RESEARCH

Does The Vehicle Type Affect the Persistence of Calcium Hydroxide When Removing with Sonic Activation?

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ABSTRACT

Does The Vehicle Type Affect the Persistence of Calcium Hydroxide When Removing with Sonic Activation?

Background: This *in vitro* study aimed to evaluate the persistence of calcium hydroxide (CH) associated with different vehicles on the artificial cavities after removing with sonic activation or conventional needle irrigation (CNI).

Methods: Seventy-two extracted single-rooted teeth were instrumented with ProTaper Universal rotary system up to F4. The roots were split longitudinally, and standardized cavities were prepared. The roots were assigned into 3 groups (n=24), according to vehicles used; distilled water, glycerin, and propylene glycol. In each group, cavities were filled with CH mixed with the respective vehicle. After reassembly, the removal of CH dressing was performed with either sonic activation (EDDY) or CNI (n=12). The remnants of CH were assessed under a microscope at ×40 magnification. A four-grade scoring system was used to evaluate. Kruskal-Wallis and Mann-Whitney U-tests were used to compare the data.

Results: There was a significant difference among groups (p=0.000). Complete removal of CH was found in the distilled water and propylene glycol groups when EDDY was used. EDDY was significantly more effective than CNI in the removal of CH mixed with distilled water and propylene glycol p=0.001 and p=0,002, respectively. Whereas no significant difference was found between EDDY and CNI in the glycerin group (p=0.219). The lowest CH remnants were found in the distilled water group when CNI was used.

Conclusion: The vehicle associated with CH and irrigation activation is important for its retrieval. EDDY provided the complete removal of CH when mixed with distilled water or propylene glycol.

KEYWORDS

Calcium hydroxide removal, EDDY, Vehicle type

ÖZ

Taşıyıcı Tipi Sonik Aktivasyon Ile Uzaklaştırıldığında Kalsiyum Hidroksitin Kök Kanal Duvarlarındaki Devamlılığını Etkiler Mi?

Amaç: Bu *in vitro* çalışma farklı taşıyıcılarla ilişkili kalsiyum hidroksitin (KH) yapay olarak oluşturulmuş kavitelerden sonik aktivasyon veya geleneksel iğne irrigasyonu (Gİİ) kullanılarak uzaklaştırılmasından sonra devamlılığını değerlendirmeyi amaçlamaktadır.

Gereç ve Yöntemler: 72 adet çekilmiş tek köklü dişler ProTaper Universal döner eğe sistemi ile F4'e kadar genişletildi. Dişler uzunlamasına kesilerek standart kaviteler açıldı. Kullanılan taşıyıcı tipine göre kökler 3 gruba ayrıldı (n=24); distile su, gliserin ve propilen glikol. Her bir grupta, kaviteler bu taşıyıcılardan biriyle karıştırılan kalsiyum hidroksitle dolduruldu. Kök parçalarının tekrar birleştirilmesinden sonra kalsiyum hidroksitin uzaklaştırılması ya sonik aktivasyon (EDDY) ya da Gİİ ile yapıldı (n=12). Kalan KH artıkları bir mikroskop kullanılarak x40 büyütme ile değerlendirildi. Değerlendirme için 4-skorlu skala kullanıldı. Kruskal-Wallis, Mann-Whitney U testleri verileri karşılaştırmak için kullanıldı.

Bulgular: Gruplar arasında anlamlı fark bulundu (p=0.000). EDDY kullanıldığında, distile su ve propilen glikol ile karıştırılan KH'in tamamen uzaklaştırıldığı bulundu. EDDY, distile su ve propilen glikol ile karıştırılan KH'i uzaklaştırmada, Gİİ'den daha etkili bulundu p=0.001 ve p=0,002, sırasıyla. Fakat gliserin ile karıştırılan KH'i uzaklaştırmada EDDY ve Gİİ arasında fark bulunmadı (p=0.219). Gİİ kullanıldığında kalan KH artıkları en az distile su grubunda bulundu.

Sonuç: KH ile ilişkili taşıyıcı tipi ve yıkama solusyonunun aktivasyonu uzaklaştırılmasında önemlidir. EDDY distile su veya propilen glikol ile karıştırılan KH'in tamamen uzaklaştırılmasını sağlamıştır.

ANAHTAR KELİMELER

Kalsiyum hidroksitin uzaklaştırılması, EDDY, Taşıyıcı tipi

Calcium hydroxide (CH) has been commonly used as an interappointment paste because of its antimicrobial activity[1], effectiveness on neutralization of bacterial endotoxin[2] and stimulate periapical healing.[3] However, CH has some limitations. It has been reported that the sealing ability of root canal sealers can be affected by the remnants of CH.[4-6] Therefore, CH should be removed completely before the permanent root canal filling. Due to the manual irrigation with a syringe is unable to remove CH completely, irrigation activation with combination of chemical agents has been suggested to ensure favorable results.[7] Recently, EDDY (VDW, Munich, Germany) has been introduced for irrigant activation. It is a polyamide polymer tip with a size 25 and .04 taper. According to manufacturer's instructions, EDDY tips are powered at a high frequency of up to 6000 Hz by air scaler. It is also stated that with vibration of 5000 to 6000 Hz, EDDY creates a three-dimensional movement. EDDY has been reported as an effective irrigation activation method in the removal of

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CH.[7,8]

CH can be mixed with either an aqueous or a viscous solution to facilitate its insertion into to root canal and to improve its biological or microbiological properties.[9] Aqueous solutions are the most commonly used carriers promoting high solubility and rapid ion dissociates. On the other hand, a viscous vehicle, due to its high molecular weight the dissociation of CH become slower.[10] Propylene glycol has been used as a viscous vehicle and provides the slow release of calcium and hydroxyl ions.[11] Glycerin is another viscous colorless and hygroscopic vehicle that facilitates placement of CH in the root canals.[12]

Several studies with different irrigants and techniques investigated the removal of CH from root canal systems.[7,8,13-16] In some of these studies, authors used aqueous CH suspensions[7], viscous suspensions[8,13,15,16], and some did not report the vehicle type.[14] To the authors' knowledge, little is known about the effect of the aqueous and viscous vehicles on the CH persistence on the root canal walls after removing with sonic activation. Therefore, the presence of remnants of CH mixed with distilled water, propylene glycol, or glycerin on dentin walls after removal with EDDY or conventional needle irrigation was evaluated in this study. The null hypothesis tested was there would be no difference between different vehicles and irrigation techniques.

MATERIALS AND METHODS

Seventy-two extracted straight and single-rooted mandibular premolars with a single root canal and intact root tips were used for this in vitro study after the university non-interventional clinical research ethics board approval (protocol no: 2020/13–7). The crowns were removed to standardize the length of the roots.17 A 18 mm standardized root length and a 17 mm working length (WL) was obtained for each specimen. The root canals were instrumented using the ProTaper Universal rotary system (Dentsply Maillefer; Ballagiues, Switzerland) up to size 40 (F4) using an endodontic motor (X-Smart: Dentsply Maillefer; Ballagiues, Switzerland) with the settings according to the manufacturer's instructions. During instrumentation, irrigation was delivered via a 30-gauge side-vented irrigation needle (Max-i Probe: Dentsply Maillefer North America). 2 mL 2.5% NaOCl (sodium hypochlorite) was used after each file changes. 5 mL EDTA 17% and 10-mL distilled water were used for the final irrigation.

Longitudinally grooves were prepared on the buccal and lingual root surfaces after root canal preparation completed. Roots split into two halves along their buccolingual long axis with a hammer and a chisel. A standard cavity of 3 mm in length, 1 mm in width and 0.5 mm in depth was prepared in one root segment, 2-3 mm from the apex using a diamond bur. Three groups were assigned according to the vehicle used (n =24): Group distilled water: CH mixed with distilled water; Group glycerin: CH mixed with glycerin; and Group 3: propylene glycol CH mixed with propylene glycol. All medicaments used were mixed to a creamy consistency on a glass slab using CH powder and the respective solution. Each cavity was filled with CH paste mixed with the respective vehicles using paper points. Roots were reassembled with wax and the apical foramen was covered with wax to simulate a closed system.7 After 1 week at 37°C of storage, in each group calcium hydroxide was removed with EDDY or conventional needle irrigation (CNI) as follows (n=12):

Conventional needle irrigation (CNI): A 30-gauge irrigation needle (Max-i Probe) placed 1 mm short of the WL. Root canals were irrigated with a total of 6 mL 5% NaOCl, 2 mL of 17% EDTA and a final wash with 5 mL of distilled water.

EDDY: EDDY (#25, 0.04) was used with a handpiece (SonicFlex 2003 L; Kavo, Biberach, Germany) in the root canal 1 mm short from the WL. Agitation of 2 mL of 5% NaOCl was performed with EDDY for 20 s and repeated twice more. Subsequently, 2 mL of 17% EDTA was agitated for 20 s with EDDY. Then, root canals irrigated with 5 mL of distilled water.

The root halves were separated again to detect the CH remnants. Photographs of each cavity were saved as tagged image file using a stereomicroscope (Leica M320 F12, Heerbrugg, Schweiz) at ×40 magnification. The amount of calcium hydroxide remaining in the grooves was independently scored by 2 calibrated and blinded operators according to the four-grade scoring system17: score 0, the groove is empty; score 1, <50% of the groove is filled with CH; score 2, >50% of the groove is filled with CH; score 3, 100% of the groove is filled with CH (Figure 1).

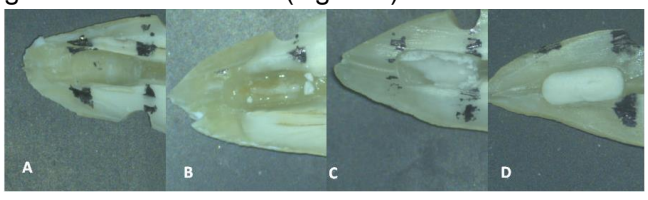

Figure 1

Representative images for four-grade scoring system. A) score 0; the groove is empty B) score 1; less than half of the groove is filled C) score 2; more than half of the groove is filled D) score 3; the groove is filled completely (×40)

Differences were analyzed using the Kruskal–Wallis and Mann–Whitney tests with Bonferroni correction

(p=0.05).

RESULTS

Table 1 shows the results. There was a significant difference among groups (p=0.000). The lowest CH remnants were found in the distilled water group when CNI was used. Complete removal of CH was found in the distilled water and propylene glycol groups when EDDY was used. EDDY was significantly more effective than CNI in the removal of CH in distilled water and propylene glycol groups (p=0,001 and p=0,002, respectively). Whereas no significant difference was found between EDDY and CNI in the glycerin group (p=0,219).

Table 1.

The Scoring Results of the Artificial Cavities

Groups		Median	Minimum	Maximum
Distilled water	CNI	1.0[a]	0	3
	EDDY	.00[b]	0	0
Glycerin	CNI	3.0[c]	2	3
	EDDY	2.0[c]	1	3
Propylene Glycol	CNI	3.0[dc]	0	3
	EDDY	.00[eb]	0	3

Values with different superscript letters were statistically different at P = .05

DISCUSSION

This *in vitro* study was conducted to evaluate the persistence of an aqueous and two viscous suspensions of CH on the artificial cavities after removing with EDDY or CNI. Root canals were prepared up to size 40/.06. Therefore, enough space for EDDY activation (tip size 25 and .04 taper) was provided. Cavities were simulated in the apical third of the roots by using diamond burs to obtain standardization. A combination of NaOCl and EDTA was used for removing CH during the irrigation process with the same volume and irrigation times for both groups.

The present results revealed that there was a significant difference among groups. Therefore, the null hypothesis tested was rejected. The lowest CH remnants were found in the distilled water group when CNI was used. The results of this study were similar to those of previous studies.[18,19] Nandini et al.[18] reported that CH mixed with silicone oil and iodoform was more challenging to remove than CH mixed with distilled water. Similarly, Lambrianidis et al.19 demonstrated significantly more CH remnants when mixed with methylcellulose compared to distilled water. On the contrary, Balvedi et al.[20] did not demostrated a significant difference among saline, polyethylene glycol, and polyethylene glycol camphorated paramonochlorophenol when used passive ultrasonic irrigation or manual irrigation.

Furthermore, De Faria-Junior et al.[21] demonstrated that association of different vehicles with CH did not affect its persistence. They used silicone oil, 2% chlorhexidine gluconate, and propylene glycol in their study. The differences between these results may be attributed to the different methodologies and types of vehicles used. In that study, researchers solely used NaOCl without any activation during the CH removing process. However, in the present study NaOCl and EDTA with sonic activation was used.

According to the present results, sonic activation with EDDY was more effective than CNI when CH mixed with distilled water or propylene glycol. However, this difference was not observed in the glycerin group. CH with glycerin demonstrated significantly higher retention capacity than CH mixed with distilled water and propylene glycol when EDDY was used. Glycerin resisted dissolution and was retained in the cavity even though irrigation activation. The removal efficiency of EDDY has been assessed in two previous reports.[7,8] These studies reported the effectiveness of EDDY in the removal of CH when compared with manual irrigation. In the study by Donnermeyer et al.[7] an aqueous CH paste was prepared and solely used NaOCl. However, Marques-da-Silva et al.[8] used a viscous suspension and used a combination of NaOCl and EDTA during the activation process. In those studies, EDDY did not provide complete removal of CH. However, the findings of the present study showed that all cavities in teeth of the distilled water group were removed completely with EDDY. It can be concluded that using both of NaOCl and EDTA with sonic activation might improve the removal results of CH mixed with distilled water or propylene glycol.

CONCLUSION

The findings indicate that the vehicle mixed with calcium hydroxide and activation technique is important for its retrieval. EDDY provided the complete removal of CH when mixed with distilled water or propylene glycol. Further studies with this association are necessary for better appreciation of the subject.

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