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Original Article

A comparative evaluation of apical microleakage of MTA fillapex and AH26 sealers in the presence of blood in the canal space of the teeth

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Abstract

Introduction: Apical seal in blood or dry root canal is a problem in endodontic treatment. Failure of apical seal causes inflammatory reaction and failure root canal treatment. Because of the sealer properties, root canal should be dry for obturation. But hydrophilic sealers can adhere to root canal walls nowadays and this problem is still controversial. This study aimed at determining the apical microleakage of AH26 and MTA Fillapex sealers in dry and bloody condition.

Methods: This experimental in vitro study was done on 48 extracted central teeth. The researchers used the Mtwo rotary files for root canal instrumentation. In this process, the teeth were divided into four groups (2 dry groups and 2 bloody groups) and two groups as positive and negative control (each group of 4 teeth). All sealers were prepared according to the factory instruction and the obturation was done with gutta-percha and sealer. After 7 days in 100% moisture condition, the teeth were placed in the ink for 3 days and then were cut across longitudinal axis and the level of microleakage was measured by stereomicroscope. Finally, the data were analyzed by SPSS software, ANOVA, Chi-Square and t-test statistical tests.

Results: The mean of MTA Fillapex and AH26 apical microleakage in blood groups were (448.61±34.67) Mm and (429.84±31.63) Mm respectively. The minimum microleakage belonged to AH26 sealer, but it was not significant.

Conclusion: AH26 sealer is a better barrier against microleakage in comparison with MTA Fillapx, although it is not significant. Also, the evidence suggests drying the canal leads to a better apical seal and the blood significantly increases apical microleakage.

Keywords: Blood, Dental materials, Root canal filling materials

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مقایسه ریزنشت اپیکالی سیلرهای AH26, MTA Fillapex در حضور خون داخل کانال دندان

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چکیده

مقدمه: میزان سیل اپیکالی درحضور خون یا در محیط خشک کانالهای ریشه دندان یکی از مشکلات درمان ریشه دندان می باشد. عدم موفقیت در سیل اپیکالی یکی از علل واکنش التهابی و شکست درمان ریشه دندان می باشد. به دلیل خواص برخی سیلرها، تصور بر این بود که داخل کانال ها برای مرحله پر کردن باید کاملاً خشک باشد، اما امروزه با حضور سیلرهای هیدروفیلی که توانایی اتصال به عاج دیواره کانال ریشه دندان را دارند، این مسأله هنوز مورد سؤال است، هدف از انجام این مطالعه مقایسه ریزنشت اپیکالی، AH26 و MTA Fillapex در حضور خون در داخل کانال می باشد.

مواد و روش ها: این مطالعه تجربی آزمایشگاهی بر روی ۴۸ دندان سانترال کشیده شده انسان انجام شد، این دندان ها با استفاده از فایل های روتاری Mtwo آماده سازی شدند. سپس دندان ها به ۴ گروه ۱۰ تایی (۲ گروه خشک و ۲ گروه پر شده از خون انسانی) و دو گروه ۴ تایی کنترل منفی و مثبت تقسیم شدند. تمامی سیلرها طبق دستورالعمل شرکت سازنده آماده و پرکردن کانال هر دندان با استفاده از گوتاپرکا با روش تراکم جانبی انجام پذیرفت. دندان ها پس از گذشت ۷ روز که در شرایط رطوبت ۱۰۰٪ در دمای ۳۷ درجه سانتیگراد قرار داشتند به مدت ۳ روز در جوهر آبی قرار گرفتند و بعد از آن در جهت محور طولی دندان، برش زده شدند و میزان نفوذ رنگ آبی با استفاده از استریومیکروسکوپ اندازه گیری می شود. نتایج ثبت شده با نرم افزار SPSS وآزمون های آماری T-test، Chi-square، ANOVA دو طرفه مورد تجزیه و تحلیل قرار گرفتند.

یافته ها: متوسط ریز نشت اپیکالی سیلرهای MTA Fillapex و AH26 درحضور خون به ترتیب عبارتند از: (۴۴۸/۶۱±۳۴/۶۷) و (۴۲۹/۸۴±۳۱/۶۳) میکرومتر.کمترین ریزنشت اپیکالی مربوط به سیلرAH26 بود، اگر چه معنا دار نبود.

نتیجه گیری: کمترین ریزنشت اپیکالی مربوط به سیلر AH26 بود، اگر چه معنا دار نبود. شواهد به دست آمده نشان می دهد که خشک کردن کامل کانال می تواند منجر به بدست آمدن مهر و موم اپیکالی بهتری شوند و خون نیز تاثیر معناداری را بر ریزنشت اپیکال نشان داد.

واژگان کلیدی: خون، مواد دندانی، مواد پرکننده کانال ریشه

Introduction

At the preparation phase of the root canal treatment, the main purpose is the complete removal of necrotic debris and also shaping the canals in order to facilitate the insertion of the obturation material into the canal (1). After cleaning and shaping of the root canal, all the efforts are directed towards achieving an appropriate apical seal. It is very important to access the best apical seal for the reduction of the amount of microleakage and potential treatment failure. Lack of an appropriate apical seal has been reported as the most common reason for root canal therapy failure (2). Apical seal failure allows the remained substances in the canal to pass the apical foramen and to reach the periapical tissue (3).

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Effective sealing of endodontic material should provide conditions that interrupt the contact between substances and the apical foramen towards the surrounding periapical tissue (4). Sealers with gutta percha are utilized in order to attain the highest apical seal. The endodontic textbooks suggest to completely dry the root canals in order to seal off the canal spaces (5, 6). This leads to good adhesion of sealers to dentinal wall canal and obturation materials.

However, conditions such as inadequate isolation, exudate withdrawal from apex, inadequate apical extrusion of paper points while drying up, inflammatory lesions and presence of cyst around the root interfere with the complete drying up of the canal (5, 6).

Saliva and residual liquids have a negative impact on the sealing ability of the canal obturation materials. Due to the apical inflammation or over instrumentation, the blood inside the canal might prevent from setting up the sealers or it might increase or decrease setting time (7).

MTA Fillapex sealer of the root canal with Mineral Trioxde Aggregate (MTA) possesses ISO6786 standard as a root canal sealers as well as having all the useful properties of MTA (8).

Since there are few studies in the literature that have investigated the microleakage of MTA Fillapex sealers in comparison with today's high consuming sealers, then the researchers made an attempt to conduct a wider investigation in this field. AH26 root canal sealer is the first resin sealer. This substance is an epoxy resin sealer which has been initially developed as common filler.

Due to owning desirable properties such as appropriate flow, proper dentinal sealing ability and sufficient functioning time, the AH26 is one of the most consuming sealers in dentistry nowadays. To do so, it has been utilized in the present study (8).

Therefore, the purpose of this study was to compare the apical sealing ability of AH26 and MTA Fillapex sealers with the presence or absence of blood within the canal.

Methods

The present in vitro study was done on 48 samples of single root central-incisor teeth extracted from human being collected from town clinics. All the samples included the following properties:

1. Intact teeth without caries lower than CEJ and coronal restorations
2. Mature teeth with closed end
3. Teeth with flat, tapered and without curvature
4. Teeth whose root canal was not calcified
5. Absence of fracture or crack in the roots of the selected teeth

Tooth Preparation

Immediately after teeth extraction, the teeth were cleaned up, the soft and hard tissues were removed and then in order to do superficial disinfection, they were immersed in 5.25% sodium hypochlorite (Man co., Iran) for 24 h.

The teeth were kept in sterilized physiology serum of 0.9% (Parenteral Co., Iran) at room temperature until testing. The dental crowns were cut from CEJ region perpendicular to the long axis of the tooth using rotating diamond disk with plenty of water so the roots with almost the same length were provided in all samples with caliper (the length of all samples in the present study equals to 12mm).

Single Length techniques, Micro Motor machine (NSK, Japan) and Rotary File (Mtwo, VDW Germany) were utilized for the preparation of the root canals. In present study, a micro motor machine was set up with the speed of 350 RPM, and torque with 1.2 NCM.

A hand file ISO#15 (Dentsply, Switzerland) was entered into the canal so that its tip could be seen from the apical foramen. The function length of all samples was 11mm. The function length was selected 1mm shorter than the length of the canal.

At the initial stage, the No. 10-rotary file with 4% taper was first inserted into the canal. Afterwards, No. 15, 20 and 25- rotary files had been used with the same function length and taper equals to 5%, 6% and 6%, respectively. Then, in the cleaning and shaping stage of the canal, it was prepared by using the rotary files of No. 30, 35, 40, and 45-rotary files with the same function length and taper of 5%, 4%, 4%, and 4%, respectively.

To protect the patency at the intervals of filing of each step and the next step, the canal was rinsed with pressure by using a syringe containing a sterilized physiology serum of 0.9%.

Then, a hand file of no. 10 with the same length of the canal was entered into it so that the debris could be exited from the apical foramen. Finally, the teeth were randomly divided into four groups of ten. First the root canal of ten teeth were dried up by paper cone of no.

30 in A1 group, so no moisture remained. After that, the human blood (prepared from Blood Transfusion Organization) was injected into the canal by using an injection syringe in a way that the canal entry was filled with blood. Proceeding, AH26 sealer (Dentsply Germany) was prepared according to the manufacturers' instruction. The root canal was filled up through lateral condensation with the help of gutta percha and AH26 sealer. Group M1: Ten teeth were used according to the mentioned technique with the exception that the AH26 sealer was replaced by MTA Fillapex sealer.

Then the twenty prepared teeth were randomly divided into two groups of ten. All the canals were dried up by using the paper cone no. 30; therefore, the canal remained dry. These twenty dried teeth were split into groups of A2 and M2. In this group, the canals after the assurance of being dried up were obturated in the same way as it was explained dipped in blood group. Four teeth as the positive control group were not coated with nail polish and the coronal surface to the apex was sealed with sticky wax. The surface of the other four teeth as the negative control group was coated with nail polish to 1mm of apex and the coronal was sealed with sticky wax. Then, the root canal orifice of all teeth was sealed with by sticky wax.

The outside of the teeth was completely coated with two layers of nail polish within 1mm of the root apex. The teeth were kept in an incubator for 7 days (100%of moisture and 37°c temperature) in order to complete the setting of sealer.

Then the samples were laid into pelicans blue ink solution for 72 hours. After that, the samples were cut along the longitudinal axis of the teeth in sagittal form by using a hand piece and a diamond disc close to the canal center.

Then, the teeth were split up into two halves by a spatula. A stereomicroscope with a magnification of 20 was employed to estimate the color penetration rate. The most color penetration along with gutta percha was positive for every single of the samples.

Finally, the data were analyzed using by SPSS software, ANOVA, Chi-Square and T-test statistical tests. The evaluation of the extent of microleakage on the surface where the most color penetration was observed had been performed by using a computer and a digital camera (Maticam 2000, Japan) and a computing software (Motic Image plus 2.0 Ml) by micrometers. At the end, the data were analyzed by SPSS 18 software and T-test, and then followed by ANOVA statistical test. The significance was considered $p<0.0005$.

Results

The results obtained from the present study on 48 samples of single central-incisor extracted human teeth attributed the lowest level of apical microleakage was in AH26 sealer. AH26 applied dried root canal had the lowest degree of apical microleakage compared with the presence of blood inside the canal. The apical microleakage of sealers in the dry group and in the group with the presence of blood in the canal was calculated 349.81 and 439.66 micrometer, respectively (table 1).

Table 1. The mean of microleakage of sealers studiedin blood and dryness

Condition	Number	Mean±SD
Bloody	20	439.66±33.83*
Dry	20	349.81±84.68*

*standard deviation

The mean of apical microleakage in AH26 and MTA Fillapex sealers under dry canal condition was significantly lower than the canal containing blood. The AH26 and MTA Fillapex sealers did not have significant difference in dried condition and the canal contained blood. The evidence showed that drying up the canal could completely lead to achieve a better apical sealing off. The mean of apical microleakage in sealers under dried canal condition was significantly lower than that of under the canal was dipped in blood condition. The comparison of various apical microleakage sealers under the divided conditions of dry and blood indicated that a significant statistical difference between the two conditions (table 2). $p\leq0.005$ was considered to be significant.

Table 2. The average of apical microleakage related to every sealer studied

Sealer condition	MTA Fillapex Mean±SD	AH26 Mean±SD	P value
Dry	367.55±54.95*	329.57±106.54*	0.34
Bloody	448.61±34.67*	429.84±31.63*	0.20
P value	0.01	0.001	-

* standard deviation

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Discussion

In the present study, the researchers investigated the degree of apical microleakage of AH26 and MTA Fillapex sealers under the conditions in which the canal was both dry and contained blood. The least amount of microleakage under both dry and dipped in blood conditions was AH26 sealer.

On the whole, the group without blood demonstrated the least amount of apical microleakage which indicated that drying the canal could completely lead to a better apical sealing condition.

In a study conducted by Khalilak and et al. about the impact of the blood on the degree of apical microleakage of AH26 and Epiphany sealers demonstrated that in a wet environment after one day there was no significant difference between two sealers in apical microleakage.

While after three weeks, the microleakage was significantly lower in AH26 group. Therefore, the present study confirmed the results of Khalilak's research.

Moreover, the degree of microleakage in dry condition was lower which was confirmed by this study (9). Negam and et al. investigated the impact of human blood on the sealing ability of sealers (AH26, Roth, Tubli seal, endomethasone, Diaket and Neogenol).

In their research, after filling the root canals, the samples were placed in methylene blue for one hour. According to the results, the least degree of micro-leakage under all conditions was related to Tubli seal and AH26, respectively. The present study also demonstrated the least microleakage value of AH26 sealer (10).

Khedmat and et al. conducted a study on the comparison among the apical seal of Apexit, AH26 and Dorifill. The degree of microleakage of the AH26 sealer was compared to other sealers after 30 days. There was not any observed statistical significant difference between AH26 and Dorifill; in addition, the least degree of microleakage was due to Dorifill (11).

In the present study, the microleakage of AH26 demonstrated the least degree of microleakage among the sealers investigated the factors that result in the difference between this study and the abovementioned studies; one can refer to the setting time of the samples in pelican sink solution.

In this study, the time for placing the samples in the solution was less than Khedmat's study which led to the differences in findings. WU and et al. studied the liquid replacement along the gutta percha filling accompanied with and without sealer. After preparation, the canals were filled through gutta percha vertical compaction. There was not any sealer used in the 4th group.

The sealers used included Roeko seal, AH26, EWT Pulp canal sealer. Measuring the degree of microleakage did not demonstrate any statistical significant difference among the four groups in replacing the liquid (p=38%).

The group without any sealer illustrated the high liquid replacement. AH26 group was the only sealer which demonstrated the least liquid replacement compared with the group without sealer (p=0.006). According to the results obtained, it could be concluded that filling with AH26 sealer provided a better seal. Consequently, the present research demonstrated the AH26 sealer had the best sealing ability (12).

A study was conducted by SheikhRezai and et al. studied on the impact of the properties inside the canal on the apical microleakage when they filled by using AH26 and Rosen. According to the results, AH26 sealer demonstrated the least degree of microleakage with the presence or absence of moisture; all of them have been confirmed through the present research (13).

Khayat and et al. investigated the apical microleakage of ZOE, Tubliseal, AH26 and CRCS sealers and they found that the least apical microleakage was within AH26 sealer and the most apical microleakage was for CRCS sealer which have been confirmed by the present research (14).

Conclusions

The results of the present study indicated that the least amount of apical microleakage in both condition of dry and blood inclusion was AH26 sealer, and our supposition about the decrease of amount of apical microleakage in blood inclusion by using MTA Fillpex was not accepted. Then, by comparing this to dry canal condition, the blood had a negative impact on the degree of apical seal of sealers.

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