



RESEARCH ARTICLE

EFFECT OF INTRAORIFICE DEPTH ON THE SEALING ABILITY OF INTRAORIFICE SEALING AGENT – AN IN VITRO STUDY.

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Abstract

Aim: The present study was conducted to evaluate the effect of intraorifice depth on the sealing ability of intraorifice sealing agent using methylene blue as a dye tracer.

Material And Method: Twenty extracted premolars were decoronated, cleaned and shaped and obturated with guttapercha points and following which guttapercha was removed from each group at varying depths of 1mm, 2mm and 3mm respectively and these empty canal space were then filled with light cure glass ionomer cement as intraorifice sealing agent and then the microleakage was measured in each group by assessing the amount of dye penetration using a stereomicroscope by using methylene blue as the dye tracer after the specimens were sectioned longitudinally.

Results: According to the study conducted group 3 ($p=0.001<0.000$) showed less leakage when compared to the other three groups. However there was no significant difference between group 2 and group 1.

Conclusion: In the current study, GROUP 3 with 3 mm of light cure glass ionomer cement showed the least microleakage due to the superior sealing properties of the material.

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Introduction:-

Endodontic therapy aims to eliminate infection in the root canal system and to prevent reinfection from the apical and coronal directions. While both apical and coronal leakage are major causes leading to root canal treatment failure, coronal leakage is thought to be a more important factor deciding the clinical outcome.^[1] Without an adequate coronal seal, long term success remains questionable and failure to maintain the seal may expose obturated root canals to microbes that could retard healing and create infection in the periradicular, periodontal ligament or supporting osseous structure.^[2]

The concept of orifice bonding was introduced on the basis that the use of a material to seal the orifice, in addition to the restoration could mitigate bacterial leakage if that restoration was delayed, vanished or became unfunctional.^[3] A coronal filling material is considered to be effective when it is able to fulfill certain properties including good sealability, abrasion and compression resistance, lack of porosity, easy handling, compatibility with intracanal medicaments and good esthetic appearance.^[4]

Webber et al (1978) supported that the sealing ability of temporary fillings decreased over time . Realizing this , permanent restorative materials (glass ionomer or composite resin) were placed as an additional layer beneath these intermediate restorative materials to seal the pulp chamber.^[5] Ray and Trope stated that the technical quality of the coronal restoration may be significantly more important than the technical quality of endodontic treatment for apical periodontal health.^[6]

According to the type of material used and exposure time to the oral cavity , all temporary materials leak to some extent and the degree to which different temporary filling materials are capable of establishing and maintaining a good coronal seal is often questioned.^[7]

Different studies have shown that materials such as Cavit, Composite, Pro Root Mineral Trioxide Aggregate, Intermediate Restorative Material, Super Ethoxy Benzoic Acid etc are beneficial in preventing coronal microleakage.^[8]

Methodologies in vitro are used to estimate sealing quality. Commonly used traces are dyes, radioisotopes, bacteria and their by products such as endotoxins. Methods like dye penetration and fluid filtration shows high reproducibility.^[9]

Very few studies have postulated the effect of depth of placement of intraorifice sealing agent on the coronal microleakage in endodontically treated teeth. Hence the objective of this study is to evaluate the effect of intraorifice depth on the sealing ability of light cure glass ionomer cement (Ionoseal) when the glass ionomer cement is placed in to the endodontically treated teeth at 1mm, 2mm and 3mm depth respectively using methylene blue dye as the tracer.

Materials and methods:-

Selection and preparation of teeth:-

Twenty single rooted premolars with fully formed apices were selected for the study. Teeth with open apices, dilacerated root , with apical resorption or large carious lesions approaching the pulp were excluded. The sample teeth were thoroughly cleaned by removal of debris , soft tissue attachment and calculus from the tooth surface. They were then washed thoroughly under running water and kept preserved in saline ready for the use in the study. Teeth were decoronated at the cemento-enamel junction using diamond discs under copious irrigation. Standard lengths of the roots were adjusted to be 13mm.

Endodontic procedure:-

The biomechanical preparation of the teeth were initiated by the determination of the working length using a size no 10 K file until it appeared flushed to the apex. This measurement was then adjusted to 1mm short of the working length. Glide path was confirmed using a size no 15 K file and the canal orifices were uniformly enlarged using gates glidden drills up to size number 3. Following which the canals were prepared using the RevoS NiTi system (Micromega, Besancon , France) according to the manufacturer's instructions up to number 25 and 6% taper. During instrumentation the canals were thoroughly irrigated with 5.25% sodium hypochlorite and RC prep was used as the lubricant in between each instrumentation. Once instrumentation was completed the canals were rinsed with 2 ml 17% EDTA solution and a final rinse with chlorhexidine 0.2% w/v. Specimens were then dried with absorbent paper points and obturated with the corresponding guttapercha points with size no. 25 and 6% taper (Dentsply, Maillefer, Ballaigues, Switzerland) and AH Plus sealer (Dentsply, Detrey , Konstanz , Germany) and the samples were preserved in 100% humidity in a humidifier for 48 hours to allow complete setting of the sealer.

Teeth Specimens Grouping And Orifice Cavity Depth Preparation:-

At this stage, teeth specimens were randomly divided into four groups of five samples each (n=5) namely control group, group 1, group 2 and group 3.

Group 1: 1 mm of light cure glass ionomer as orifice barrier material.

Group 2: 2 mm of light cure glass ionomer as orifice barrier material.

Group 3: 3 mm of light cure glass ionomer as orifice barrier material.

Sealing of the excess guttapercha at the desired level of 1mm, 2mm and 3mm respectively and vertical compaction at the canal orifices were done using suitable sized pluggers. This left a 1mm, 2mm and 3mm empty canal orifice in the teeth in their respective groups which was verified by a graduated periodontal probe. This space was then

scrubbed and cleaned from excess sealer using cotton pellets and alcohol. Prepared orifice cavities were flushed with a 1ml of 17% EDTA solution followed by a final rinse with 1 ml saline and gently air dried.

Restorative Procedure:-

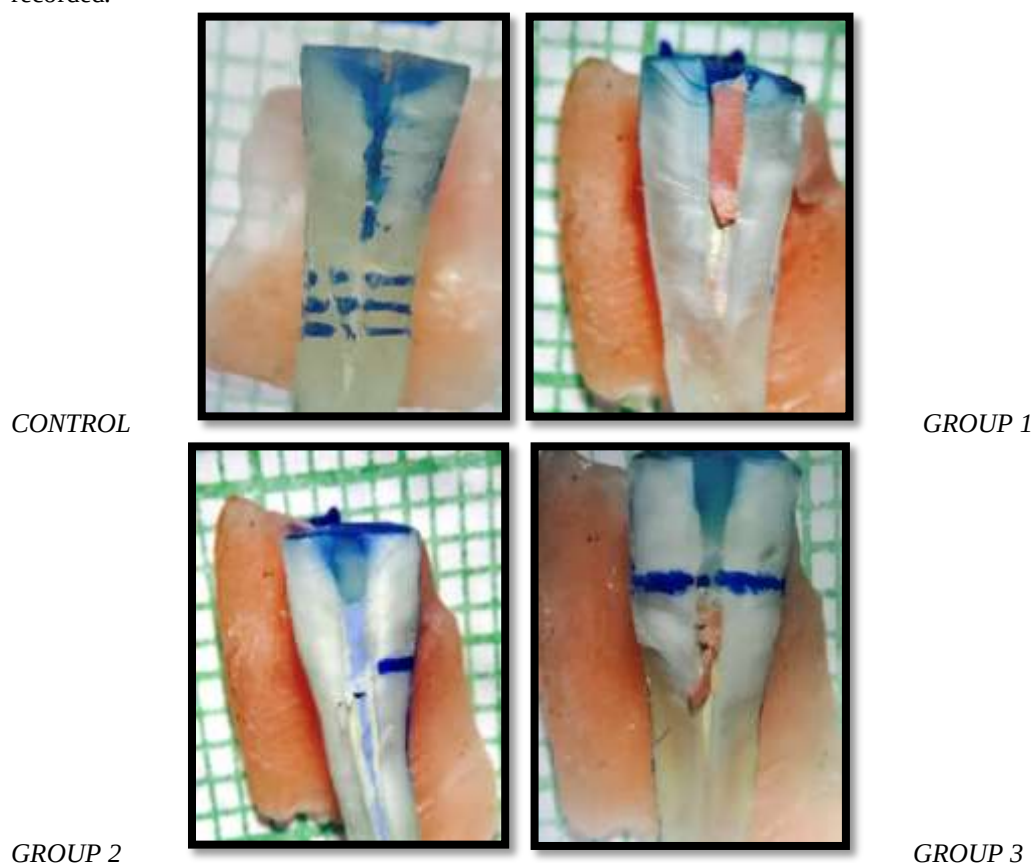
Experimental groups 1-3 except the control were allocated for orifice barrier filling using light cure glass ionomer (LCGIC;GCcorporation,Tokyo,Japan). The light cure glass ionomer cement was then syringed according to manufacturer's instructions into the experimental groups at 1mm, 2mm and 3mm empty canal orifices respectively and light cured. Each tooth specimen was placed into a coded tube and preserved in 100% humidity at 37°C for 48 hours to allow for complete experimental material setting.

Assessment procedure:-

For each specimen, root apex was blocked by sticky wax. Three layers of nail varnish was coated on to the root surface from cemento-enamel junction to the root apex except 1mm around the orifice barrier and allowed to dry. Samples were submerged in 2% methylene blue dye for 72 hours. Following this the teeth were rinsed under running water for 5 minutes and the nail varnish was removed using scalpel from the root surfaces. The teeth were then sectioned longitudinally using diamond discs under copious water spray.

Stereomicroscopic evaluation:-

The sections were then observed under a stereomicroscope and the images were then transferred to the computer software (Image J) and the depth of dye penetration in mm for each specimen was measured by measuring distance from the coronal extent of the orifice material to the greatest depth of penetration of the dye and the readings were recorded.

**Statistical analysis:**

Data was analyzed for significance by Analysis of Variance (ANOVA) and further pair wise comparison was performed by Bonferroni test.

Results:-

Findings of this study showed that there was dye penetration in to the prepared cavities in all the groups. An objective description of all the observations was recorded and statistically analyzed.

Control group: mean dye leakage value was 4.00 ± 0.79

Group 1: mean dye leakage value was 2.70 ± 0.76

Group 2: mean dye leakage value was 2.54 ± 0.46

Group 3: mean dye leakage value was 1.10 ± 0.82

Mean of group 3 is least followed by group 2, group 1 and the control group. ANOVA tests shows that there is significant difference as $p=0.000 < 0.001$. Further pair wise comparison by multiple bonferroni tests showed that when compared to the control group, group 3 is highly significant than group 1 and group 2 which showed significant difference as compared to the control group. Group 3 showed significant difference when compared to group 1 while group 2 did not show much significant difference when compared to group 1. When compared to group 2; group 3 showed significant difference in their values.

Table 1:-

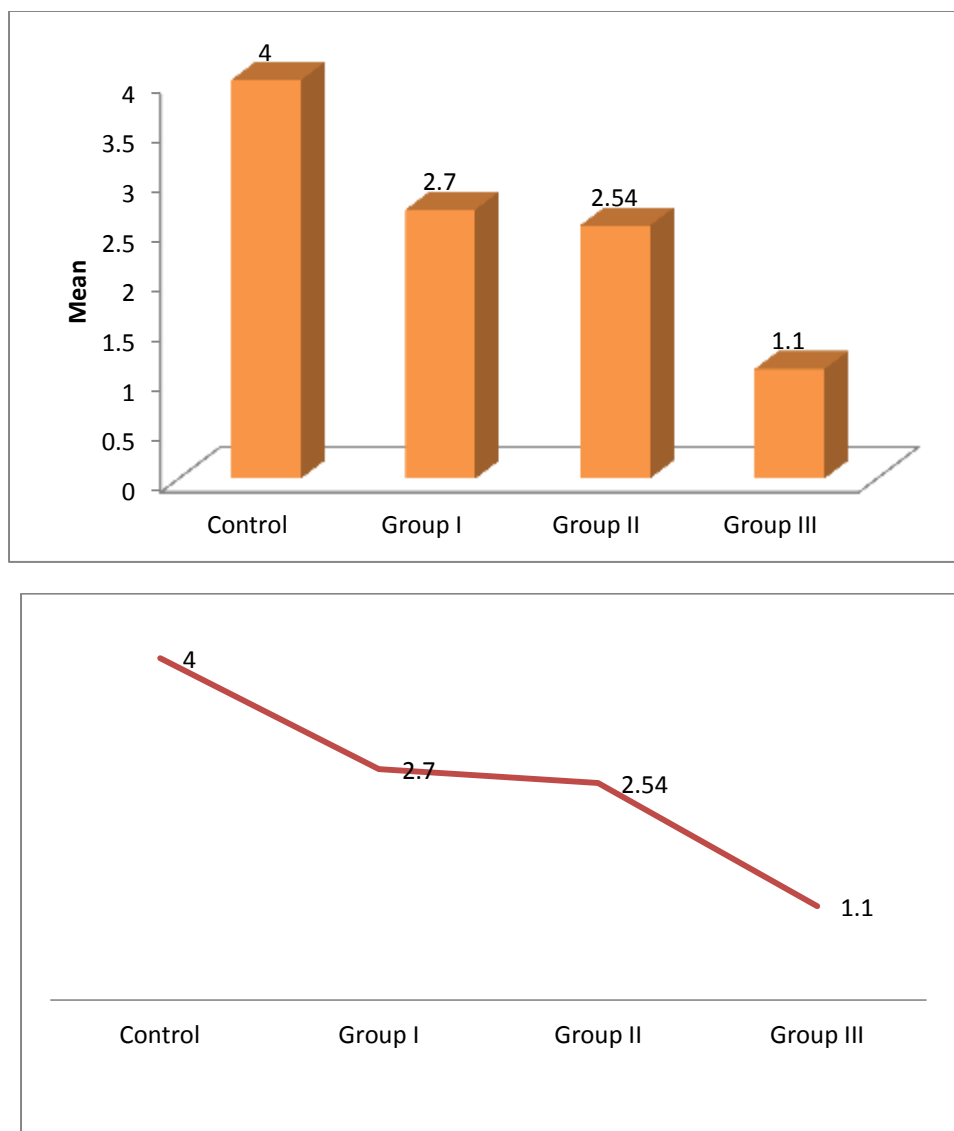
	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA F	p
				Lower Bound	Upper Bound		
Control	5	4.00	.79	3.02	4.98	13.515	.000 HS
Group I	5	2.70	.76	1.76	3.64		
Group II	5	2.54	.46	1.97	3.11		
Group III	5	1.10	.82	.08	2.12		

Table 2:-**Multiple Comparisons by bonferroni test**

Dependent Variable: Observation

Bonferroni

		Mean Difference	Std. Error	p	
Control	Group I	1.30000	.45640	.047	sig
	Group II	1.46000	.45640	.034	sig
	Group III	2.90000	.45640	.000	HS
Group I	Group II	.16000	.45640	1.000	NS
	Group III	1.60000	.45640	.018	sig
Group II	Group III	1.44000	.45640	.037	sig



Discussion:-

The goal of all the endodontic treatments is to achieve a three dimensional fluid tight seal. The failures seen in root canal treatments are usually caused when microorganisms and or their products gain access in to the canals due to an improper seal leading to microleakage in to the canals. Thus we need to take utmost care in creating best of the seals in all the three directions apically, coronally and laterally.^[10] Many anatomical parameters and clinical considerations can influence the outcome of non surgical root canal treatment. But the most commonly encountered problem influencing the long term success of root canal treatment is the microleakage.^[11] After the coronal seal is lost from the root canal treated tooth its just a matter of time for the contamination of the entire length of the root canal system by microorganisms and their by products.^[12]

The concept that one cause of failure of root canal treatment may be the result of coronal leakage is not a new one. Marshall & Massler in 1961 were concerned about the role of occlusal seal in root filled teeth. They wondered whether the overall seal of the root canal was altered if the seal was broken coronally. They also speculated on the prognosis of root-canal treatment if the quality of obturation of the root canal was poor, but the coronal seal was good. They undertook a leakage study using a radioactive tracer and showed that coronal leakage occurred despite the presence of a coronal dressing.^[13] Dye penetration method is simple, easier and cost effective to check the microleakage in root canal treated teeth.^[14]

Most leakage evaluations produced semi quantitative data. The most popular method was linear measurement of tracer(dye or radioisotope) penetration along a root canal filling. This method was based on the supposition that linear tracer penetration can indicate the length of the gap appearing the root canal filling and the root canal walls. Measurements were made after different methods of sample preparation such as longitudinal splitting of the root, making cross sections perpendicular to the longitudinal axis of the root or decalcification of clearing of the root using various other techniques.^[15] Microleakage dye penetration study designs face challenges related to the nature of the penetrating material (radioisotopes, liquid dyes, fluid filtration, and electro-chemical), which because of differences in molecular size, viscosity, surface tension, or decoloration could influence the penetration capability and detection.^[16]

This method for an immediate coronal seal in the orifice of the root canal immediately after root-canal therapy may prevent a short-term microleakage and provide a more logical choice for the placement of an adequate seal.^[17] Numerous materials have shown leakage but at varying depths.^[18] Parolia et al. stated that they selected 3.5mm material thickness to seal the canal orifices as it was previously recommended to be the minimum thickness required. However, this was reported in 1978 as the suitable depth of a temporary filling material and not for an intraorifice barrier.^[23] Although previous research supports the effectiveness of intra-orifice barriers, there is no consensus as to the protocol or material used as the coronal barrier after root canal treatment.^[19-21]

Based on this premise this study was done to evaluate the effect of intraorifice depth in the sealing ability of orifice filling materials using methylene blue as the dye tracer. Methylene blue was used in the present study because of its low molecular weight and penetrated deeply when compared to other dyes.^[5]

In the present study light cure glass ionomer cement was used as the orifice sealing material. The control group in the study did not have an orifice sealing material and showed maximum dye penetration through the root canal filling. Group 3 samples with 3 mm of orifice sealing material showed minimum microleakage when compared to group 1 samples and group 2 samples.

The reason behind minimal leakage in group 3 samples is suggestive of the fact that glass ionomer cement bonds chemically to the tooth structure by development of an ion exchange layer adjacent to the dentin and the shear bond strength of light cure glass ionomer cement is higher than that of conventional glass ionomer cement.^[2]

The ideal properties of an intraorifice barrier suggested by Wolcott *et al.* include the following characteristics: Easily placed, bonds to tooth structure, seals against microleakage, distinguishable from the natural tooth structure, and does not interfere with the final restoration.^[22]

The effect of depth of intraorifice sealing agent placed on the sealing ability depends on the properties of the materials which are used as orifice sealing agents. A minimum of 3mm depth of the orifice barrier material is required to provide a necessary seal. Different studies have stated varying depths for the placement of the orifice sealing material.^[23-26]

In the present study when the light cure glass ionomer cement is placed at a depth of 3 mm showed least microleakage because of its effective bonding to the root canal walls. Further studies need to be done comparing various orifice sealing agents at varying orifice depths to evaluate the most ideal intraorifice sealing material which can provide the best coronal seal in endodontically treated teeth to prevent coronal microleakage.

Conclusion:-

The present study concluded that light cure glass ionomer cement when placed at a depth of 3 mm as the orifice barrier showed least microleakage which is effective due to the superior sealing properties of the cement. Lack of coronal seal can be a detrimental factor contaminating the obturated root canal and in turn influence the treatment outcome. From this perspective it is important that the intracanal barrier should provide adequate coronal seal and prevent the entry of bacterial toxins into the root canal that compromises the success of the root canal treatment.

References:-

1. Jiang QZ, Zhang QI, Jie HE. An evaluation of intraorifice sealing material for coronal microleakage in obturated root canals. *Chin J Dent Res.*2009;12(1):31-6.
2. Parekh B, Irani RS, Sathe S, Hegde V. Intraorifice sealing ability of different materials in endodontically treated teeth: an *in vitro* study. *J Conserv Dent.* 2014;17(3):234-7.
3. GomaaMM, GhulmanMA. Evaluation of four materials as barriers to coronal microleakage in a novel intraorifice cavity design. *International journal of clinical dentistry* ;6(2):150-7
4. Shahi S, Samiei M, Rahimi S, Nezami H. In vitro comparison of dye penetration through four temporary restorative materials. *Iran Endod J.*2010;5(2):59-62
5. Malik G, P Bogra, Singh S, Samra RK. Comparative evaluation of intracanal sealing ability of mineral trioxide aggregate and glass ionomer cement: an *in vitro* study. *J Conserv Dent.* 2013;16(6):540- 45.
6. Wolanek AG, Loushine JR, Weller N, Kimbrough FW, Volkman RK. In vitro bacterial penetration of endodontically treated teeth coronally sealed with a dentin bonding agent. *Journal of Endodontics.*2001;27(5):354-7
7. Barrieshi-Nusair KM, Hammad HM. Intracanal sealing comparison of mineral trioxide aggregate and glass ionomer. *Quintessence Int.* 2005;36:539-45
8. Sanchez BEM, Castillo GS, Rodriguez GPM, Luque FMC. Intraorifice sealing ability of different materials in endodontically treated teeth. *Med Oral Patol Oral Cir Bucal.*2011 Jan 1;16 (1):e105-9.
9. Verisimmo MD, Vale DSM. Methodologies for assessment of apical and coronal leakage of endodontic filling materials-a critical review. *Journal of Oral Science.*2006;48(3):93-8
10. Divya KT, Satish G, Srinivasa TS, Reddy V, Umashankar K, Rao BM. Comparative evaluation of sealing ability of four different restorative materials used as coronal sealants: an *in vitro* study. *J Int Oral Health.*2014;6(4):12-7.
11. Shetty A, Srinivasan R, Nasreen F. Comparison of the sealing ability of mineral trioxide aggregate and three conventional restorative materials when placed coronally over gutta-percha as sealing material - An *in vitro* study. *Endodontology* : 15-22
12. Britto RL, Grimaudo JN, Vertucci JF. Coronal Microleakage Assessed by Polymicrobial Markers. *J Contemp Dent Pract* 2003 August;4(3):001-010.
13. Saunders WP, Saunders EM. Coronal leakage as a cause of failure in root-canal therapy: a review. *Endod Dent Traumatol* 1994; 10: 105-108.
14. Parolia A, Acharya RS, Saraswathi V, Ballal V, Mohan M. Sealing Ability of Four Materials in the Orifice of Root Canal Systems Obturated With Gutta-Percha. *Endodontology*:65-70
15. Wu KM, Wessellink RP. Endodontic leakage studies reconsidered. Part-1: Methodology, application and relevance. *International Endodontic Journal* 1993;26:37-43
16. Mavec CJ, Johnson DJ, Blundell ER. Effects of an Intracanal Glass Ionomer Barrier on Coronal Microleakage in Teeth with Post Space. *J Endod* 2006;32:120 -22
17. Sauaia TS, Gomes PFA, Pinheiro E, Zaia A A, Ferraz CCR, Souza FJ, Piracicaba et al. Microleakage evaluation of intraorifice sealing materials in endodontically treated teeth. *Oral Surg, Oral Med, Oral Pathol, Oral Radiol Endod.* 2006;102(2):242-46.
18. Yavari H, Samiei M, Shahi S, Aghazadeh M, Jafari F, Abdolrahimi M, Asgary S. Micro leakage comparison of four dental materials as intra orifice barriers in endodontically treated teeth. *Iran Endod J.*2012;7(1):25-30.
19. Yavari H, Samiei M, Eskandarinezhad M, Shahi S, Aghazadeh M, Pasvey Y. An *in vitro* comparison of coronal micro leakage of three orifice barriers filling materials. *Iran Endod J.* 2012;7(3):156-60.
20. Wolcott JF, Hicks ML, Himel VT. Evaluation of pigmented intraorifice barriers in endodontically treated teeth. *J Endod.* 1999;25(9):589-92.
21. Bailon-Sanchez ME, Gonzalez-Castillo S, Gonzalez-Rodriguez MP, Poyatos-Martinez R, Ferrer-Luque CM. Intraorifice sealing ability of different materials in endodontically treated teeth. *Med Oral Patol Oral Cir Bucal.* 2011;16(1):e105-9.
22. Baryam HM, Celikten B, Baryam E, Bozkurt A. Fluid flow evaluation of coronal microleakage intraorifice barrier materials in endodontically treated teeth. *Eur J Den.*2013;7(3):359-62.
23. Ghulman AM, Gomaa M. Effect of Intra-Orifice Depth on Sealing Ability of Four Materials in the Orifices of Root-Filled Teeth: An Ex-Vivo Study. *International Journal of Dentistry.*2012
24. R. M. Jack and G. G. Goodell, "In vitro comparison of microleakage between resilon alone and gutta-percha with a glass-ionomer intraorifice barrier using fluid filtration model," *Journal of Endodontics*, vol. 34, no. 6, pp. 718-720, 2008.
25. Z. Mohammadi and A. Khademi, "An evaluation of MTA cements as coronal barrier," *International Endodontic Journal*, vol. 1, pp. 106-108, 2006.
26. S. Jenkins, J. Kulild, K. Williams, W. Lyons, and C. Lee, "Sealing ability of three materials in the orifice of root canal systems obturated with gutta-percha," *Journal of Endodontics*, vol. 32, no. 3, pp. 225-227, 2006.