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RESEARCH ARTICLE

Comparative evaluation of the efficacy of EndoActivator, ProUltraand Canal brush systems with conventional needle irrigation without chemically active adjunct in removing calcium hydroxide from root canals: a scanning electron microscopic study.

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Abstract:
Calcium hydroxide the most commonly used intracanalmedicament, should be completely removed from root canal walls before obturation, otherwise it may hinder the penetration of root canal sealers and affect the proper fluid tight seal. Canal shape and method of applicationhad an impact on the residual calcium hydroxide remaining. Application with a lentulo spiral has been found to be more homogenous and deeper in tubules than injection of Ca(OH)2 paste. Different techniques have been introduced to improve removing of calcium hydroxide from root canal system. But till date none of the techniques was able to completely remove calcium hydroxide. The aim of this study was to compare the cleaning efficacy of endoactivator, Canal brush and ProUltrain removing calcium hydroxide from root canal walls.

Key Words: Calcium hydroxide,irrigation,endoactivator,intracanal medicament, canal brush.

Introduction

Calcium hydroxide remains the medication of choice for root canals treated in more than one visit.It inhibits the growth of bacteria between appointments.it is routinely recommended as intra canal medicament for teeth with periapicallesions. It needs to be filled homogeneously and densely into the whole length of canal to achieve maximal benefits.[1]Among the several placement methods lentulospiral is the most efficient and commonly use placement method.[2,3]All inter appointment dressing placed inside the canal needs to be removed before obturating with guttaperchabecause the residual Ca(OH)2 may interact with theroot canal sealer and interfere with its sealing abilityand increase microleakage. Various methods and/or irrigation substanceshave been proposed for removal of CH dressing. Studies have showed that irrigation with sodiumhypochlorite alone is not efficient to remove CHmedication.[4]Among the several irrigation protocols studied, the best removal of CH is achieved by instrumentation and EDTA followed by NaOCl.[5] The elimination may be carried out by mechanical and chemical means simultaneously. So the most frequently described method forremoval of Ca(OH)2 from the root canal is instrumentationof the root canal with the master apical file incombination with copious irrigation of sodium hypochlorite(NaOCl) and EDTA .[6,7] However, it has been reported that removal ofCa(OH)2 from the apical root canal wall, when this method is used, is difficult. When Ca(OH)2 is removed from the main canalwith a file, remnants will remain in canal extensions orirregularities. Further Ni-Tiinstruments and NaOCl with passive ultrasonicirrigation have been found to remove Ca(OH) moreeffectively from the root canal.[6,8]Ultrasonic and sonic activation of irrigants have been found to be very beneficial during irrigation.[9,10]The Canal Brush (Roeko Canal Brush™, Coltène/Whaledent, Langenau, Germany) is an endodonticmicrobrush recently introduced. This highly flexiblemicrobrush is molded entirely from polypropylene andcan be used manually with a rotary action. However,the brush was more efficient when operated at 600rpm in a contra-angle handpiece.[8]Therefore, the present

study was designed to evaluatethe effectiveness of Sonic,Ultrasonicand Canal Brush technique in removingCa(OH) from the root canal system by using thescanning electron microscope (SEM).

Materials and methods:-

Ninety freshly extracted human single-rooted teethwere used in this study. Following extraction the teethwere stored for two days at room temperature in 3%NaOCl to remove organic debris. Subsequently theywere scaled with ultrasonic, washed with distilledwater for the removal of any calculus or soft tissuedebris and then immersed in 10% formalin solutionuntil use. The crowns of theteeth were removed 14mm from the apex tostandardize their length. A size 10K-file was placed inthe canals until it was visible at the apical foramen.The working lengths were determined by subtracting1mm from this measurement. Canal preparation was performed usingan electric engine (X-Smart,DentsplyMaillefer) withconstant speed of 250 rpm and rotational force of 1.6N.cm, at the working length. All roots were preparedusing ProTaper rotary system (Dentsply, Maillefer,Ballaigues, Switzerland) to a # F4 (#40, 6% apical thirdtaper) instrument as the MAF.Teeth wereirrigated with 5mL 2.5% NaOCl and 5mL 17% EDTA for1minute for final flush to remove smear layer.After completing the instrumentation, thecanals were dried with paper points. Eighty teeth were filled with calcium hydroxide paste(Metapaste, Metadent Co., Chongju, Korea) by using a lentulo spiral (DentsplyMaillefer), according to the manufacturer's instructions.Five teeth were left as positive and five as negativecontrols.The coronal 3 mm of all the canals weresealed with Cavit. All specimens were kept in a closed box,with the roots placed in moist environment for 7 days atroom temperature. After this period, the coronal accesswas opened and the canal was irrigated with 5 mL of2.5% NaOCl solution. The teeth were randomly assigned into fourexperimental groups (n =20). According to the rotaryinstrument and final irrigating solution used for removalof CH residues: G1-endoactivator, G2-ProUltra,G3-Canal brush and G-4 Neddle irrigation only.In all irrigation is done with 2.5% NaOCl. The solutions were aspiratedwith a green Navitip point (Ultradent), and dried withabsorbent paper points.The remaining teeth servedas positive (n =5) and negative (n =5) controls. Teeth were split along their long axisin a buccolingual direction using a surgical chisel. ForSEM analysis, the specimens were dehydrated, fixed onaluminium stubs, sputter-coated with gold, and examinedwith a scanning electron microscope at 10 kV (JEOL,Tokyo, Japan) at 100X magnification. Three previously calibrated examinersevaluated the cleanliness of root canal walls, by assigningeach specimen with a score. The scoring procedure was performed by 2 calibrated and blindedevaluators who were trained in the evaluation procedure using thefollowing 5-grade scale.[11]

Score 1: 80%–100% removal of Ca(OH)2 (total cleanliness)
Score 2: 60%–80% removal of Ca(OH)2 (great cleanliness)
Score 3: 40%–60% removal of Ca(OH)2 (partial cleanliness)
Score 4: 20%–40% removal of Ca(OH)2 (light cleanliness)
Score 5: 0%–20% removal of Ca(OH)2 (no cleanliness)

Figure 1 shows representative scanning electron microscopic micrographs of groups

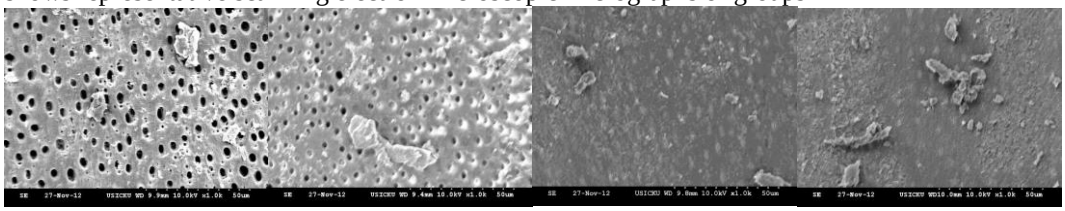

Figure 1.Scanning electron microscopic images representative of scores attribution.

Statistical analysis was performed by Statistical Package for Social Sciences (SPSS) 11.5 software (SPSS Inc., Chicago, IL, United States). Data were expressed as mean. The differences between techniques were evaluated by Mann-Whitney U test. The level of significance wasset at $P< 0.05$.

Results:-

The results of the study are shown in Table 1. Remnants of medicament were found in all experimentalTeeth and none of the groups showed complete removal ofCa(OH)2 dressing. The positive control teeth showed completecoverage of their canal walls with $Ca(OH)_2$ as opposed to negative controlswith total cleanliness. Each device was compared with the conventional irrigation needlegroup. However, a statistically significant differencebetween the groups can be shown ($P < .001$) using the analysis of variancetest. Group 1 ;Endoactivator was found to be statistically significant cleaner fromall other groups ,both at apical as well as coronal level. There was no significant differencePro Ultra and Canal brush in the removal of calcium hydroxide from root canal in

cervical (P=0.67) and apical(P=0.51) part of canal. Group 4;neddle irrigation shows higher scores of calcium removal than any other group.

Table 1: Mean score of dentine debris or $Ca(OH)_2$ removal from root canal by different methods.

Group	n	Apical area		Coronal area	
		Mean	SD	Mean	SD
Endoactivator (G-1)	20	0.6	0.09	0.2	0.01
Pro ultra(G-2)	20	2.01	0.32	1.7	0.1
Canal brush(G-3)	20	2.30	0.2	1.4	0.08
Neddle irrigation(G-4)	20	3	0.02	3	0.6

Figure 2.Bar graphs showing distribution of scores for all the devices in the coronal and apical thirds

Discussion:-

Residual $Ca(OH)_2$ influences the setting mechanismof various types of root canal sealers and therefore should be removed before obturation of root canals. Calcium hydroxide pastes are not easily removed from root canal walls. The aim requires new devices with high effectiveness and easy handling for clinical application. Many factors can influence removing calcium hydroxide from root canal walllike master apical file, size of needle for irrigation delivery, length of time devoted to irrigation and system that is used for canal irrigation.[12, 13]The procedure used in this study for theremoval of the intracanal medicament is the standard protocol employed widely in clinical practice. In the present scanning electron microscopic study, the main goalwas to evaluate the effectiveness of conventional needle irrigation incomparison with the EndoActivator, ProUltraPiezoFlowsystems and Canal brush in combination with 0.5% NaOCl and 18% EDTA in removingcalcium hydroxide from root canal walls. Many methods have been used for evaluation of residual debris or calcium hydroxide on canal walls likescoring method, scanning electron microscopy , volumetric analysis by spiral CT and longitudinal sectioning and steromicroscopy, photo graphic imaging and blind examination by observers.[6,14] We choose the scanning electron microscope for evaluating thecleanliness of root canal walls surfaces because many investigators showed that the use of the scanningelectron microscope is a reliable method in examining andevaluating the removal of $Ca(OH)_2$ from the root canal walls whenusing different instrumentation and irrigation systems.[15,16,17] Sonic and ultrasonic irrigation were reported to improve removalof the smear layer in the apical third of curved root canals comparedwith conventional irrigation.[17]Moreover, EDTA has been consideredmore effective than NaOCl in the removal of inorganic substancessuch as the smear layer and $Ca(OH)_2$.[15]Canal brush has been introduced as a new device to assistant in irrigation and removal of smear layer from root canal walls.In our study, the Canal Brush was used with a contra-angle handpiece running at 600rpm. The results indicate that EndoActivator with NaOCl as irrigantwas more effective in removal of $Ca(OH)_2$ paste from anroot canal walls in the coronal as well as apical areasthan ProUltra ultrasonic activation ,canal brush or by means of neddledelivery of NaOCl. The efficiency in eliminating $Ca(OH)_2$ from root canals by the EndoActivatorin combination with irrigation may be caused by its primaryfunction, which has been reported to produce vigorous intracanal fluidagitation through acoustic streaming and cavitations.[17,18]The results of Ultrasonic activation of ProUltra withhypochlorite were better than the results of irrigationby means of syringe delivery of NaOCl indicating thatthe extra capacity to remove matter from the rootcanal of ultrasonic activation with NaOCl as irrigant. The use of passive ultrasonic irrigation is based on the transmission ofenergy from an ultrasonically oscillating instrument to the irrigant in the root canal. In this experiment, the use of PiezoFlow created relativelycleaner root canal walls in the coronal and middle thirds than inthe apical one compared with conventional needle irrigation. Sodium hypochlorite as irrigant is more effective inremoving dentine debris from the root canal duringPUI.[19, 20]This is in agreement with results of the previous studies done by Balvedi RP, Sami Alturaiki et al and Maalouf L et al.[13, 17, 21]Observations of our study are opposite to those of van der Sluis et al.[19]In our study, Endoactivator in combination with irrigants removed more $Ca(OH)_2$ medication than the Pro Ultra and Canal Brush system.

Conclusion:-

None of the techniques used in this study removedthe inter-appointment root canal medicaments effectively. However, the EndoActivator Systemshowed better results in removing $Ca(OH)_2$ than other experimental techniques. Further studies should be undertaken withother techniques of root canal preparation and irrigating solutions to evaluate the removal of intracanal dressingfrom the root canal walls.

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