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ORIGINAL RESEARCH

Evaluating the Influence of Irrigants on Coronal Microleakage of Various Adhesive Restorative Materials Using Polymicrobial Marker: A Prospective Study

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ABSTRACT

Introduction: Failure in achieving the coronal marginal integrity could possibly questions the prognosis of the endodontically treated teeth. The success and the aim of an endodontic therapy tends to reduce infection in the root canal system and to eliminate reinfection from the apical and coronal region.

Materials and Methodology: A total of 80 freshly extracted, intact human mandibular premolars were selected and being used for this study. 40 samples were irrigated with 2 mL of 3% sodium hypochlorite and 17% EDTA, finally rinsed with saline. For another 40 samples irrigation regimen was 2 ml of 3% sodium hypochlorite and tublicid plus, finally rinsed with saline. Coronal section of 4 mm length was used in this study which was further obtained by sectioning tooth horizontally with diamond disk. All the samples were prepared so that they have a through and through channel and were coated superficially with three layers of nail varnish and were then autoclaved. Each group comprising of 40 samples were again sub grouped into two such that each has 20 teeth (n=20) and restored with nanocomposite and nano glass ionomer cement based on the manufacturer protocols.

Results: Sample was irrigated with EDTA and further restored with nanocomposite demonstrated maximum leakage with mean number of days at which leakage occurred was 55.82 and least microleakage was seen with samples that were irrigated with tublicid plus and restored with nanocomposite with mean number of days at which leakage observed was at 71.32.

Conclusion: To conclude that no material could possibly replace lost tooth structure. Either the irrigants or the restorative materials may not effectively prevent microleakage. Therefore, from this study, definitive treatment like crown placement should be done without any delay in order to achieve a good prognosis of the endodontic treatment. Failing to do so could result in a fatal prognosis and outcome of the endodontically treated teeth.

Keywords: Root Canal Irrigants, Marginal Leakage, Polymicrobial Marker, Adhesive Restorative Material.

INTRODUCTION

The success and the aim of an endodontic therapy tends to reduce infection in the root canal system and to eliminate reinfection from the apical and coronal region. While both the apical and coronal microleakage are the major causes that leads to root canal treatment failure and coronal leakage is proved to be a the most important factor in deciding the clinical outcome of the therapy.[1]When thereis inadequate coronal seal, long term success rate remains a havoc and the failure to maintain the seal might expose the obturated root canals with microbes that could possibly retard the healing process and thus it may create an infection in the peri-radicular, periodontal ligament or supporting bone structure.[2] The orifice bonding concept was introduced on the fact that the use of certain material to completely seal the orifice, in addition to the restoration could possibly reduce the bacterial leakage if that restoration was postponed, vanished or became unfunctional.[3] A coronal restorative material is thought to be effective when it could able to ascertain few properties that include good sealability, abrasion and compression resistance, lack of porosity, easy manageability, intracanal medicament compatibility and effective aesthetic appearance.[4]

A study conducted by *Webber* et al (1978) established that the sealing ability of the temporary coronal restorationmight be decreased over time. Taken this into account, permanent restorative materials such as glass ionomer or composite resin should be placed as an extra layer under the intermediate restorative materials to effectively seal the pulp chamber.[5]*Ray* and *Trope*quoted that the technical quality of the coronal restoration might significantly be more important than the quality of endodontic treatment for apical periodontal health.[6]Basedon the type of material being used and the exposure time to the oral cavity, all the temporary materials mayget leaked to a certain extent and the degree to which various temporary filling materials having the capability of establishing and maintaining a good coronal seal remains questionable.[7]Many studies have reported that the materials such as Cavit, Composite, Pro Root Mineral Trioxide Aggregate, Intermediate Restorative Material, Super Ethoxy Benzoic Acid are equally beneficial in preventing coronal microleakage.[8]Certain in-vitromethodologies are used to quantify the quality of sealing. Some methods like dye penetration and fluid filtration observes high reproducibility.[9]Few studies have hypothesized that the effect of depth of placement of intra-orifice sealing agent on the coronal micro-leakage in some endodontically treated teeth.

Hence, the aim of the present study was to evaluate and compare coronal microleakage of two different adhesive restorative cements placed in pulp chamber following various irrigant regimens.

MATERIALS AND METHODOLOGY

A total of 80 freshly extracted, intact human mandibular premolars were selected and being usedfor this study. Processing of the teeth involves the immersion in 3%Sodium hypochlorite for 15 min to dissolve organic tissue remnants from the root surfaces followed by their storage in saline solution till the beginning of the study.Access cavity preparation was done in all the teeth that are selected for the study using Endoaccess bur#3 and the patency was checked with 15 size k-file. Coronal enlargement was done with Gates glidden drill #4. The cusps of all teeth were flattened completely,and the crown portion of the tooth was selected for the study purpose. 40 samples were irrigated with 2mL of 3%sodium hypochlorite and 17% EDTA, finally rinsed with saline. For another 40 samples irrigation regimen was 2ml of 3%sodium hypochlorite and tublicid plus, finally rinsed with saline. Coronal section of 4mm length was used in this study which was further obtained by sectioning tooth horizontally

with diamond disk. All the samples were prepared so that they have a through and through channel and were coated superficially with three layers of nail varnish and were then autoclaved. Each group comprising of40 samples were again subgrouped into two such that each has 20 teeth (n=20) and restored with nanocomposite and nano glass ionomer cement based on the manufacturer protocols.

Group 1: 2ml 3%NaOCl + saline rinse + EDTA + final rinse with saline and restored with nanocomposite. Group 2: 2ml 3%NaOCl + saline rinse + tublicid plus + final rinse with distilled water and restored with nanocomposite.

Group 3: 2ml 3%NaOCl + saline rinse + EDTA + final rinse with saline and restored with nano glass ionomer cement.

Group 4: 2ml 3%NaOCl + saline rinse + tublicid plus + final rinse with distilled water and restored with nano glass ionomer cement.

In order to attain aging process artificially, all samples were subjected to thermocycling with 150 cycles at 5ºC and 55 ºC for dwell time about 30 sec.Various methods have been applied to reveal the sealing capability of the materialsbut owing to the limitations of dye process, radioisotopeand pressure driven fluid transport methods, bacterial challenge might provide a reliable indicator of clinical implicationswhich is followed by a microbiological study.The samples were placed in a specialised tubes called ependroff tubes and sealed with acrylic and cyanoacrylate adhesive such that small part of the tooth was suspended out of the specialised tubes which are meant to be in contact with the sterile broth in a glass-bottles of 100cc volume. After following an adequate autoclaving procedure, brain heart infusion broth inoculated with Enterococcus faecalis, Candida albicans for one day and were placed in the ependroff tubes and sterile brain heart infusion broth was also placed in glass bottles. All the samples were placed in an incubator at 37 ºCand routinely for every 5days the brain heart infusion broth inoculated with Enterococcus faecalis, Candida albicans in ependroff tubes was further replaced with fresh bacteria inoculated broth. And for upto 3 months, the samples were observed for turbidity every dayfor effective visualisation of the occurrence of microleakage.Record must be maintained and the day of occurrence of turbidity was noted. Results were statistically analysed usingkruskal-walis ANOVA test and Chi-square test.

RESULTS

Kruskal-Wallis one way ANOVA test and Chi-square test was followed to statistically analyse the sealing ability of the restorative materials which is effectively placed after the removal of smear layer by irrigating with various irrigation solutions. It was noted that there was no significant difference observed between the four groups. Sample was irrigated with EDTA and further restored with nanocomposite demonstrated maximum leakage with mean number of days at which leakage occurred was 55.82 and least microleakage was seen with samples that were irrigated with tublicid plus and restored with nanocomposite with mean number of days at which leakage observed was at 71.32.

Table 1: Mean number of days at which the leakage occurred in each group

Groups	Mean number of days	SD
Ketac N100 with EDTA	63.45	8.32
Nano composite with EDTA	55.82	12.45
Ketac N100 with tublicid plus	56.67	4.92
Nano composite with tublicid plus	71.32	7.66
Total	61.81	8.45
F – value	6.9324	
P – value	0.0008	

DISCUSSION

The process of microleakage could be defined as a clinically undetectable/unnoticedseepage of bacteria, fluids, molecules or ions between a cavity wall and the restorative material that was placed to it. Certain properties like the integrity and durability of the marginal seal have been considered as the prime concern in studying the performance of various dental restorative materials. Microleakage could possibly be identified as a dynamic phenomenon when viewed or examined clinically. Coronal leakage is considered to be the important factor in determining the prognosis of an endodontic treatment. In recent days, attention has been directed on the procedures that were performed to attain an effective coronal seal immediately after the completion of the root canal therapy.[10]Post endodontic restoration with adhesive filling material effectivelyallows the transmission of functional stresses along the bonded interface onto the tooth.[11,12] For adhesive cement to effectively bond to tooth structure, the adherend should always be free from surface contaminants such as smear layer which is generated during the instrumentation and can be forced 1-5 mm into the dentinal tubules, to make a smear plug that could possibly reduce the dentine permeability. The layer that is formed is fairly acid labile and can easily be dissolved by fluids with the pH ranged between 6.0 - 6.8. Some bacteria have the ability which may degrade the smear layer throughfew proteolytic enzymes that reduce the collagen component rather than the hydroxyapatite component. When the smear layer is not subjected to be removal, it acts as a substrate for the bacterial growth since the smear layer has the great susceptibility for the bacterial growth and penetration.[13] Lack of adhesion and sealing between the final restoration and tooth structure could effectivelyallow the movement of micro-organisms or their toxins along canal walls or through voids in root canal filling material to the periapical areas and thereby compromising on the prognosis of non-surgical endodontic treatment. When there is compromise in the marginal seal, hypersensitivity to thermal and osmotic stimuli could be noticed which causes hydrodynamic fluid movement through a degrading smear layer into the patent dentinal tubules that is lying underneath the coronal restoration.

So the desirable property of the irrigants is that they should possess the property of smear layer removal and also revealed that the canal surfaces left without a smear layer could allow easy penetration of filling materials into patent dentinal tubules, increasing the contact surface, improving mechanical retention and reducing the possibility of microleakage through the filled canal which is independent of the obturation technique that has been followed during the endodontic therapy.[14,15] The type of irrigant was found to be positively eliminate coronal microleakage. An ideal irrigants should have the ability to eliminate smear layer.[16]In order to attain these properties manyroot canal irrigants are used either alone or in combination with other irrigants. In this study sodium hypochlorite, EDTA and tublicid plus were effectively used since sodium hypochlorite is the most popular and well advocated irrigant that has various properties which could contribute to achieve chemical debridement of the root canal system such as antibacterial and lubricant effect and has the capability of dissolution of tissue remnants and flushing out loose debris.But it lacks the capacity to remove the smear layer from the dentin wall. Various chelating agent solutions such as EDTA could decalcify and soften dentin thereby eliminating the inorganic component of the smear layer. Therefore, a proteolytic agent like NaOCl is administered for dissolving inorganic tissue components.[17] The advantage of this single mixture is that it has chelating as well as organic solvent action. This will prevent the usage of a large volume of combination solution in order to remove the smear layer.[18]So the probability of various combination of solutions such as ethylene diamine tetra-acetic acid (EDTA) and NaOCl is effectively used to remove the smear layer from the root canal walls. But the treatment with EDTA left a chelated layer of dentine at the dentine-root filling interface which could contribute additionally to ongoing demineralization, which results in further increase of apical-leakage.

Therefore, owing to these limitations, the quest for the search for a better root canal irrigant is not stopping.[19]Tublicid plus which has the same action of EDTA was used in this study to compare the efficacy of sealing ability of restoration. Kruskal-Wallis one way ANOVA test and Chi-square test was followed to statistically analyse the sealing ability of the restorative materials and was observed that there was no significant difference among the four groups in the process of preventing coronal microleakage. It was observed that samples irrigated with tublicid plus and restored with nanocomposites revealed better sealing ability and least sealing ability was seen with group restored with samples irrigated with EDTA and restored with nano glass ionomer cement.

CONCLUSION

To conclude that no material could possibly replace lost tooth structure. Either the irrigants or the restorative materials may not effectively prevent microleakage. Therefore, from this study, definitive treatment like crown placement should be done without any delay in order to achieve a good prognosis of the endodontic treatment. Failing to do so could result in a fatal prognosis and outcome of the endodontically treated teeth.

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