

In vitro comparative study of apical microfiltration in retrograde fillings between dental cements: MTA Repair Hp and Biodentine

Estudio comparativo "in vitro" de lamicro filtración apical en obturaciones retrógradasentre cementos dentales: MTA Repair Hp y Biodentine

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Abstract

Objective: To compare "in vitro" the degree of bacterial microfiltration in the apical third of the root canal, when performing the retrograde filling technique using two endodontic cements: MTA Repair Hp (Angellus) and Biodentine (Septodont).

Materials and methods: Twenty-two uniradicular teeth were used (upper central and lateral incisors), whose ducts were instrumented up to the working length with the Limas K File hand instruments (Dentsply / Maillefer, Ballaigues, Switzerland). The teeth were randomly divided into 4 groups A, B, C and D, group A and B of 10 teeth each. The root canals of group A were obturated using retrograde technique with MTA Repair Hp, and those of Group B with Biodentine, Group C root canals positive control, Group D root canals negative control. The samples were screened and photographed, and the images were analyzed in the three thirds root using the program Motic Images 5.0.

Results: Group A (MTA Repair Hp) showed a greater penetration of Chinese ink in the last 3 millimeters of the apical third, as well as in the middle third in relation to Group B (Biodentine), and although this difference was not statistically significant one observed a tendency to smaller microfiltrations with Biodentine.

Conclusion: The technique of retrograde obturation with Biodentine presents a greater tendency to provide a more hermetic peripheral seal of the apical third, as compared to the retrograde obturation technique with MTA Repair Hp.

Key words: MTA, Biodentine, retrograde obturation, apical microfiltration.

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Resumen

Objetivo: Comparar “in vitro” el grado de microfiltración bacteriana en el tercio apical del conducto radicular, al realizar la técnica de obturación retrógrada mediante el uso de dos cementos endodónticos: el MTA Repair Hp (Angellus) y el Biodentine (Septodont).

Materiales y Métodos: Se utilizaron 22 dientes uniradiculares extraídos (incisivos centrales y laterales superiores) cuyos conductos fueron instrumentados hasta la longitud de trabajo con los instrumentos manuales Limas K File (Dentsply/Maillefer, Ballaigues, Suiza). Los dientes se dividieron al azar en 4 grupos A, B, C y D, el grupo A y B de 10 piezas dentales cada uno. Los conductos radiculares del grupo A fueron obturados mediante técnica retrógrada con MTA Repair Hp, y los del Grupo B con Biodentine, Grupo C conducto control positivo, Grupo D conducto control negativo. Las muestras fueron transparentadas y fotografiadas, y las imágenes se analizaron en los tres tercios radiculares mediante el programa Motiv Images 5.0.

Resultados: El grupo A (MTA Repair Hp) mostró una penetración mayor de la tinta china en los 3 últimos milímetros del tercio apical, así como en tercio medio respecto al Grupo B (Biodentine), y aunque esta diferencia fue estadísticamente significativa si se observa una tendencia a menores microfiltraciones con el Biodentine.

Conclusión: La técnica de obturación retrógrada con Biodentine presenta una mayor tendencia a brindar un sellado periférico más hermético del tercio apical, en comparación con la técnica de obturación retrógrada con MTA Repair Hp.

Palabras clave: MTA, Biodentine, obturación retrógrada, microfiltración apical.

INTRODUCTION:

The proper endodontic treatment depends on the necessary procedures to shape, clean, disinfect and seal the complex system of root canals in three-dimensional form, that is, achieve a hermetic seal (1,2). This will allow to occupy the space created by the surgical preparation including, as far as possible, its ramifications or any of its anatomical variations, and without forgetting the importance of performing in a short period of time a definitive coronary restoration constituted as purpose of all endodontic procedures. However, this objective cannot always be achieved absolutely, due to the presence of both coronary and apical leaks, as shown by the numerous studies (3).

Retrograde filling is a technique that is performed when conventional endodontic treatment is not feasible. It will be approached through periapical surgery in the following cases: need to establish drainages, in the presence of anatomical complications of the root canal such as: calcified ducts,

non-negotiable root curvatures, incomplete apical development with failed apexification, root resorption, fenestration and dehiscence, iatrogenic problems such as: non-removable root canal materials, steps, perforations, over-instrumentation, exaggerated over-obturation, persistent postoperative pain, scarring not achieved; in traumas such as: root fractures with pulpal necrosis, dental avulsion, horizontal fracture of the apical third, failure of previously endodontically treated cases, periodontal considerations, need for biopsy, chronic apical osteitis, and for surgical reasons (4).

This is the reason why the selection of a good material for the apical filling is a fundamental step for the resolution of the situations already mentioned. The main conditions that this material must present are its biocompatibility and the provision of a hermetic seal to avoid filtration; not to be toxic, nor reabsorbable, radiopaque, bacteriostatic and have the capacity to induce osteogenesis and cementogenesis.

The resection of the apical zone and the application of cement will seal and prevent the microfiltration of microorganisms resident in the area. The dental cements used for a retrograde filling in periapical surgery have been a subject of discussion and permanent investigation, since years ago; non-biocompatible and non-bioactive materials were used, such as: zinc oxide and eugenol, glass ionomer and amalgams, demonstrating the presence of high levels of microfiltration, as well as being toxic, carcinogenic, corrosive and their use is contraindicated by the FDA. For this reason, dental laboratories have been contributing with their research, to find a cement that is suitable for the in vivo treatment of patients, which does not cause or produce side effects that affect health and allow endodontic treatment through apical surgery succeed in the long term (4).

At present, numerous in vitro investigations are being carried out to verify the effectiveness of new materials and verify their marginal sealing capacity. Many of the results are satisfactory and provide superior characteristics to the materials commonly used. But, on the other hand, many of the materials lack long-term clinical studies. Nowadays, there is a range of cements that are very close to the required characteristics; These, complemented by an adequate diagnosis and the correct clinical procedures guarantee the success of the root canal treatment. Among the current cements that have much more biocompatible and bioactive properties we have: MTA, developed at the University of Loma Linda, California in the 1990s; it is a material based on Portland cement and bismuth oxide, used as dental cement for the filling of the root after the apicoectomy and for the repair of the root perforations presenting hydraulic and antimicrobial properties (4,5) thanks to its alkaline pH, the result of the formation of

calcium oxide, which is subsequently converted into calcium hydroxide. (6).

This conversion results in a high alkaline pH of initially 10.2 and after 12.5 at 3 hours with beneficial antibacterial effects, however this pH decreases in the presence of blood, which causes discoloration in the tissues. Unlike many other dental materials, MTA solidifies in a moist environment (7).

On the other hand, we have the Biodentine cement, which is: biocompatible and bioactive with the periradicular tissues; It has a composition similar to MTA but with improved characteristics; based on the properties of each of these elements, the need arises to perform a comparative study to determine their effectiveness to avoid microfiltration in retrograde obturation in extracted uniradicular teeth.

MATERIALS AND METHODS

A comparative study of a descriptive, experimental and quantitative type was carried out, with documentary and laboratory research, to determine the degree of microfiltration of dental cements MTA and Biodentine in retrograde fillings, in 22 central and upper lateral incisors. The samples were obtained from the donation of private dental offices. Once the samples were neutralized, the preparation of the cavity for the treatment of ducts was carried out. For the biomechanical process, the step back technique was used, up to three more sizes of the file that adjusted to the working length and the obturation of the root canals was performed with the technique of lateral and vertical compaction, using the Sealapex endodontic sealer (SybronEndo) and coronally was filled with glass ionomer. After

each tooth, a 3mm apicoectomy of the apex was performed, for which a Zecrya burr with high speed turbine and constant irrigation was used and the retrograde preparation of a class I apical box of the dental roots was performed with a tip of ultrasound.

In the two dental control samples the previous steps were also performed; the first sample being sealed with 3 layers of nail varnish covering the retrograde access and used as a negative control, and the second sample was not sealed to be used as a positive control. The specimens were divided into two groups of 10 samples each, and the apical filling was made by retrograde filling of the canal; 10 samples were sealed with the MTA cement and the other group of 10 samples were sealed with Biodentine; for the verification of the two cements; this whole procedure was carried out according to the manufacturer's specifications.

It was left for 12 minutes at room temperature until it finished setting. The samples were divided into Petri dishes for each cement, placed in an incubator at 37° and 100% humidity with distilled water so that the dental cements hardened in 24 hours.

After 24 hours, the roots were varnished with two layers of nail polish, except for the area of the retro-obturation; 2mm of the dental apices were immersed in ink in a vacuum pump at 7.98 Pa for 15 minutes, to perform a penetration to activate the ink in the apices in case of microfiltration. The dental roots were removed from the vacuum pump and the samples were left for 48 hours in the ink for a passive introduction. At 48 hours the excess of Chinese ink was washed and the nail varnish was removed using acetone and finally to check whether apical microfiltration

existed it was checked by diafanization of the dental roots.

Through the use of a stereo microscope and through the software program Motic Images 5.0, it was possible to demonstrate and compare whether or not microfiltration existed in each sample and thus check at 3mm depth of application of dental cements.

Statistical analysis: the T-student test was carried out to compare the means of length and width of the microfiltration between the two materials used, using the SPSS program, version 22.

RESULTS

Table 1 shows the comparison of the width and length of microfiltration in the root canals using MTA Repair and Biodentine dental cements. It was observed that there are no statistically significant differences in the width and length of the microfiltration of the ducts applying either of the two dental cements, but a tendency is observed that the width and length of the microfiltration are smaller when the Biodentine is used.

Table 1. Comparison of the width and length of the microfiltration according to the dental cement used (MTA and Biodentine)

Variables	MTA (n=10)	Biodentine (n=10)	P
Microfiltration-Width (mm)	0.71±0.631	0.38±0.407	0.182
Microfiltration-Long (mm)	1.28±1.133	0.51±0.574	0.071

Results expressed as mean ± standard deviation. Statistically significant difference: $p < 0.05$ (T-Student).

It was evidenced that of the 10 samples in which the MTA Repair Hp was applied, 9 presented filtration and of the 10 samples in which Biodentine was placed: 7 presented filtration. Regarding filtration by thirds, a slight filtration tendency was observed in the apical third in the Biodentine samples, while in the majority of MTA samples filtration occurred in the middle and apical third of the root, demonstrating the efficacy of Biodentine as dental cement since it maintains a minimum microfiltration tendency.

It is evident that when observing the filtration in the analysis of thirds, Biodentine maintains a tendency of slight filtration observable in the first third (apical), unlike MTA, where the majority of its samples present fixed filtration in the second and third third; evidencing the efficacy of Biodentine as dental cement that best prevents microfiltration (Figure 1).

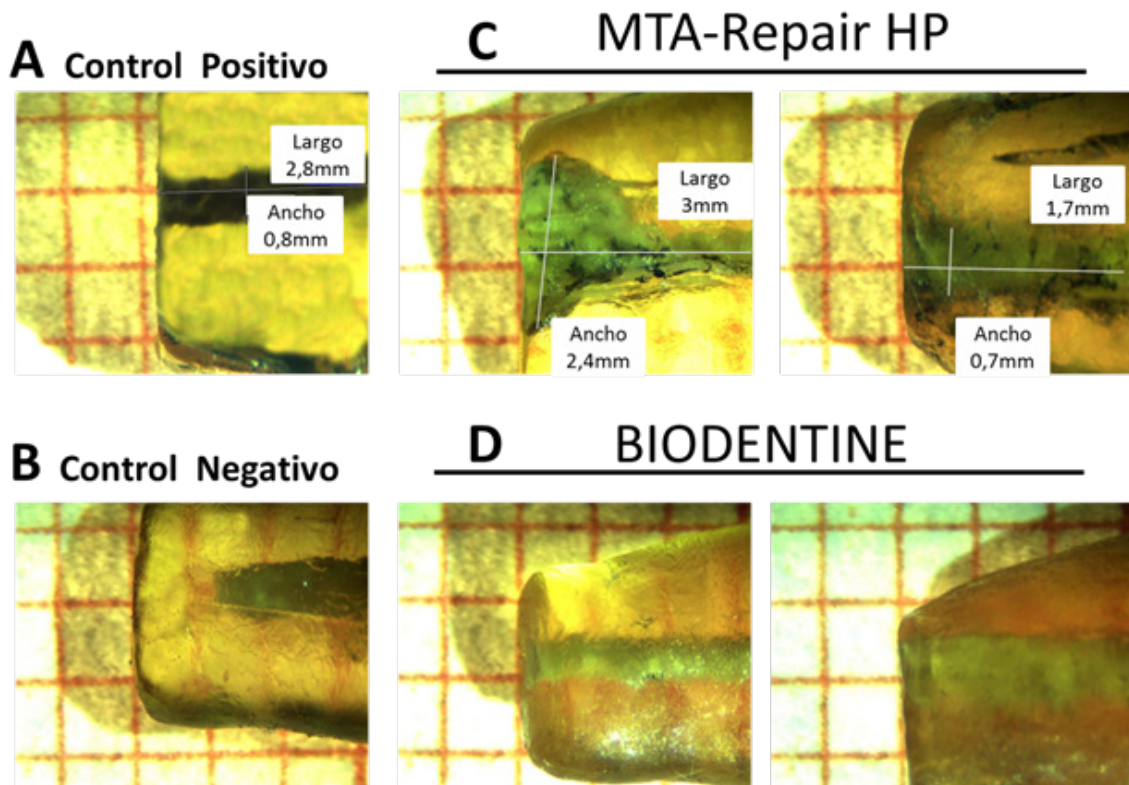


Figure 1. Sample of retrograde fillings with MTA Repair Hp (C) and Biodentine (D)

DISCUSSION

According to the studies carried out, Biodentine is more effective when used in endodontic treatments, since the results in each of the tests show that microfiltration is minimal, leaving aside the MTA material. Although MTA, according to Correa in 2015, it is considered as a biocompatible material, with great sealing capacity, which in environmental characteristics such as moisture sets perfectly and promotes tissue regeneration (8).

According to the investigation carried out by Correa, it concludes that the retro-sealing material that is most frequently used at present is the MTA; after that, a new one called Biodentine emerges, which after performing the different tests, the results indicated that after a certain time, the Biodentine had greater efficiency compared to MTA, and as the number of hours passed, they had better results; that is to say, the longer the samples were immersed, the resistance to microfiltration of the cements increases with Biodentine superior to MTA, it was also proved that the sealing properties are maintained over time. Being the result of this study similar to the present, it concludes in the same way and recommends Biodentine in practice (9).

With further investigation of results of similar studies it was found the study of Kaup and collaborators, where the Biodentine and the MTA Gris Angelus, have the same results, that is to say that both materials have favorable characteristics and that due to this they do not have significant differences in terms of microfiltration; However, both materials showed different qualities in terms of handling, setting time and porosity; in this study there was no statistically significant difference in percentages (10).

Regarding the comparison with other types of materials, the research of Ozlem compared the amount of microfiltration, using for this study 36 primary canines filled with tricalcium silicate (Biodentine) and with two types of glass ionomers (Ketac Molar and Vitremer), where the pieces were subjected to temperature tests, to be submerged in methylene blue and this way checking the degree of microfiltration; which resulted in Vitremer being the material that presented less filtration of methylene blue, while: Biodentine and Ketac Molar presented microfiltration in similar percentages (11).

Some physicochemical properties of MTA can be improved by replacing the bismuth oxide (Bi_2O_3) used as a radiopacifier with zirconium oxide (12) used in calcium silicate and tricalcium cements promoting better properties such as: mechanical resistance, calcium release, pH increase and better biological response and solubility (13). Several investigators evaluated the sealing ability of MTA in perforation repair presenting acceptable results (14). However, this new product based on calcium silicate "Biodentine" presents characteristics that surpass the latter, (15) being its main components the tricalcium and dicalcium silicate as main core materials and on the other hand, the zirconium oxide serves as a radiopacifier (16,17). The material is characterized by the release of calcium in the solution (18). Due to its high compressive strength, manufacturers recommend Biodentine to be used as a temporary restoration or as a substitute for dentine under composite restorations, apart from other endodontic uses such as retrograde filling (19). Therefore, the authors recommend that these mechanical / pathological communications between the root system and the external surface of the tooth should be sealed with a biocompatible material (20), thus preventing bacterial filtration to the

root canal and colonization of the apex, the main condition for success of periapical surgery (21).

In the bibliography available to us, we have not found works that evaluate the apical microfiltration of cements used for retrograde obturation, using the diaphanization method.

CONCLUSION

According to the results obtained on the samples analyzed, the retrograde obturation technique with Biodentine has a greater tendency to provide a more hermetic peripheral seal of the apical third, compared to the retrograde obturation technique with MTA Repair Hp.

Conflict of interests

The authors declare that they have no conflicts of interest in relation to this study and affirm that they have not received external financing to do so.

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