INFLUENCE OF INTRACANAL MEDICAMENT ON APICAL SEAL

ABSTRACT

AIM OF THE STUDY:

Calcium hydroxide is the most routinely used intracanal medicament and has antibacterial properties; it enhances hard tissue formation, dissolves tissue, and inhibits tooth resorption. It is known that the triad of preparation, disinfection and maintaining adequate seal is the key to successful endodontic treatment. .Therefore it is essential to know the effect of Ca $(OH)^2$ hydroxide on apical seal, in order to reduce the chances of endodontic failure. Therefore, the aim of this study is to evaluate the effect of intracanal medicament on apical seal.

STUDY DESIGN:

Quasi Experimental study

PLACE OF THE STUDY:

The samples were prepared at Ziauddin University and was analyzed at Karachi University

METHODOLOGY

Mandibular premolars were prepared using step back technique and were divided into two groups A (no intracanal medicament) and Group B (intracanal medicament was placed). Samples were placed in Indian ink dye for 7 days and were then cleaned in running water and clearing process was carried out before sectioning up to 5mm (1mm each) using Microtome and analyzed under stereomicroscope. Shapiro-Wilks test and Mann Whitney U test was used.

RESULTS

Group with intracanal medicament showed least amount of dye penetration i.e. mean value 2.30±1.832 as compared to non-medicated group mean value (2.96 ±1.69) but the results were not statically significant p value 0.072.

CONCLUSION

The results of this study concluded that there is no statistically significant difference in leakage between group A and group B (i-e non-medicated and medicated group).

KEY WORDS

Intracanal medicament, Endodontic therapy, Apical Seal, Non-setting Calcium hydroxide.

INTRODUCTION

In dentistry, lots of advancement has taken place in endodontics directed towards prevention and management of pulpal and per radicular disease. Aim of endodontic therapy is to restore the natural tooth functionally as well as esthetically [1] The success of the treatment depends predominantly on the reduction or complete eradication of pathogens and their byproducts, as it has been abolished in the Millers report that presence of micro biota is major deterrent for the initiation and perpetuation of pulp and periapical diseases. [2, 3] Therefore, the main goal of therapy is to eliminate or reduce amount of causative agent leading to infection of pulpal and periapical tissue. [4, 5]. Since, complete removal of microorganisms from root canal system is not possible through mechanical cleaning due to complexity of root canal anatomy (Fig 1), an effective antimicrobial agent as intracanal medication (Table 1) should be used to improve treatment outcome as its proven from different studies that medicaments placed inside the canal could markedly affect the diversity and quantity of cultivable microorganisms in infected canals ([6, 7].

The antimicrobial substances used as an intracanal medicament are classified into five main groups 1) Antibiotics (2) Calcium hydroxide (3) non-phenolic biocides (4) phenolic biocides (5) Iodine compounds[8] . But, in modern therapy, Calcium hydroxide, introduced by Herman as a pulp capping agent, is the highly recommended and widely used interappointment intracanal medicament based on its antimicrobial, antiresorptive and tissue dissolving property [9] The bactericidal effects of this intracanal medicament are due to several mechanisms i.e. a) Chemically through: Hydroxyl ions disturbs the bacterial cytoplasmic membrane which leads to disturbance in enzymatic activity and metabolism of bacterial cell and DNA replication inhibition by splitting DNA and b) Physically by: Creating a protective barrier that withholds substrate for bacterial growth and also occupies accessory spaces within the canal, thus preventing ingress and multiplication of bacteria into the root canal system. Also, it limits the space for bacterial multiplication and also stops substrates for their growth [9,10]

For maximum affect, Intracanal medicament should be filled densely and homogenously to the root apex. Various techniques has been described in literature which includes lentulo spiral bur, injection with a syringe followed by compaction with a plugger, use of the Messing gun, and MacSpadden compactor.[11]. Sigurdsson et al reported in 1992 that the use of Lentulo spiral (Fig 2) resulted in best placement paste in minimally instrumented (size #25 K file) curved canals and is most convenient method for delivering paste into the root canal as stated by Dumsha and Gutmann. This slow-speed instrument is available in a variety of sizes and selected instrument should be placed till working length easily without interference.

Inspite of increase use of Ca (OH) 2 as an intracanal medicament in dentistry, there are a lot of controversial results regarding its effect on apical leakage with different root canal sealers. As before filling of the root canal, the calcium hydroxide medicament should be removed as any residual medicament on the canal walls will affect the sealing ability of the filling material and sealer depending upon the type of sealer used. None of the method has been proven to remove the intracanal medicament completely from the canal. Assessment of influence of calcium hydroxide on the sealing ability of different sealers is necessary because complete removal of calcium hydroxide from the canal is difficult. Therefore this study will help us to determine its effect on apical micro leakage (AML).

MATERIALS AND METHODS

- **Research Design:**

Quasi Experimental study

- **Study settings:**

The samples (Extracted teeth) were collected from Oral Maxillofacial and Surgery Department of Ziauddin College Of Dentistry, Ziauddin University.

The sample preparation (Root canal treatment) and demineralization, dehydration and dephanization of each tooth was performed in the Department of Operative Dentistry.

The sectioning and preparation of slides was done in Oral Biology Lab of Ziauddin University.

The prepared slides were then analyzed under stereomicroscope in University of Karachi.

- **Sampling technique:**

Convenience sampling technique was used for sample recruitment.

- **Inclusion Criteria:**

1. Mandibular premolars extracted due to orthodontic treatment were included in this study.
2. Extracted teeth of patient's age more than 15years were included.

- **Exclusion Criteria:**

Tooth with radiographic features of fracture.

1. Tooth with severe divergent roots were excluded.
2. Tooth with features of internal or external resorption were excluded.
3. Tooth with open apex were excluded.
4. Tooth with blocked or obliterated canals were excluded.
5. Tooth having variation regarding canal morphology were excluded.

- **Sample Preparation:**

All samples were prepared by a single operator using the following protocol. Calculus and soft debris will be removed with the help of ultrasonic scaler tip (Fig 2). The instrumentation was done in a single visit. Canal preparation was done using Step back technique. The roots were held in a moist gauze during instrumentation to prevent dehydration. Straight fissure bur was used for Access cavity preparation in a high speed headpiece. Endodontic explorer was used for canal orifice location. The canal of each tooth was cleaned using #10 K-file and working length was then determined using radiographic technique (Fig 3). After working length canal preparation was done using step back technique using ISO standardized stainless steel hand files of 25 mm length (Mani). The canal was instrumented up to master apical file size#40 K file (diameter of

0.4mm at Do and 0.72mm at D16) till full working length.Frequent recapitulation was done using #15 K file to maintain the patency of the apical foramen. Step back was done, 3 files above MAF i.e. till #55 K file.

Irrigation with 2ml of 3 % NaOCl solution (Canasol; MK international) (Fig 4) in between each file was done and 17%EDTA (Meta Biomed CO.LTD.) (Fig 5) was used as lubricating agent. After preparation, final irrigation was done with 10ml of 3% sodium hypochlorite.

After completion of this procedure, teeth will be randomly divided into two groups, 50 teeth in each group: (Fig 6)

Group A (Control group) ---- Teeth included in this group were not medicated with non-setting calcium hydroxide (intracanal medicament).

Group B (Experimental group) --- Teeth included in this group were medicated with non-setting calcium hydroxide paste after preparation and it was placed in the canal with the help of lentulo spiral bur in slow speed hand piece.

A radiograph was taken for each tooth in group B to assess the uniformity of intracanal medicament, and the teeth will then be left for 14days. Canal orifice was covered with dry sterile cotton pellet followed by an Intermediate Restorative Material Cavit (Favodent) in both groups.

Intracanal medicament was removed from teeth in experimental group after 14 days with K file of the same size as the MAF along with sodium hypochlorite as an irrigants. Root surface was covered with nail varnish except for apical 4mm which remained exposed, to allow dye penetration in the canal via apical region. Before proceeding for obturation, Obturation was assessed radio graphically (Fig 7).The teeth were stored in gauze and placed for 72 hours to allow sealer to set. After the procedure, all teeth were immersed in Indian ink. . After one week, the teeth were washed in running water to remove external dye. Nail varnish was removed using scalpel blade. Demineralization of teeth was done in 5% hydrochloric acid, for 24 hours. Dehydration was done in ethanol in ascending order i.e.70%, 80%, 90% and 100 % for 4 hours each, and finally methyl salicylate was for 2 hours for diaphanization. The cleared teeth were dried and sectioned at 1mm up to 5mm using microtome (Fig 8 &9) and analyzed by means of a stereomicroscope (x 40 mag.) (Fig 10) Amount of leakage was assessed by the extent of penetration of the dye. The extent of dye penetration was measured in millimeters by an experienced, calibrated examiner, from the apical area to the maximum penetration of the dye. (Fig 11)

RESULTS

The 100 teeth were divided into two groups A and B with 50 samples each. In Group A (control) no intracanal medicament was placed and in Group B (experiment group) intracanal medicament was placed for 14 days. Teeth were assessed via Stereomicroscope to evaluate apical sealing ability using dye penetration method. The study results showed no statistical difference between the control and experiment group in apical leakage but medicated group showed least amount of leakage comparatively.(Table 2, Fig 11)

DISCUSSION

The aim of endodontic therapy is to prevent and manage the infection with the objective of eliminating causative agent and debris through chemo mechanical means and providing adequate apical and coronal seal to prevent reinfection. However, it is stated in several studies that chemo mechanical instrumentation alone is unable to eliminate or reduce the number of microorganisms and will only render 50-70% of infected canals free of microorganisms [12, 13]. Since, complete elimination of micro bacteria is not possible through mechanical preparation an effective antimicrobial agent as intracanal medication should be used to improve treatment outcome. [6,14] as its proven from different studies that medicaments placed inside the canal could markedly affect the diversity and quantity of cultivable microorganisms in infected canals [6,7].

The antimicrobial substances used as an intracanal medicament are classified into five main groups 1) Antibiotics (2) Calcium hydroxide (3) non-phenolic biocides (4) phenolic biocides (5) Iodine compounds. [8] In modern therapy, Calcium hydroxide is the highly recommended and widely used interappointment intracanal medicament based on its antimicrobial, antiresorptive and tissue dissolving property. It was first introduced as a pulp capping agent by Herman in 1920 [9]. According to Cvek, its use became extensive in 1930s because of pioneering work of Hermann. Nygren gave the initial reference for the use of calcium hydroxide for managing "fistuladentalis" [15]. Preserving the involved pulp was first endeavor by Codman. Apexification with Calcium hydroxide before the use of MTA was originated by Heithersay and Frank [16] the first case of successful pulpal healing with Ca (OH) 2 was reported between 1934 and 1941. After this report and Second World War, the use of calcium hydroxide were expanded and now calcium hydroxide is widely used in Endodontics. [14**Error! Bookmark not defined.**The antibacterial mechanism of Ca (OH) 2 on bacterial cells are probably due to protein denaturation and damage to DNA and cytoplasmic membrane due to the release of hydroxyl ions. This medicine is also used in weeping canals where obturation with exudate is contraindicated. For such teeth placing calcium hydroxide is very helpful, which neutralizes the acidic pH of the periapical tissues. [10,17]

Moreover, the prognosis of the treatment depends also depends on the quality of coronal and apical seal along with proper cleaning and obturation of the canal. Improper apical seal has been reported as most common cause of endodontic treatment failure in different studies [5, 18, 19]. According to Cohen's et al, and Ingle *et al*. the latter in the so-called "Washington study" inadequate apical seal is responsible for up to 60% of the treatment failure [20]. Sjogren et al also reported recurrence of endodontic pathosis following inadequate sealing of the root apex [21] .The micro leakage (passage of bacteria, fluids and chemical substance) between the root canal walls and obturating material may adversely affect the success of endodontic therapy. [22]

The integrity of the apical seal is dependent on variety of factors such as quality and length of obturation, irrigation used, type and properties of sealer used , negative pH in the periapical area, presence of voids, moisture, fluids, smear layer, and/or remnants of any intracanal medicament placed. [23,24]

The purpose of this study was to evaluate the effect on calcium hydroxide when used as an intracanal medicament on the apical seal and different studies have been conducted to evaluate the same with controversial results. . Porkaew et al. [22] conducted a study to evaluate the effect of calcium hydroxide as an intracanal medicament and concluded that the application of Ca (OH) 2 as an intracanal medicament prior to obturation reduces the apical leakage effectively. This result was also supported by Holland R et al in 1995 [25] Kim SK et al. [26] and Hamidi, M.R. et al. [27] several explanations were formulated for the described effect. One possibility may be that the Ca $(OH)_2$ has been mechanically forced into the dentinal tubules during obturation thereby reducing the dentinal permeability, this would decrease the ability of the dye to penetrate into the canal walls. [22]. another possibility proposed by Weisenseel et al was plugs at the apical area formed may reduce the ability of dye to penetrate. [28] Wu et al. has described the possibility of false results occurring with previous dye leakage studies using methylene blue dye, because it may lose its color in contact with calcium hydroxide [29]. However results of study by Shahi, S. and Hanareh, F. showed opposite results and observed that the leakage was least in non-medicated group. [30] which was also supported by Tandan, M. et al. [31] A study by Adel M et al,

concluded that use of intracanal medicament increases the apical leakage of resilon filled root canals. [32] The results of this study concluded that there is no statistically significant difference in leakage between group A and group B (i-e non-medicated and medicated group).

Moreover, The type of sealer used may also effect the sealing ability of the root canal therefore attention must be given in reducing the leakage apically and coronally for better treatment prognosis by selecting the favorable materials.

CONCLUSION

The results of this study concluded that there is no statistically significant difference in leakage between group A and group B (i-e non-medicated and medicated group).

Moreover, The type of sealer used may also effect the sealing ability of the root canal therefore attention must be given in reducing the leakage apically and coronally for better treatment prognosis by selecting the favorable materials.

RECOMMENDATION

- This laboratory based study does not replicate clinical conditions, they can only provide a simple means of evaluating and comparing different endodontic materials used therefore further studies should be conducted to assess the clinical performance of different sealers.
- Different techniques of leakage assessment should be compared together for accuracy of results.

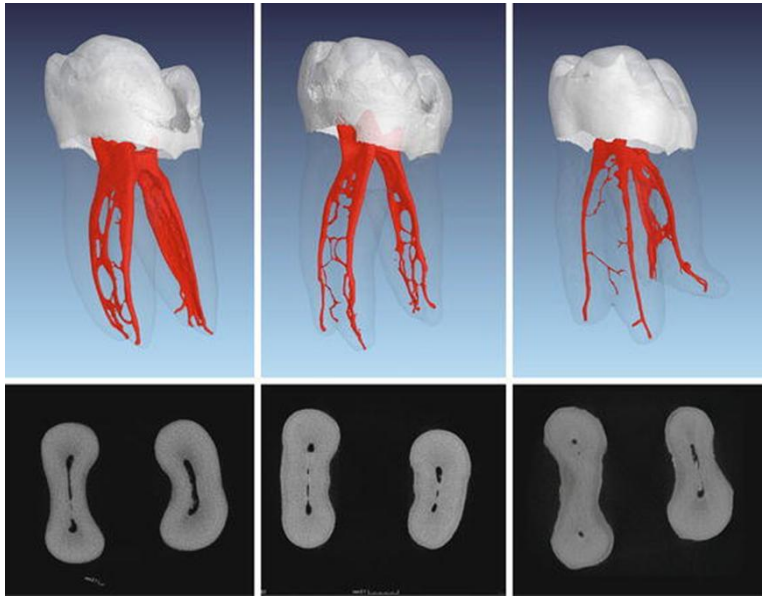


Figure 1 Micro-computed tomography images of extracted teeth from patients of different ages. Three-dimensional reconstructions and corresponding cross sections from the middle third of the roots are shown.

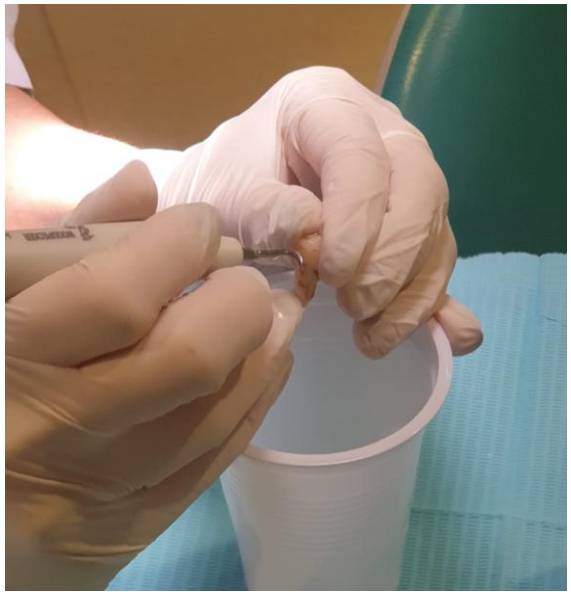


Figure 2 Clinical picture taken while doing ultrasonic scaling of extracted tooth

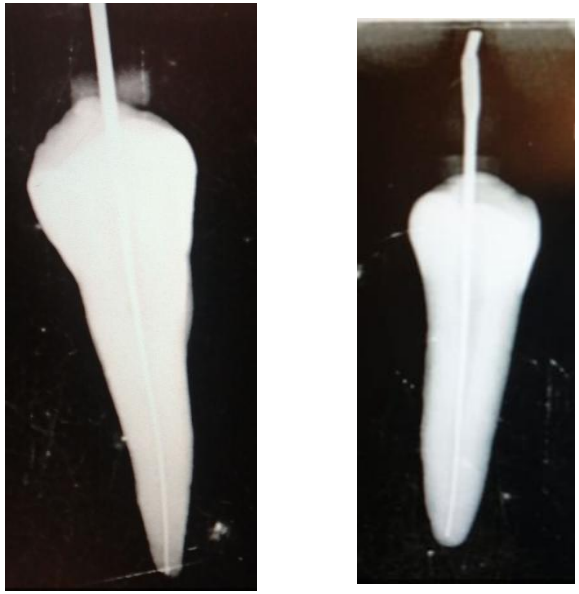


Figure 3 *Randomly selected radiographs showing during the preparation of canals for working length confirmation of teeth*

Figure 4 showing bottle of Canasol (3 % sodium hypochloride) used as a root canal irrigant. Along with 3 % sodium hypochloride it also contains sodium chloride, sodium carbonate, solute q.s.ad.

Figure 5 *EDTA (ethylene diamine tetra acetic acid) cream for root canal cleaning anf smear layer removal*

Figure 6 Randomly divided teeth in group A (control) and B (experimental group)

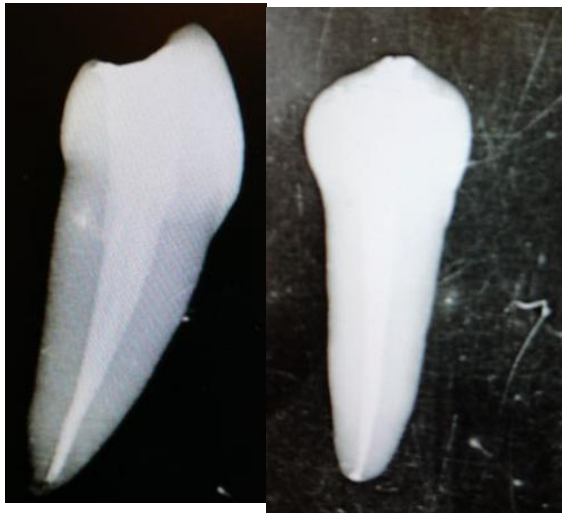


Figure 7 Radiographic assessment of obturation

Figure 8 Picture showing focused image of slides containing apical sections at 1, 2, 3, 4,and 5mm.

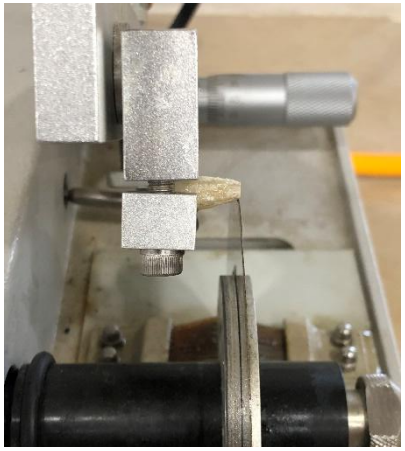
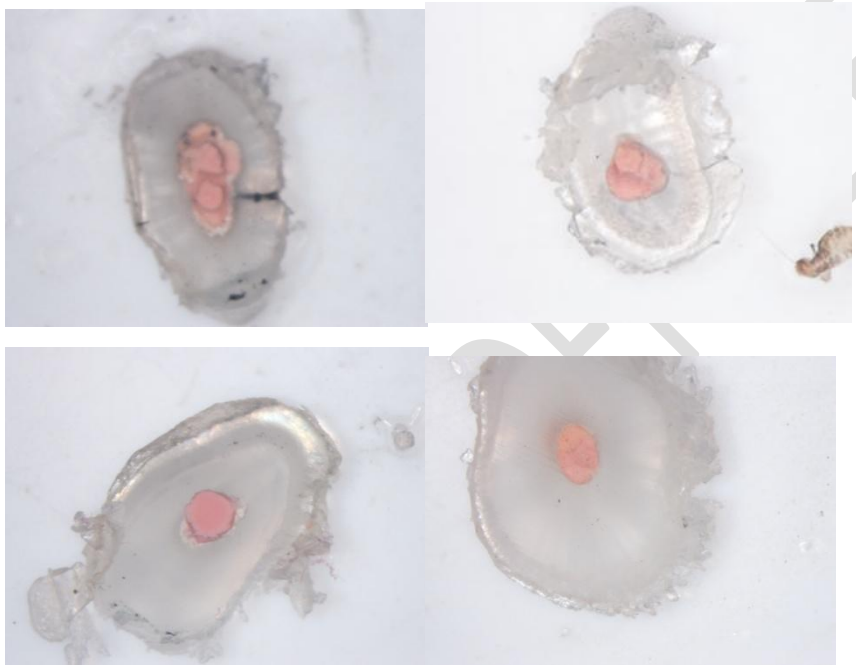


Figure 9 showing sectioning of tooth at 3mm.



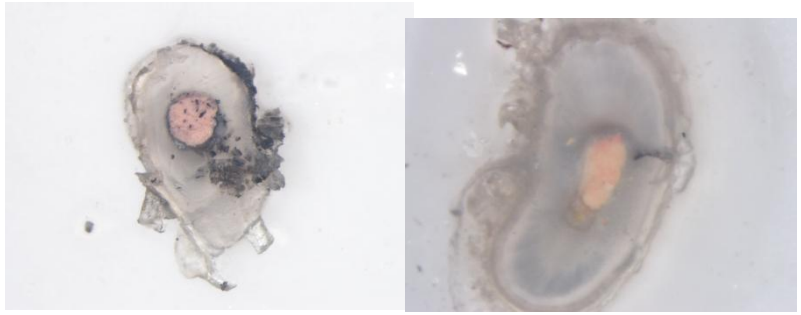


Figure 10 Stereomicroscope images showing apical micro leakage via Indianinkdye penetration.

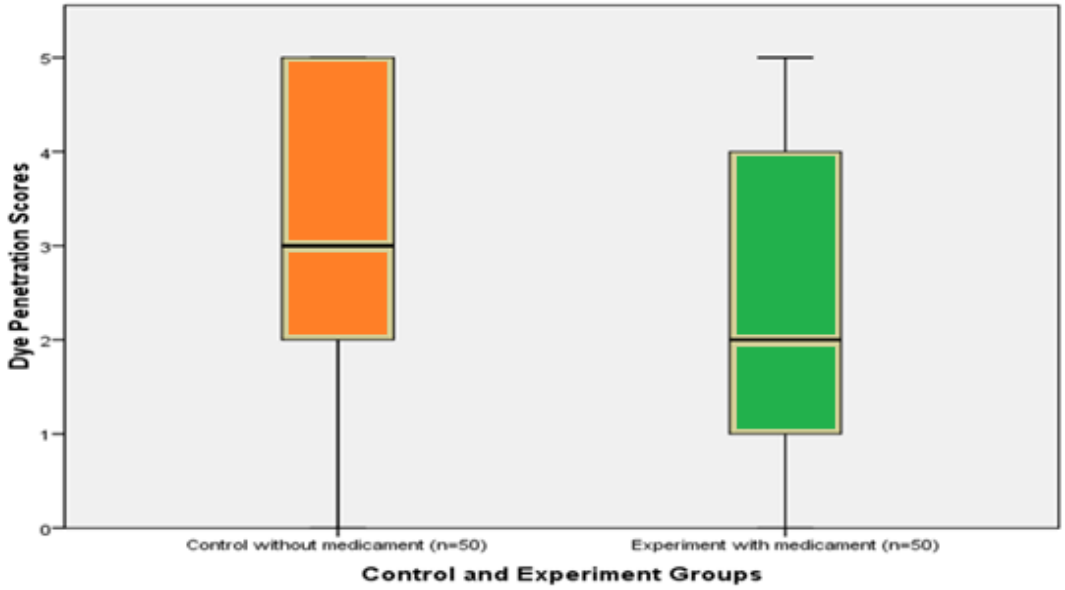


Figure 11 Box-plot representing apical leakage scores between control and experiment group.

	INDICATIONS OF INTRACANAL MEDICAMENT
1	To dry weeping or canal with persistence exudation.
2	To eliminate any remaining pathogens in the pulp space
3	To create an infection free environment in root canal system
4	To neutralize acid pH created by pathogens and debris
5	To act as a barrier against leakage from the temporary filling

Table 1 Indications of Intracanal medicament

S.no	Study Group	Apical leakage		P value
		Mean ± SD	Median (IQR)	
1.	**A** Control (without medicament) n=50	2.96 ±1.69	3(3)	0.072

2.	**B** Experiment (with medicament) n=50	2.30±1.832	2(3.25)	

P-value < 0.05 is considered significant

Mann-Whitney U test was applied.

Table 2 Apical leakages of control (GROUP A) and experiment groups(GROUP B)

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