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RESEARCH ARTICLE
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MEASURING THE SIDE EFFECTS OF DIFFERENT ROOT CANAL IRRIGATING SOLUTIONS ON BULK-FILL COMPOSITE BONDING TO CORONAL TOOTH STRUCTURE BY MICRO-TENSILE BOND STRENGTH EVALUATION

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Abstract:
Aim: To measure the bad effects of different root canal irrigating solutions on bulk-fill composite bonding to coronal tooth structure by Micro-tensile bond strength evaluation.
Method: 15 human permanent lower molars were selected for the present study. To standardize, every tooth has decoronated to 4 mm coronal to cementoenamel junction using diamond disc bur for standardization, and making sure that the hight of the pulp chambers wall is 3mm from pulp chamber floor. All teeth prepared by ProTaper rotary instruments up to size F3, ProTaper obturators #F3 were used to fill the root canals and resin sealer (ADSEAL) were used for filling the canals via the lateral

condensation method. 2 mm apically of the coronal gutta percha was removed to make a space for liner material. Glass ionomer restorative was used as liner material over the gutta percha to the level pulp chamber floor. The obturated teeth were then randomized divided into three identical test groups **Group A (Sodium hypochlorite)**, **Group B (Chlorhexidinle)**, and **Group C (EDTA)** of 5 molars each in accordance with the final irrigation solution used in the pulp chamber. Each test group was received 1ml from the tested irrigation solution according to the groups for 1minute and received ultra sonic irrigation for 20 seconds. These steps were repeated 4 times to reach 5 minutes final. then pulp chamber walls irrigated by saline for 1 minutes. The dentin surface was coated with a self-etch adhesive technique. A 3mm Single layer of composite resin 3M™ Filtek™ One Bulk Fill Restorative were bonded on the treated dentin surfaces. Micro-tensile bond strength test was used to measure the bond strength of bulk-fill composite bonding to coronal tooth structures.
Results: The highest mean value of micro tensile bond strength was recorded in **group B (Chlorhexidine) 19.80 ± 1.42** with statistically significant difference (**P value = 0.015**) in comparing with the other two test groups**,** the **group A (Sodium hypochlorite)** recorded **14.38 ± 0.91,** while **group C (EDTA)** recorded the lowest values of micro tensile bond strength **12.95 ± 1.38**.
Conclusion: Chlorhexidine has less hazards effects on Micro-tensile bond strength of composite bond to coronal dentine when comparing to Sodium hypochlorite and EDTA**.**

Introduction:

Endodontic treatment, which involves extracting the whole components of the root canal structure through shaping, is a standard method for maintaining non-vital teeth. For a cleaning to be effective, chemicals must be dissolved from inaccessible areas, irrigation agents must be used to wash off loose debris, and tools must be used to manually remove dentin [(1)].
On other hand the success of root canal therapy depends on both apical and the coronal sealing of bonded restorations [(2,3)]. When the final restoration fails, microorganisms and their toxins in the root canals may influence the prognosis of endodontic treatment [(4)].
As bulk-fill composite used widely in dental clinics, their efficacy and ability to substitute conventional composites have not yet been confirmed. The most often asked questions to have mostly to do with the proper polymerization within the thicknesses specified by the producers. which, if insufficient, might compromise the restoration's long-term survivability and its mechanical and biological compatibility qualities [(5)].
Numerous endodontic irrigation agents are often utilized, such as as citric acid (CA), ethylenediaminetetraacetic acid (EDTA), sodium hypochlorite (NaOCl), and chlorhexidine (CHX) gluconate. Such substances all have different characteristics, and they may interact with dentin in rather different ways. For instance, whereas NaOCl is a potent antibacterial, its inhibition of resin polymerization may have a deleterious influence on bond strength [(6)]. On the other hand, CHX gluconate, has a broad spectrum antibacterial [(7)].
Some studies demonstrated that the irrigants which used during root canal therapy reduced the dentin bond strength of bonding agents [(8,9)]. However, in other studies, endodontic irrigating solutions did not significantly influence bond strength [(10,11)].
So, our present study was directed to test the bad effects of different root canal irrigating solutions on bulk-fill composite bonding to coronal tooth structure by Micro-tensile bond strength evaluation.

Materials and methods:

For the current investigation, 15 human permanent lower molars that had just been removed and showed no signs of decay or other problems were chosen. All molars were kept in distilled water at room temperature to avoid dehydration [(12)]. All teeth were examined under a magnification lens to check for cracks. To guarantee uniform pulp chamber shape, radiographs of every tooth were taken in the buccolingual and mesiodistal orientations.

The included criteria of the selected teeth:
The teeth were fully developed apex without interior resorption, decay, calcification of the canal, or history of endodontic therapy.
To standardize, every tooth has decoronated to 4 mm coronal to cementoenamel junction using diamond disc bur for standardization, and making sure that the hight of the pulp chambers wall is 3mm from pulp chamber floor.
To guarantee the apical patency of the canals, a K-file size 10 (Dentsply Maillefer, Switzerland) was transferred to the apex of each canal. The identical file was reinserted into the canal till it was observed through the apical foremen, at which point the working length (WL) was noted [(13)].
Dentsply Maillefer, Ballaigues, Switzerland provided engine-driven ProTaper rotary devices for the preparation of the root canals chemo mechanically, which were subsequently subjected to irrigation via 5,25% NaOCl. The final tool employed in the apical area was an F3 finishing file. Following preparation, the root canals were cleaned using 5,25% NaOCl, 0,9% NaCl, and 15% EDTA (for removal the smear layer) before being dried by paper points.
ProTaper obturators #F3 were utilized to fill the root canals and resin sealer (ADSEAL - Root Canal Sealer META BIOMED) were used for filling the canals via the lateral condensation method. 2 mm apically of the coronal gutta percha was removed to make a space for liner material.

liner material placement:
Glass ionomer restorative (Ketac™ N100 Light-Curing Nano-Ionomer Restorative Refill (3M™, ESPE, U.S.A) shade A3) was used as liner material over the gutta percha to the level pulp chamber floor.

Teeth grouping:
The obturated teeth were then randomized divided into three identical test groups **Group A (Sodium hypochlorite)**, **Group B (Chlorhexidinle)**, and **Group C (EDTA)** of 5 molars each in accordance with the final irrigation solution used in the pulp chamber.
Each test group was received 1ml from the tested irrigation solution according to the groups for 1minute and received ultra sonic irrigation for 20 seconds. These steps were repeated 4 times to reach 5 minutes final. then pulp chamber walls irrigated by saline for 1 minutes.

Dentin surface preparation:
All tooth specimens' occlusal dentin surfaces had been etched for 15 seconds using a 37% phosphoric acid solution (3M ESPE, Germany) following completely washing using distilled water and blotting-drying.

Resin composite restoration at coronal pulpal dentine:
The dentin surfaces were coated with a self-etch adhesive technique (3M ESPE, USA) in accordance with the manufacturer's directions. A 3 mm Single-layer of composite resin 3M™ Filtek™ One Bulk Fill Restorative (3 M ESPE, USA) was applied to the pretreated dentin surfaces at ambient temperature. The composite was subsequently polymerized for 20s utilizing a VALO (Ultradent) LED light-curing device (LCU) that provided an irradiation of 1000 mW/cm2.

Micro tensile bond strength testing:
Micro-tensile bond strength test (μ-TBS) the tooth crown was removed just apical to the cementum enamel junction by 2mm using a diamond blade set at a slow speed (Isomet, Buehler Ltd., USA). In order to micro-tensile evaluation, three or four slabs of 6 3mm in height from the composite and the tooth structures (3mm of composite and 3mm of the tooth structures), width and thickness were 4 mm and 1 mm, respectively, were obtained via buccolingual sectioning of the samples, and every group included ten experimental samples (two specimens from each tooth). After that, the slabs were cut into a cylindrical form with an ordinary diamond bur (TF13/TF11, MANI, Japan). For every sample,

the adhesive interface's smallest cross-sectional diameter was around 1.0 mm2 [14]. Using an electronic micrometer, the ultimate bonded zone width and thickness were determined to the nearest 0.01 mm. Using cyanoacrylate adhesive, every sample were attached to a Geraldelli jig and tensioned (using a Micro-tensile tester from Isomet, USA) at a crosshead speed of 1 mm/min until failure [15]. With dividing the force applied at breakdown by the cross-sectional bonding region, bond strengths were computed (figure 1).

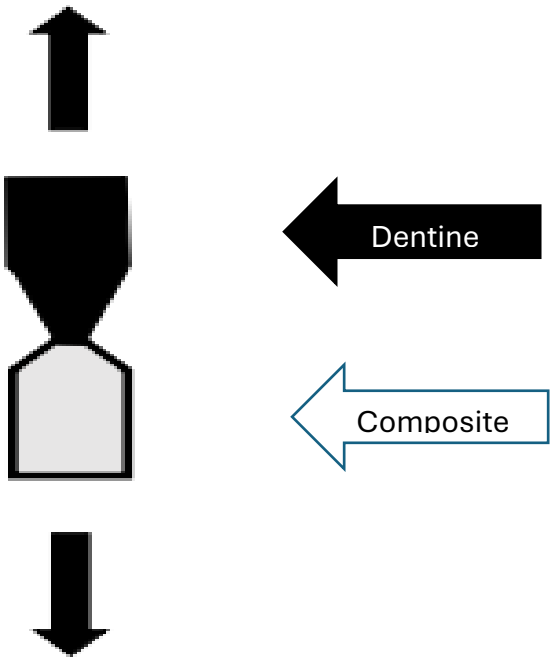

Figure (1): A photograph showing a schematic diagram for preparing the specimen to be measured by the Micro-tensile bond strength.

Statistical evaluation:

Using the Kolmogorov-Smirnov test (SPSS 17.0 software; SPSS Inc., Chicago, IL, USA), the normality of the variable distribution was assessed. A one-way ANOVA was then used to statistically analyse the micro-tensile bond strength data. Tukey's test was used for post hoc analysis.

Results:

Table 1 and Figure 2 exhibit the averages and standard deviations of the micro tensile bond strength. The highest mean value of micro tensile bond strength was recorded in **group B (Chlorhexidine) 19.80 ± 1.42** with statistically significant difference (**P value = 0.015**) in comparing with the other two test groups**,** the **group A (Sodium hypochlorite)** recorded **14.38 ± 0.91,** while **group C (EDTA)** recorded the lowest values of micro tensile bond strength **12.95 ± 1.38**.

Table (1): Micro-tensile bond strength means scores (means ± standard deviations).

Groups	means ± standard deviations
Group A: (Sodium hypochlorite)	14.38 ± 0.91^{B}
Group B: (Chlorhexidine)	19.80 ± 1.42^{A}
Group C:(EDTA)	12.95 ± 1.38^{B}
P value	0.015

Different letters indicate a significant difference.

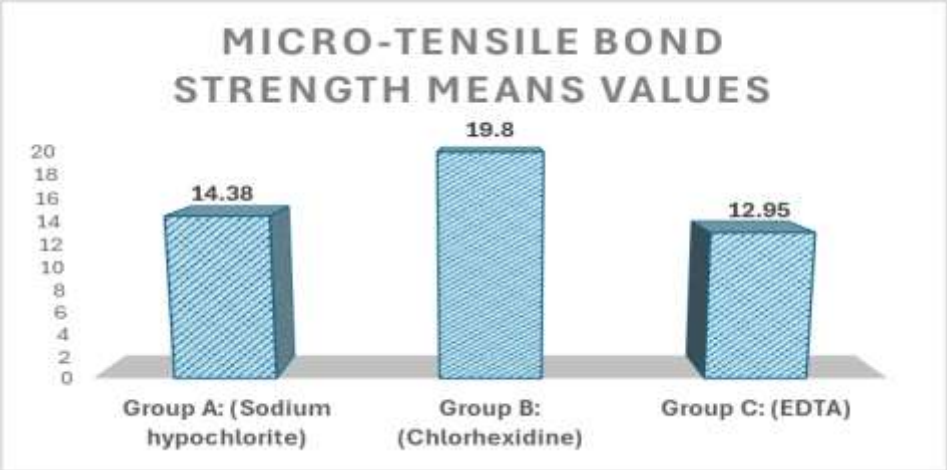

Figure (2): A photograph showing the Micro-tensile bond strength means values.

Discussion:

Improved bond strength between the ultimate restoration and the dentin surfaces after root canal therapy boosts the restorations' longevity, mechanical durability against mastication forces, and marginal sealing, all of which are critical for the long-time clinical effectiveness of the restorative procedure [(16)].

In the same field our present research was directed to measure the bad impact of different root canal irrigating solutions on bulk-fill composite bonding to coronal tooth structure by Micro-tensile bond strength evaluation.

The tested solutions used in this study were **Sodium hypochlorite** in Group A, **Chlorhexidine** in Group B, and **EDTA** in Group C. On other hand we used Micro-tensile bond strength to test the adhesion strength of bulk-fill composite bonded to pulp chamber dentine.

We used these three irrigating solutions in our study, because they are commonly used in dental clinics.

All steps of root canal were done in natural teeth instead of using the tooth crown only for testing the bad effect of root canal irrigating solutions on bulk-fill composite bonding to coronal tooth structures by Micro-tensile bond strength evaluation to mimic the clinical situation.

To standardize, every tooth has decoronated to 4 mm coronal to cementoenamel junction using diamond disc bur for standardization, and making sure that the hight of the pulp chambers wall is 3mm from pulp chamber floor.

In this study we used Bulk Fill Restorative to put 3 mm single layer of composite. Also, we used Micro-tensile bond strength evaluation due to the most popular test for assessing how well adhesive systems bond is the evaluation of the bond strength of small samples (less than 1 mm2 in cross-sectional area). This test has a homogeneous strain and stress area, which is crucial for achieving the majority of bond interface failing [(17)].

In concerning the results, the study revealed that the highest mean value of micro tensile bond strength was recorded with **group B (Chlorhexidine)** with statistically significant difference in comparing with the other two test groups**, group A (Sodium hypochlorite)**, and **group C (EDTA)** which recorded the lowest scores of micro tensile bond strength.

The hybrid layer's deterioration at the dentin adhesive contact is primarily responsible for the reduction in bond strength. Several papers have shown that bond durability is absent. In summary, dentin collagen fibril degeneration is one of the processes that leads to bond breakdown [(18 – 20)].

The explanations of our results may be because of the three irrigating materials on dentine, which is: **Chlorhexidine**: Considerably enhance the hybrid layer's durability [(21)]. **Carrilho *et al.*** [(22)] assessed CHX's impact on the durability of the resin-dentin bond. The outcomes demonstrated a much greater bonding strength maintenance with CHX.

Sodium hypochlorite: NaOCl degrades dentin because it dissolves dentinal collagen [23]. Furthermore, because leftover NaOCl generates oxygen, it could hinder polymerization of the resin bonding agent.

EDTA: Is made up of multiple minerals, the most common being calcium disodium EDTA and disodium EDTA. Soluble calcium chelates are created when EDTA combines with the calcium ions in dentin. According to reports, dentin was decalcified by EDTA in 5 minutes to a depth of 20–30 μm [24].

Our results were like **Erdemir *et al.*** [25] showed that NaOCl considerably reduced the bond strength of the C & B Meta bond to the root canal dentin. According to **Shinohara *et al.*** [26] the utilization of NaOCl enhanced microleakage across dentin edges, which based on the adhesive technique employed. Moreover, according to research by **Morris *et al.*** [27] stated that NaOCl and EDTA both dramatically weakened the resin cement's connection with root dentin.

On other hand the results were contradicting to **Correr *et al.*** [28] showed that the dentin bond strength was unaffected by using NaOCl irrigation solution. **Wachlarowicz *et al.*** [29] looked at how dentin bond strength were affected by frequently used endodontic irrigation solutions. They discovered that only NaOCl increased the dentin bond strength. In the same way **Bohrer *et al.*** [30] revealed that the use of endodontic irrigating solutions does not negatively influence bond strength of adhesives to occlusal enamel as well as dentin.

Conclusion:

Chlorhexidine has less hazards effects on Micro-tensile bond strength of composite bond to coronal dentine when comparing to **Sodium hypochlorite** and EDTA**.**

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