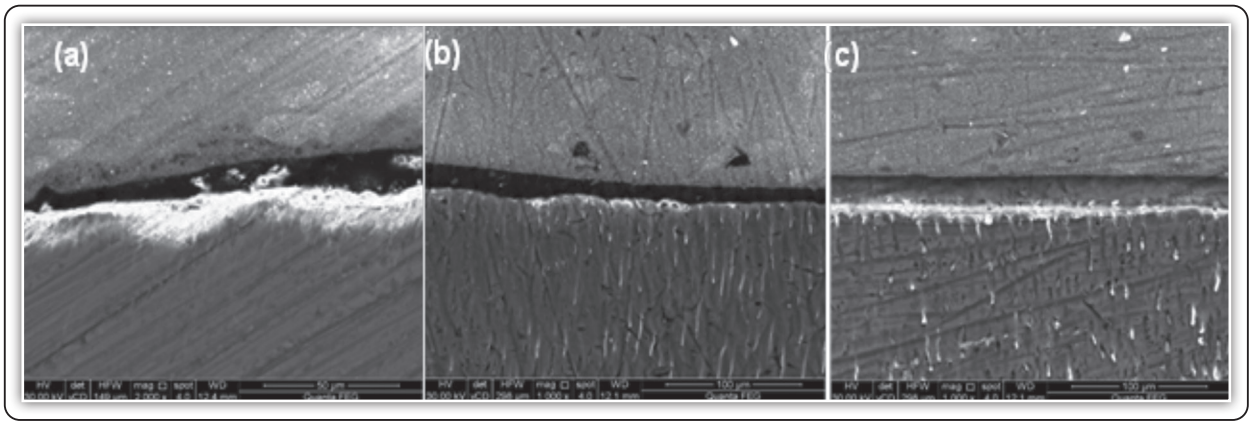

FIG (4) SEM showing the Microleakage score % after thermo mechanical loading:, 1- CMR material either (a) flowable resin showing score 3, (b) Resin Modified Glass Ionomer showing scor1, 2- (c) non-elevated nano ceramic composite in the distal region showing score 2

RESULTS

A- Effect of the CMR materials on marginal integrity of the final composite restoration (before and after the TML).

The result of the current research Fig. (5) illustrated that significant difference in margin integrity was observed between the CMR materials where the highest leakage was achieved in the elevated mesial flowable group while the lowest leakage was achieved in the elevated mesial RMGI group.

B- Effect of the CMR technique on marginal integrity of the final resin composite restoration (before and after the TML).

The result of the present study (Fig. (5) revealed that no significant difference in marginal integrity between elevated mesial group (whether with FR or RMGI) and non-elevated distal group.

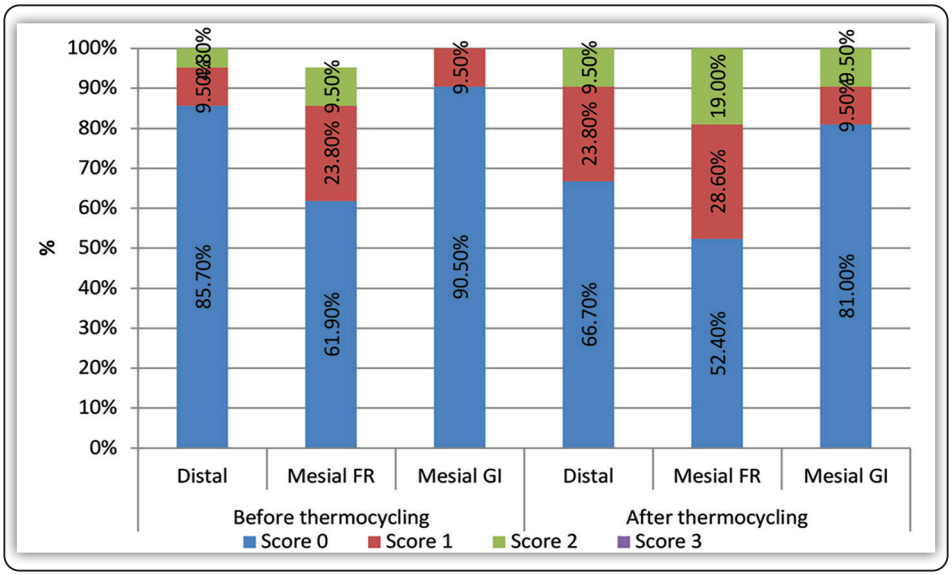

FIG (5) Bar chart showing the distribution of Micro leakage Scores % in all groups (before and after the TML).

DISCUSSION

(CMR) a non-invasive preparation in deep Class II cavities with cervical margins beneath the (CEJ). It entails applying a tofflemire matrix first, Then instantaneous dentin sealing and lifting the deep sub gingival margin of a cavity utilizing flowable composite as a base layer. Additionally, using this method enables the implantation of substantial direct composite resin restorations [9,17].

The fluids leakage between the tooth surface and the material is known as microleakage. It arises from a breakdown at the tooth-restoration interface, which causes pulpal inflammation, recurrent caries, and tooth discoloration [18,19]. The composition, flow, elasticity, and stresses brought on by the cavity preparation method can all have an impact on a material's capacity to restore a cavity [20].

The most popular techniques to mimic the physiological aging that biomaterials go through in clinical settings are thermal and mechanical loading. A temperature range of 5 –55ºC was suggested as an appropriate aging technique in an ISO standard[21,22].

The null hypothesis in this study which had no significant effect on marginal integrity whether CMR will be used or not was partially accepted.

In the current study the result of the effect of the (CMR) materials on marginal integrity of Zenit nanoceramic composite restoration (before and after TML) (Fig (5)) illustrated that significant difference was observed in margin integrity between the CMR materials (before and after the TML) where the highest leakage was achieved in the elevated mesial flowable resin group while the lowest leakage was achieved in the elevated mesial resin glass ionomer group.

The capacity of RMGI beneath the composite in CMR to decrease stresses that arise during insertion and polymerization shrinkage can be used to explain the prior result. CMR may therefore enhance the marginal adaptation of indirect restorations [8].

The previous finding was consistent with **Lefever** [23] who reported that the marginal integrity of supragingival uplift the cervical margins is significantly affected by the gingival relocated materials.

The previous outcome was also in accordance with **Zavattini** [24] who reported that the flowable composites offer an adequate or even superior marginal seal than nanohybrid and bulk-filled composites. After the TML, they are more prone to deterioration.

The previous finding was not in agreement with **Grubbs** [11] who said that the mechanical fatigue and margin adaptation were not influenced by materials used for CMR: which were RMGI and bulk fill composite. This contradiction may be due to the type of final restoration (nanoceramic onlay), type of adhesive (RelyX), number of repeating thermal and mechanical cycles (100,000 cycles).

In the current research the result of the effect of the CMR technique on marginal integrity of Zenit resin composite restoration (before and after the TML).

Fig. (5) revealed that no significant difference was noted in marginal integrity between elevated mesial flowable resin, elevated mesial resin glass ionomer group and non-elevated distal group (before and after TML).

The prior outcome can be explained by the fact that CMR raises the cervical margin of deep preparations and offers instantaneous dentin sealing, which results in a reinforced collagen . Less marginal leakage is one of this technique's additional benefits [25].

The previous finding was in agreement with **Juloski** [9] who denoted that the durability of a flowable and a traditional packable composite had no significant difference between two different viscosity composites, with respect to microleakage.

The prior finding did not agree with **Dietschi**[26] who found that the flowable composites had a better marginal adaptability than stiff materials. This discrepancy may be caused by the fact that specimens were only treated to mechanical loading in prior studies while they were only submitted to TML in this investigation and MOD cavity was not extended below CEJ.

CONCLUSIONS

Cervical margin relocation technique seems to be promising acceptable technique to improve the marginal integrity. Marginal integrity in cervical margin relocation technique was material-dependent. Thermal and mechanical loading had no significant effect on marginal integrity regardless of cervical margin relocation technique.

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