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Editorial

To the Master and Advisor, Prof. Dr. Hidelberto Francisco Pesce

The History of humanity
is based upon biographies
Dante Alighieri "the voice of silent centuries"
Joana D'Arc, "Orleans' lady and French mother"
Leonardo Da Vinci, "Master of arts and science"
Shakespeare, "The creator of a new world"
Every person has the liberty
to write his biography
Pesce, "Masters' sheppard"
Pesce, "The actor of shining pieces"
Pesce, "Every moment's Master"
...But a flower is born
and the essence in reality
due to the creator's ability
made purity and ideal become entwined
This is your trophy, our master!
The thesis of life...
Pesce, the show must go on...
Your theater made us actors, gave us ligth
made us shine, made us doctors
Pesce, thank you very much
We miss you so...
The same way your master left,
Now, you are whith him, to witness the beautiful
moments shared when he was present,
celebrating every victory, assisting every follower.
Remember his saying:
Regardless the unencounters, thank for the encounters
And our friendship will go trough the abstract
with no silver or gold
and, although invisible to our eyes,
your spech would be there, everyday
Thanky you for the encounters, and from the encounters, Bebeto
Now we know that Van Gogh horses are still alive.

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CERVICAL ENAMEL PROJECTION: A FREQUENT CAUSE OF PERIODONTAL AND ENDODONTIC FAILURES.

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The periodontal lesions which result from the presence of the cervical enamel projection should be included in the differential diagnosis of the periodontal lesions induced by endodontic factors. This being so, a review of concepts, diagnosis criteria and clinical consequences of CEP is of great importance to the pratice of endodontics. We shall do so using a clinical case.

Key words: Periodontal abscess - tooth abnormalities -periodontal pocket

INTRODUCTION

Periodontitis has various ethiological factors involved and may damage the supporting periodontus on one or more faces, with the formation of pockets and bone destruction, frequently involving the furcation of the upper and lower molars. The lack of an early diagnosis identifying the cause may induce the loss the tooth involved in the periodontal disease.

Anatomical conditions may be involved in the ethiopathogeny of the periodontal lesion, especially in cases of cervical enamel projection (CEP) in molars, on both the buccal and lingual faces. In the presence of the CEP, the localized extension of the enamel in the direction of the furcation changes the contour of the enamel-cement junction, which may reach different depth levels.

The ectopic presence of the enamel on the root surface impedes the insertion of the fibers of the periodontal attachment. Initially, a long epithelial junction establishes itself and later a deep gingival groove develops, easing the formation of bacterial dental plaque, making removal difficult and leading to the installation of the periodontitis.

Interest in CEP gained force after MASTER and HOSKINS[6], in 1964, when they showed clinically and on extrated teeth, the presence in 90% of the cases with pathological involvement isolated from the furcation in molars. The authors established a classification for the extention of the CEP:

- first degree: discrete extention of the amelocementary junction in the direction of the furcation;
- second degree: The CEP nears the furcation, but does not contact it;
- third degree: The CEP extends into the furcation.

In 1965, GREWE, MESKIN, MILLER[2] examined 5230 extracted molars and observed the cervical enamel projection present in different percentages for each tooth group. The second lower molar and the vestibular face were the most affected.

Stimulated by increasing interest in the CEP,

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for decades treated as a mere anatomical element, LEIB, BERDON, SABES[3], in 1967, examining 300 molars came to a conclusion similar as for the predominance on the vestibular face. Contrary to what other studies related, they did not notice any significant difference between the furcation lesions on surfaces either with or without the CEP. Other factors may have contributed, such as generalized periodontal illness as a result of deficient hygiene and the extention of the nearby surfaces due to the pathological process in an advanced phase.

TSATSAS, MANDI, KERANI[4], in 1973, found results similar to those of MASTERS and HOSKINS[6]. In 1608 molars studied, the CEPs showed up in 25% of the upper molars and in 35% of the lower molars. Most of the cases were classified as first degree, and the buccal face was the most affected.

The analysis of 2000 molars by SWAN and HURT[5] in 1976 proved that the first degree CEPs were the most frequent, but stressed that second and third degree projections are effectively able to affect the bifurcation by the installation of periodontitis. In these situations the lower second molars were the most involved teeth.

The prevalence of CEPs in orientals, compared to caucasians was stressed by HOU and TSAI[3] in 1987. In the same study, the authors point out the symmetry of the CEPs, detected in 93,9% of the cases.

In a historical review of the CEP in 1990, MOSKOW and CANUT[7] revealed that this type of ectopic enamel on the root surface was registred during the past century and cited WATSON and WOODS[11], when in 1926, they ventilated the possibility of the occurance of lesions on the bifurcation associated to the CEP.

LIMA and HEBLING[5] in 1993, examining 96 dental faces with inflammatory involvement of the bifurcation, registred the CEP in 83,5%. The authors characterised the CEP as a predisposing factor for the inflammatory involvement of the bifurcation of molars, independent of the group examined.

NEUVALD et al.[8] established a correlation between the ethiopathogeny of CEP and pathologies related to its presence, as well as local periodontal diseases and paradental cyst using magnifying lenses, stereoscopic microscope, periapical radiographs, light microscope and scanning electron microscope.

CASE REPORT

In 1980, the patient ACL, age 35, male, caucasian, with adequate buccal hygiene conditions and overall good health south the Dentist Surgeon presenting an acute inflammation in the region of the second lower left molar, diagnosed as Acute Periodontal Abcess (Figure 1). Once applied the emergency treatment, the patient was sent to a periodontist, who, over a period of 8 years, carried out two periodontal surgeries, as a result of relapses characterised by repeated worsening. In 1988, the patient was referred to another periodontist, who opted for conservative therapy. After several bouts of worsening, he was submitted to another local surgery, but the previous clinical picture persisted.

In 1993, a third periodontist, after another surgical intervention, referred the patient to an endodontist, in order to evaluate the pulp vitality of the affected tooth, believing there migh have been an endo-periodontal involvement. With the positive results to electric and thermal tests, the endodontic treatment was not carried out. The radiographs indicated that the periodontal problem continued to progress (Figure 2) with sporadic bouts of worsening.

In 1994, a fourth periodontist carried out yet another surgical treatment without success. Believing in the endo-periodontal involvement, the patient was submitted to endodontic treatment. During the shaping, a file broke in the buccal canal.

Since it was not possible to remove the fragment of the instrument, it was passed over and the canal was filled with Thermafil #25, because the guta-percha point did not present enough resistance to overcome the mechanical obstruction (Figure 3). Six months later there was still no clinical improvement and the tooth was extracted following the patient's decision. Macroscopically analysing the dental morphology, the presence of a cervical enamel projection was finally diagnosed on the buccal face of the affected tooth, third degree according to MASTER and HOSKINS[1], as can be seen in Figures 4,5 and 6.

The extracted tooth was submitted to scanning electron microscopy; so we could observe the enamel projection extending into the furcation and the erosion caused by the scalling of the roots (Figures 7a and 7b).

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Figure 1.
Periapical radiograph showing a deep periodontal pocket on the mesial surface of the second lower left molar.

Figure 2.
The same case, 13 years later.

Figure 3.
Radiographic appearance, after root canal therapy.

Figure 5.
Magnified photograph showing grade III CEP.

Figure 4.
Extration of the tooth reveals the presence of CEP.

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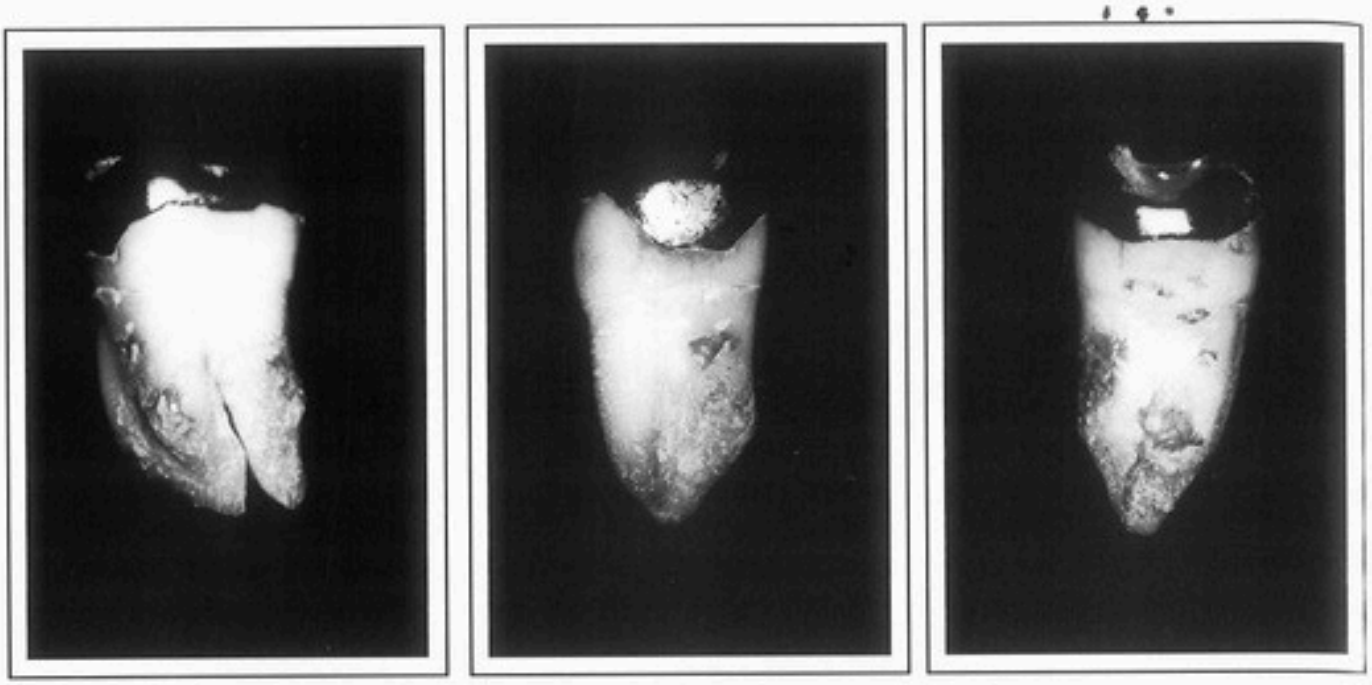

Figure 6 a, b and c.
Lingual, mesial and distal faces of the tooth. Note the deposit of calculus on the surfaces of the roots

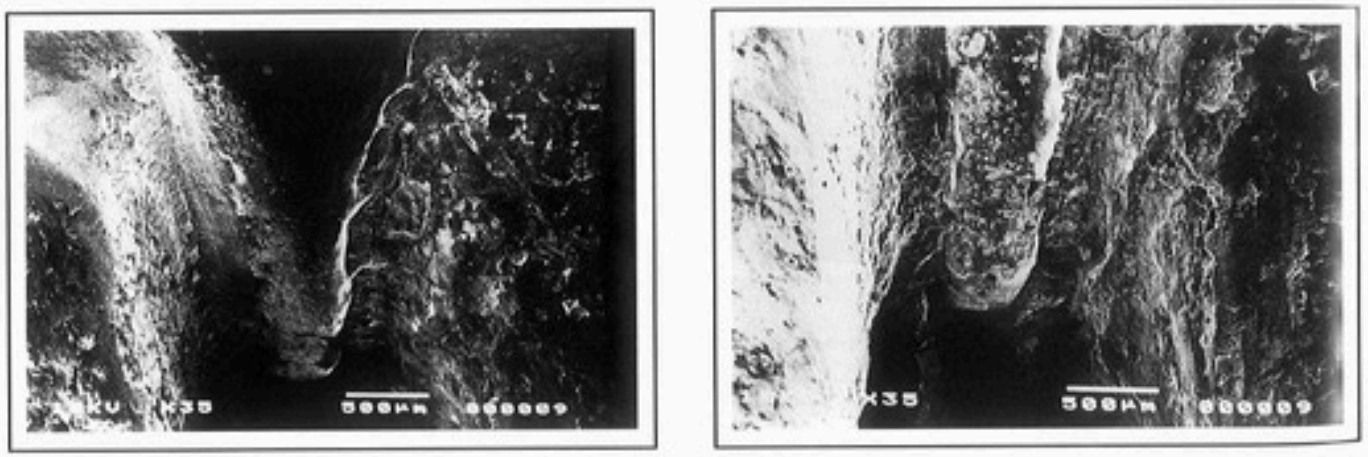

Figure 7 a and b.
S.E.M. showing the appearance of the CEP. Note the effects of the scalling of the roots.

DISCUSSION

The case related is an example of how the lack of previous knowledge of the existance of the enamel projection may make difficult safe and precise definitive diagnosis. If identified in the first diagnosis, the surgical treatment carried out could have included the exposition of the bifurcation and the preservation of the tooth with healthfuil periodontal conditions. Another option could have been ameloplasty, attempting to reinsert the periodontal structures over the affectrd root surface as has also been suggested by diverse authors[1,3,5].

The continuation of the CEP due to its not being identified, will lead to the reestablisment of the initial situation of long epithelium immediately after surgical repair, with the formation of a deep gingival groove, favoring the occurance of new bouts of periodontitis with periods of worsening, as the clinical history related has shown. The fact that pulp vitality continued indicates that the clinical picture was exclusively periodontal.

A very important factor related to the CEP is the perspective of the diagnosis which must always be

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present in cases of inflammatory periodontal involvement in the region of the bifurcations[8]. This perspective of the CEP must always be present especially in the differential diagnosis of the periodontist in cases of localised periodontitis in patients with good oral hygiene. The same must occur with endodontist, in cases of supposed isolated endo-periodontal involvement in the region of the bifurcation of the molars.

In the clinical cases with CEP, the characteristic of bilaterality must also be revealed[3]. In the present case, the patient had recently presented early involvement of the region of the bifurcation of the contralateral lower molar, also presenting the cervical enamel projection (Figure 8).

Figure 8.
Radiograph showing the contralateral lower molar, also presenting CEP

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THE INFLUENCE OF TRAUMA FROM OCCLUSION ON ENDODONTICS

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A healthy and physiological occlusion is of fundamental importance for an adequate and physiological functioning of the stomatognacthic system. According to clinical and radiological analysis trauma from occlusion may induce alterations in periodontal and pulpal support or even act as an inhibiting factor in apical reparation of teeth which have undergone endodontic treatment. This study tried to relate occlusal unbalance to periodontal and endodontal apicals.

Key words: trauma from occlusion, pulpar alterations, pulpar necrosis.

INTRODUCTION

The objective of endodontics is the complete obturation of the root canal system, that is: a hermetic and permanent sealage, which does not irritate periapical tissue[12] and leads to successful endodontic treatment. However, as it is known, endodontics does not end with the obturation of the root canal, that is, the care which the area professional must observe does not cease with the repletion of the pulpar cavity, but only after a period of preservation of at least two to three years, beginning in the first six months after surgery[2].

Most of the failures which occur are due to inadequate endodontic treatment, but when the problem arises even when clinical treatment has been well conducted, the possibility is that the etiologic factor or factors which caused the infirmity are no longer within the root canal system, but in the periapical region or even due to malfunction of the masticatory system[2].

Several authors have studied the problem and, in 1960, INGLE and WASH[6] observed in adolescent girls a syndrome characterized by alveolar decalcification and pulpar necrosis associated with compulsive bruxism. The radiological exam showed diffuse bone reabsorption associated to inferior front teeth which, upon clinical examination, presented mobility and periapical swelling without bags (normal epithelial adhesion). Some necrotic pulps, after 8-hour turbid-free bacterial cultures showed the constant traumatic pressure as being responsible for the pulpar necrosis.

There seems to be a close relationship between pathologic entities such as trauma from occlusion and periodontitis with the state of the dental pulp[10].

According to RAMFJORD and ASH[15], in 1987, trauma from occlusion may be manifested in the periodontal region, in the hard structures of the teeth, in the pulp, in the temporal-mandibular articulations, in the soft tissue of the mouth and in the neuro-muscular system.

The effect of trauma from occlusion in the production of periapical lesions was histologically and histometrically investigated by KUMAZAWA et al[8]. in 1995, clearly noting a correlation between the amplification of the periapical periodontal lesion and trauma from occlusion.

Morphological alterations and the regeneration of pepdidergical sensory nerves of the pulp and periodontal region were studied by KVINNSLAND[9], employing the

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histochemical method, after generalized dental trauma. The teeth which suffered trauma from occlusion presented morphologic alteration in the CGRP-IR and SP-IR nerves. In contrast to the controls, buttons and ramifications of blood supply were found located in the apical periodonto, gums, periodontal ligament and cervical pulp.

OKESON[13] stated that pulpitis may be one of the symptoms associated to functional disturbances of the dentition. Abnormal parafunctional activities, specially when acting upon few teeth, may create the symptoms of pulpitis, sensibility to heat and cold, which, when of short duration, is characterized as reversible. In extreme situations, the trauma may be enough to cause the pulpar tissue to reach a degree of irreversibility and the occurrence of pulpar necrosis.

A study carried out by BABICK et al[1] in 1996 evaluated the influence of occlusal wear in the relief of post-surgical pain after handling of root canals, concluding that this avoided the pain on teeth which showed pulpar vitality, sensitive to percussion and not carriers of periapical lesions.

The purpose of this clinical study was to evaluate patients showing pulpar alterations, the cause of which may be associated to trauma from occlusion.

CLINICAL CASES

Case 1

A female patient complained of intense pain on the right side of the inferior molar region during mastication. The clinical examination showed that tooth 48 had a shallow class I amalgam restoration. The periapical x-ray examination of the mentioned tooth did not show any abnormality. Due to the pain, the patient had been referred to neurological, ottorinolaringological and, later, DTM clinics, and none were able to note pathological alterations. Due to the indication of a fixed partial prosthesis to replace 46 and 47, endodontic treatment of 48 was recommended and where it was noted that the patient was a bearer of pulpar necrosis. The evaluation of the occlusion informed that the patient was a bearer of class III, only going into contact sporadically with teeth 44 and 45 and teeth 14 and 15, respectively, and tooth 48 with 17. There was an absence of 46, 47, and 37. Sporadically, element 38 got into contact with 27, 43, with 13 and 12 and, finally, with 11 with 41 and 42. Its occlusion was balanced, removing the premature contact, having the pain totally disappeared after endodontic treatment. (Figures 1a, 1b, 1c, 1d.)

Case 2

A 23 year-old student complained of throbbing pain on 41. Upon clinical examination, it was noted that the tooth had no cavities or fillings and the x-ray showed a periapical lesion. When opened, the pus was drained a there was relief from the pain. The patient had no accidental trauma history but a history of nocturnal bruxism. Upon analyzing the occlusion it was observed that the laterality of movement was bilaterally made by the incisors, rather than the canine. Element 23 was vestibularized and 45 and 46 with superior cross-bite. The 36 was also crossed as regards 26. Once the clinical case was evaluated, it was diagnosed tat the probable cause of the pulpar necrosis was trauma from occlusion. It was also observed that 31 had already undergone endodontic treatment and that the reason for the treatment may have been the same. (Figures 2a, 2b, 2c, 2d.)

Case 3

A 33-year-old patient, a computer programmer, complained of pain and came to the endodontic clinic with a dental-alveolar abscess. After clinical analysis and x-rays, it was observed that the pain had its origin in tooth 41, which presented a very evident premature contact when the patient was in position PIC. The patient reported that she had a para-functional habit beating her teeth. It is important to point out that the tooth was totally exempt of cavities or fillings and that the patient had no history of accidental trauma. (Figure 3a.)

Case 4

A 46-year-old housewife came to the clinic complaining of pain. After clinical and x-ray examinations, pulpar necrosis of tooth 42 was observed, even though it had a crown with no cavities or fillings and there was no history of accidental trauma. Clinical analysis showed that the patient did not have teeth 36, 46, 13, 24 and 25. In PIC, premature contact with tooth 42 was observed. The working movement was carried out by elements 12 with 42, instead of the canine. After endodontic treatment, the pain almost completely subsided and the patient was sent to the Oral Rehabilitation Clinic. (Figures 4a, 4b.)

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Figure 1a.
Radiological aspect of tooth 48 showing a shallow amalgam restoration (class I) presenting no abnormality.

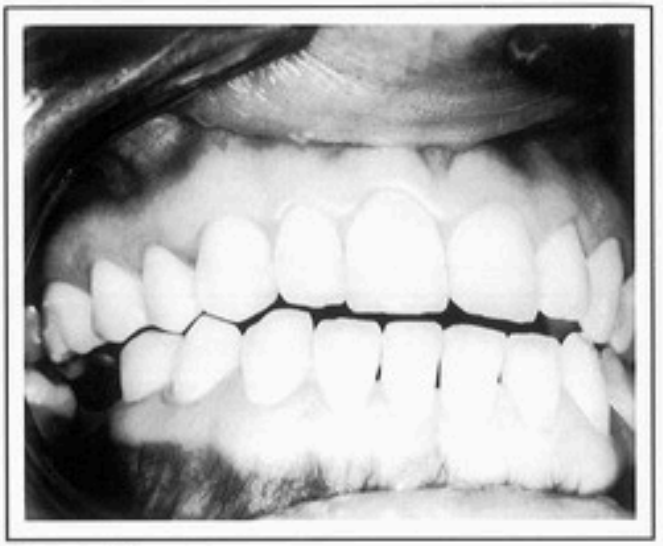

Figure 1b.
Clinical aspect of the patient in PIC (class III).

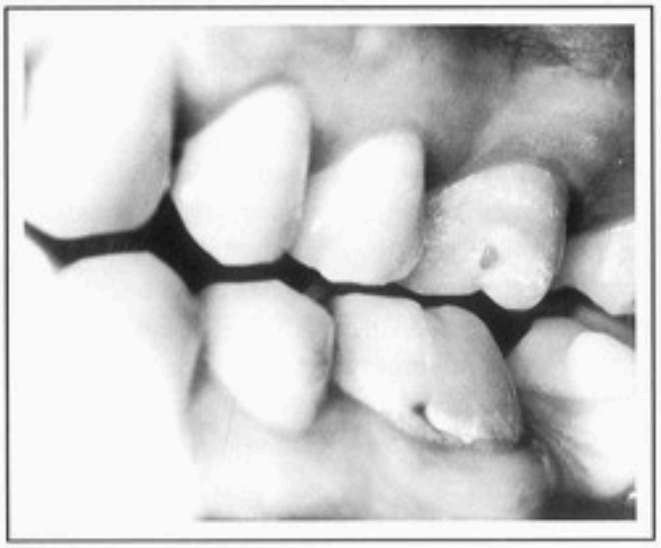

Figura 1c.
Sporadically, tooth 38 enters in contact with tooth 27.

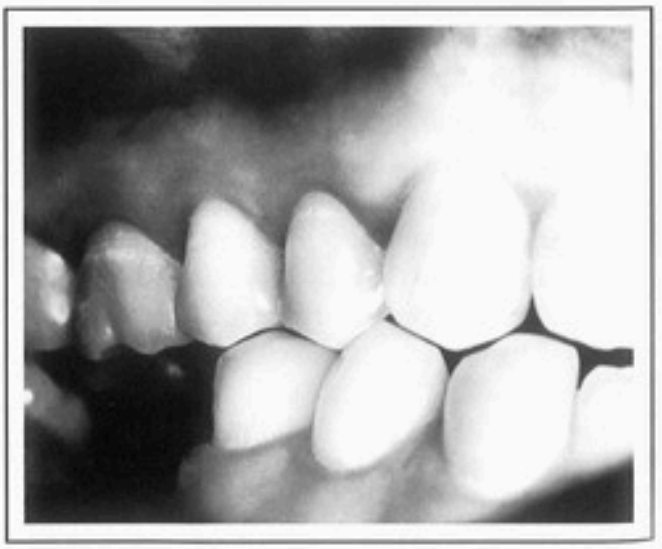

Figura 1d.
Sporadically, teeth 44 and 45 get into contact with teeth 14 and 15.

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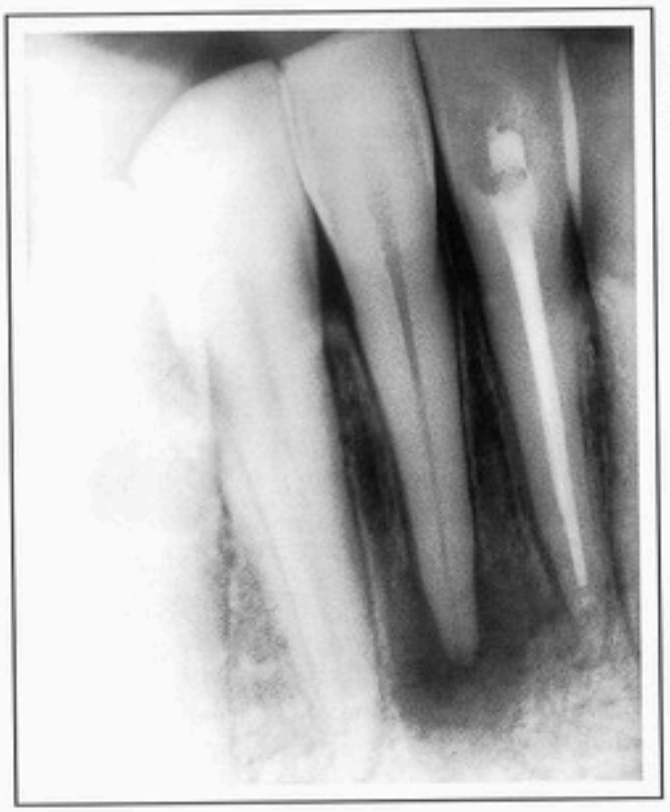

Figure 2a.
Radiological aspect of tooth 41 showing that the tooth presented no alteration to the crown.

Figura 2b.
Clinical aspect of the patient showing premature contacts on teeth 31 and 41, in PIC position.

Figura 2c.
Lateral movement carried out at the expense of the incisors, bilaterally.

Figura 2d.
Lateral movement carried out at the expense of the incisors, bilaterally.

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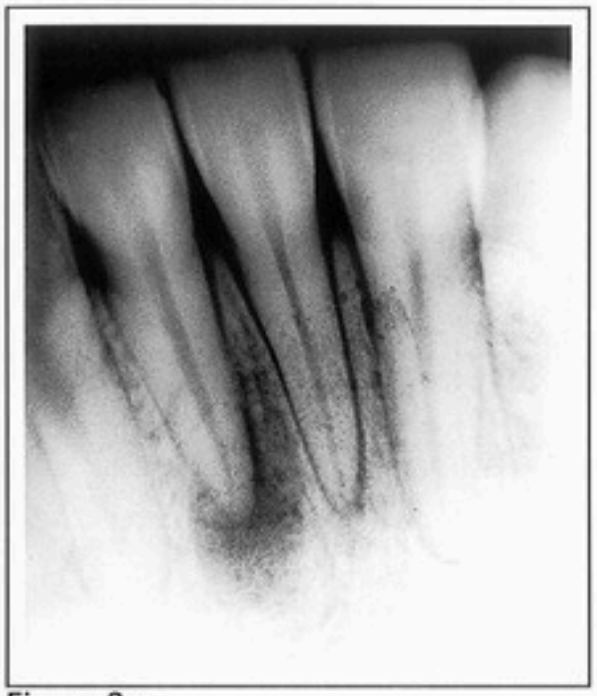

Figure 3a.
Radiological aspects showing tooth with no cavities or fillings.

Figura 4b.
Working movement made at the expense of elements 12 with 44, instead of by the canines.

DISCUSSION

Trauma from occlusion has its deleterious effect not only for the magnitude of the acting force, but also due to the frequency and nature of the process of reparation of the individual. If the frequency and the capacity of recovery are satisfactory, an adaptation process shall occur in a manner such as to produce changes in the periodontium, enabling the same to

Figure 4a.
Clinical aspect of the client showing a premature contact on tooth 42, in PIC.

withstand the forces applied5. Some authors[5, 11, 14, 20] have reported the relationship of severity of trauma from occlusion to the systemic conditions of the bearer.

Many are the stimuli which may cause somewhat pronounced reversible and irreversible alterations to the dental pulp. The response of the dental pulp, among other factors, is very much subject to the blood supply, which may be altered by the mechanical factor, in case of occlusal derangement2, such as reported in case 1, and where this factor may have determined the pulpar necrosis, as the tooth was practically whole, with only a amalgam class I. With no history of accidental trauma, the mastication on that side was carried out at the expense of this tooth (48) with 17, and 44 and 45 with 14 and 15. Endodontic treatment was carried out on 48 and the patient was sent to orthodontics and later prosthesis. It is probably almost certain that necrosis in case 4 would have occurred due to trauma from occlusion. The patient had a missing canine on the right side, which led to the deocclusion of this side by elements 12 with 42. The first tooth to suffer necrosis was 42, probably due to its inferior capacity of supporting the deocclusion effort which should have been carried out by the canine on this side. On the biomechanical aspect one must emphasize that during deocclusion it is forced to lingual, where the bone plate is less resistant as compared to the palatine plate of the analogous tooth.

The sensitivity of the teeth, specially as regards cold, is commonly found associated to trauma from occlusion, according to RAMFJORD and ASH[15], and

results from increased pressure of the blood and passive congestion (passive hyperemia), for traumatic pressure on the teeth interfere less with the arterial blood supply to the pulp than the vein return through the apical foramen. Clinical observations made by these authors, severe trauma from occlusion may originate pulpar necrosis and strangling which results in the death of the pulp has been occasionally observed in cases of severe nighttime bruxism. In case 2, besides having occlusal derangement, the patient had nighttime bruxism symptoms. According to INGLE and WASH[6], this condition of severe nighttime bruxism which induces pulpar necrosis is more badly diagnosed than it is a rare occurrence. Trauma from occlusion seems to be the only explanation for the decalcification in the alveolar support bone in cases where there is no inflammation, even if the patients do not know that they suffer from this condition, they must by made aware due to the extreme incisor abrasion and sulcus with accentuated facets. Endotontic treatment was carried out on element 41, as well as orthodontic treatment with later occlusal adjustment so as to promote regression of the periapical lesion. It is important to note that in case 3, the trauma from occlusion due to the parafunctional habit of the patient of hitting her teeth in the vertical position which, added to the premature contact, is probably the factor that led to pulpar necrosis and, later, the dentoalveolar abscess of tooth 41. Endodontic treatment was carried out on the respective tooth and, later, the patient was taken to prostheses for the needed readjustments and to be made aware of the effects of this parafunctional habit, so as to get rid of it.

JUNG7 and DOTTO[3] reported the existence of a relationship between the occlusal forces and the healing process in the periodontium after surgical injury, stating that trauma from occlusion imposes the lack of periodontal repair after epicectomy in humans.

ELDEEB and ANDREASEN[4] examined the effect of occlusal alterations and healing process of the periodontal ligament, as well as the repair of cement after surgical injury, and deduced that hyperfunctional teeth have their healing process impaired.

According to SELTZER[18], in an analysis of 146 failures in endodontic treatment, most occurred in teeth which were later covered by crowns or acted as pillars fro bridges, deducing that trauma from occlusion may possibly be a significant factor in periapical reparation.

Trauma from occlusion is related to periodontal disease, and this is related to pulpatias, due to the existence of lateral canals and accessories. A tooth with a periodontal bag, whether or not due to trauma from occlusion, is potentially a case of pulpar-periodontal syndrome[18,19].

RAWLINSON[16] associated psychological stress, bruxism and trauma from occlusion to factors causing external root reabsorption, loss of pulpar vitality.

CONCLUSIONS

- occlusal maladjustments which influence endodontics are very common, though badly diagnosed, the consequent lack of treatment leading to failure of therapy.

- the difficulty in proving the correlation between endodontic problems and those of the apical periodontal with trauma from occlusion is legitimate.

- there is a need for complementary studies at ultra-structural and histochemical levels for greater comprobation.

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EVALUATION OF THE IRRITATIVE POTENTIAL OF THE CHLORHEXIDINE SOLUTION (VITAL STAIN EXSUDATION TECHNIQUE)

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The irritative potential of 0.12% chlorhexidine solution was assessed, through the comparison to 1% sodium hypochlorite, and also to saline solution. By using the vital stain exsudation technique and spectrophotometer analysis, it became possible to conclude this solution does present a severe irritative potential.

Key words: Biocompatibility, Chlorhexidine, Irrigating substances.

INTRODUCTION

Success of endodontic therapy, in addition to mechanical preparation and hermetic sealing of the canal, involves infection control through various procedures, one of them being the use of antiseptic irrigating solutions.

At the same time, these substances contribute to the removal of organic matter and render easier the action of instruments, helping in reducing or eliminating intracanal bacterial activity during treatment.

Several authors have studied chlorhexidine gluconate solutions, at various concentrations, seeking to assess their capacity to promote and maintain canal disinfection[5,11,15,16,18].

Chlorhexidine is a cationic molecule whose bactericidal effect results from the alteration of the osmotic balance with a resultant structural disorganization of microorganism cells1. It adsorbs to surfaces, being then slowly released in its active form and assuring a residual and lasting antibacterial effect (substantivity property)[4].

The antimicrobial activity exhibited by chlorhexidine has been attested to in periodontal12 and endodontic treatments, acting also upon those microorganisms present within the dentinary tubules[1,11,15,20].

On the other hand, some studies have demonstrated the possibility of toxic effects chlorhexidine might have on cells and tissues[1,7,8,10,14,17,21].

Recentyly conducted researches show the irritative potential of these solutions to vary according to their concentration3 with an irritation considered to be severe on 1% and 2% concentrations[3,6].

Based on above findings, and considering biologic compatibility to be a requirement of irrigating solutions, the authors decided to investigate the biologic behavior of a 0.12% chlorhexidine solution, assessing its irritative potential upon rat subcutaneous connective tissue, and employing the vital stain exsudation technique such as proposed by udak et al[19].

MATERIALS AND METHODS

Twenty albino male rats of the Wistar lineage, with an approximate weight of 250 grams, were used in this experiment.

After being anesthetized by inhalation of sulphuric ether, the animals were endovenously injected, through the dorsal vein of the penis, with a 2% Evan's Blue solution in a proportion of 20 mg/Kg of body weight.

Following scalping and asepsis of the dorsal region, 0.1 ml of 0.09% saline solution was injected in the subcutane-

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ous connective tissue of the rats, in a previously stipulated site. These samples made up GROUP I (control). In the same animal, at different sites, the other soloutions were injected to form GROUPS II and III, namely:
GROUP II- 1% sodium hypochlorite (Milton solution, Merrel lePetit-Brazil).
GROUP III- 0.12% chlorhexidine (Periogard-Colgate Palmolive-Brazil).

A rotary system was instituted between sites when inoculating the solutions.

Three hours later, the animals were anesthetized and killed by having their neck vases severed. Their dorsal skin was excised, and those sites exhibiting a bluish colored edema halo were removed by means of a 2.5 cm diameter steel cutter.

Skin circles obtained by the above procedure were fragmented, immersed in 10 ml formamide and kept at 45°C for 72 hours to have the dye fully removed.

The resulting solutions were strained through glass wool and analyzed in a digital spectrophotometer with a 620 mm wave length.

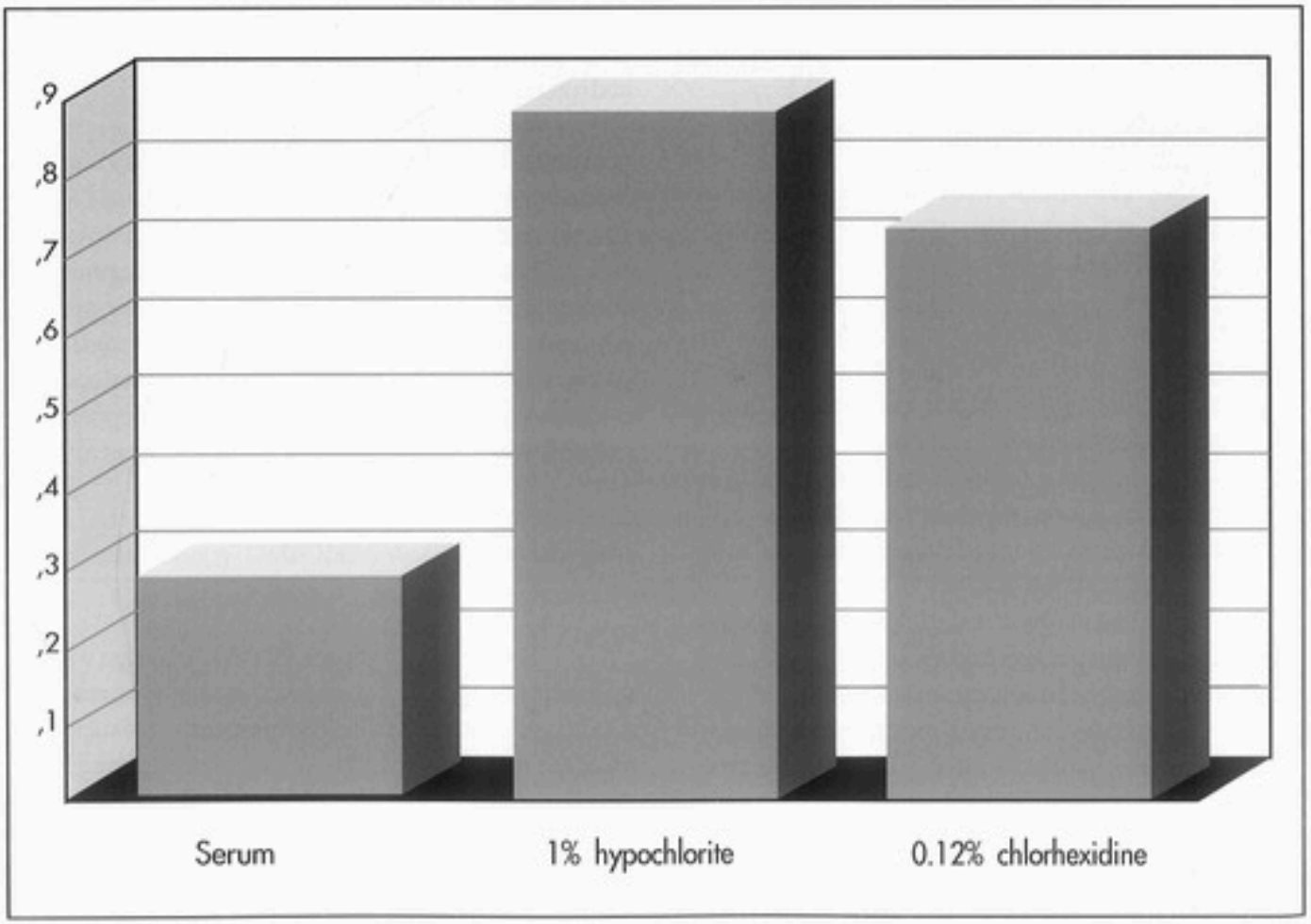
Optical density data thus obtained were statistically analyzed using Schefe's method, with a 5% level of significance.

Results were interpreted, as to the irritative potential of the employed solutions, according to criteria established by NAGEM FILHO and PEREIRA[13] (Chart I).

RESULTS

Macroscopic Evaluation

In assessing the irritative potential of solutions, it was observed clinically visible inflammatory reactions were caused by the tests on those sites where solutions had been injected. Such phenomena were characterized by the presence of bluish-colored circumscribed



edema, evidencing the exsudation of Evan's Blue dye (Figure 1).

Spectrophotometric Evaluations.

Maximum, minimum and average optical density values, such as obtained by analysis in the digital spectrophotometer, are presented on Table I.

The heaviest exsudation of Evan's Blue dye happened with the use of 1% sodium hypochlorite solution, offering an average optical density reading of 0.877, whereas the least value reading was obtained for saline solution (0.203 average).

Sodium hypochlorite solution caused a larger dye exsudation when compared to chlorhexidine (1.2 times greater) and to saline (3.5 times greater) (Graph 1).

Graph I. Comparative data for optical density averages. Serum 1% hypochlorite 0.12% chlorhexidine

CHART I- Irritative potential evaluative criteria

Optical density	Magnitude
0.0000 – 0.1249	Not significant
0.1249 – 0.3010	Mild
0.3010 - 0,6201	Moderate
0.6201 – 2.0000	Severe

Table 1. Optical density values such as determined by the injection of tested products.

	Product		
	Saline solution	1% hypochlorite	0.12% chlorhexidine
Minimal	0.063	0.387	0.145
Maximal	0.539	1.534	1.333
Average	0.281	0.877	0.724
S.D.	0.114	0.309	0.318

DISCUSSION

The employed methodology proved to be an adequate model to evaluate the biologic compatibility of the various solutions[13,19].

In spite of our efforts to standardize all technical procedures, and to use animals of similar condition, variable results between the various specimens could not be avoided. By employing 20 samples for each material, a representative average could be established for the tendency towards the exsudation phenomenon.

The amount of Evan's Blue dye at the edematous site varied according to the degree of irritation induced by the various products.

Saline solution, used as control, allowed to determine irritation caused by the injection of solutions and also by the physical presence of the substance within connective tissue; its irritative potential was considered to be a mild one.

Sodium hypochlorite solution at 1% showed to be 1.2 times more irritative than 0.12% chlorhexidine, both solutions presenting an irritative potential rated as severe.

These observations seemingly support former studies where a similar methodology had been used, showing the irritative potential of these solutions to be grater at higher concentrations[3,6].

Cases are found in the literature showing the chlorhexidine solution, in contact with live tissue, causes inhibition of protein synthesis, injury and cell death[8],

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delays the formation of granulation tissue[2,18], is toxic to the culture of epithelial cells, and causes the hemolysis of human erythrocytes[10].

There is also evidence that chlorhexidine can inhibit some neutrophilic mechanisms, cause cell lesions and, probably, tissue damage[9,21].

Based on the fact that low concentrations of clhorhexidine exhibit also an antimicrobial capacity[1,4,12,15] it seems to us valid to suggest the lesser concentration solution be the one of choice, on account of its smaller irritative potential.

We are aware results of present experiment do not allow for definitive conclusions on the possibility to use clinically the chlorhexidine solution. Here, the tested solutions have been directly injected into subcutaneous connective tissue, a situation different from that where it is used for the irrigation of root canals.

By limiting the use of chlorhexidine to the interior of the canal, its possible effects upon live cells would be exerted only through the apical foramen. Its use, without due caution, might create conditions for damages caused by the intimate contact of the solution with live tissue.

Further assessments should contribute towards an indication of the most appropriate concentrations of chlorhexidine solutions when employed as an irrigating substance during endodontic procedures.

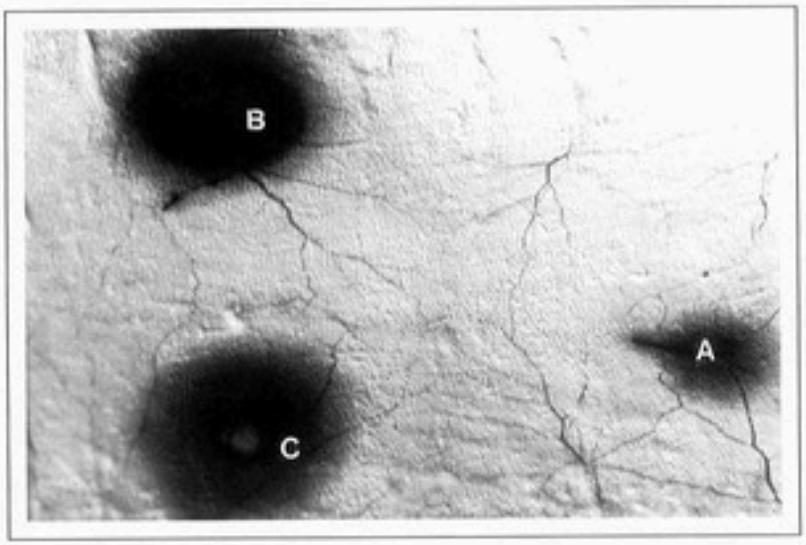

Figure1.
Photograph of dorsal region showing dye exsudation halos caused by saline solution (A), sodium hypochlorite (B) and Chlorhexidine (C).

CONCLUSIONS

Based on results obtained in the present study, and bound by the applied methodology, we concluded that:

1. The 0.12% chlorhexidine solution proved to be potentially irritating, having caused an exsudation significantly larger than that of saline solution, and similar to that of 1% sodium hypochlorite.
2. Results here obtained do not allow for definitive conclusions on the clinical use of the chlorhexidine solution. Whenever opted for, it must be used with due caution.

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HISTOMICROBIOLOGIC EVALUATION AFTER ROOT CANAL TREATMENT OF DOGS' TEETH WITH INDUCED CHRONIC PERIODONTITIS FILLED WITH DIFFERENT SEALERS

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Thirty-three roots of premolars from dogs with induced chronic periodontitis were treated endodontically using K files and 5.25% sodium hypochlorite as irrigant solution. After instrumentation, all root canals were filled with an antibacterial dressing based on calcium hydroxide which was left in place for 7 days. After this period, the root canals were filled with gutta-percha cones and a calcium hydroxide root canal filling material (Sealapex) or with gutta-percha cones and a zinc oxide-eugenol sealer (Fill Canal). After a period of 270 days the animals were sacrificed and histological sections of the teeth were stained by the method of Brown and Brenn. Histomicrobiologic analysis of the apical root region revealed larger numbers of bacteria in the group sealed with Fill Canal compared to the root canals sealed with Sealapex.

Key words: apical periodontitis; microorganisms; root canal filling materials

INTRODUCTION

In the endodontic treatment of teeth with radiographically visible chronic periodontitis, special attention should be paid to the elimination of the bacteria present in the root canal system which play a fundamental role in the development and maintenance of these lesions[7,15,23,24,27]. The percentage of successful endodontic treatment in these cases is significantly lower than the percentage observed in teeth where there is no radiographic evidence of periodontitis[11,12].

The use of intracanal medication between visits has been recommended as a complement of instrumentation in order to reduce the microbiota in root canals. The medication should reach regions of the root canal system that are inaccessible to instrumentation, inactivating the bacteria, preventing reinfection and reducing the proliferation of remaining bacteria[3,5,13,16].

In addition, correct sealing of the root canals is also very important in the endodontic treatment of infected teeth. The sealer used for infected teeth should have antibacterial properties and act on the microorganisms resistant to instrumentation and to the dressing left in place between visits[18].

Thus, the objective of the present study was to determine the presence of bacteria in the apical root region after endodontic treatment in dogs' teeth with induced chronic periodontitis filled with calcium hydroxide or zinc oxide-eugenol based sealers.

MATERIAL AND METHODS

This study was conducted on root canals of 33 roots of premolars from 3 dogs aged approximately one year. The animals were injected intravenously with 3%

Nembutal sodium at a dose of 30 mg/kg body weight and the coronary acess was realized on the occlusal surface. After exposure and removal of pulp tissue, the root canals were left exposed to the buccal environment for 7 days with the purpose of contamination. The coronary acess was then sealed with zinc oxide-eugenol sealer for the induction of periapical periodontitis. Standardized radiographs were taken at 15 days intervals until the observation of radiolucent periapical areas, which usually occurred after 45 days.

After isolation of the dental area with a rubber dam, the septic-toxic content of the root canals was removed using K files in the crown-apex direction and irrigation with a 5.25% sodium hypochlorite solution. The working length was determined and the apical foramen was enlarged using K files up to number 30 along the entire length of the root canal. Instrumentation was performed with K files up to number 70 until the limit established by the working length (2 mm below the radiographic apex), with irrigations being performed with 3.6 mL sodium hypochlorite solution at every change of file.

After instrumentation, the root canals were dried with paper points and filled with buffered 14.3% EDTA solution and shaken with a K file for a period of 3 minutes. After irrigation with physiological saline, the root canals were dried with paper points and filled with a paste based on calcium hydroxide (2.5 g calcium hydroxide, 1 g zinc oxide p.a., 0.05 g powdered rosin, 2 mL polyethylene glycol 400, and 0.04 g p-monochlorophenol) using a special cartridge-typed syringe (ML endodontic syringe, S.S. White Artigos Dentários, Rio de Janeiro, Brazil) with a disposable 27-gauge long dental needle (Terumo, Tokyo, Japan). The pulp chamber was filled with a sterilized cotton pellet and the crown opening sealed with zinc oxide-eugenol cement.

Seven days later, the root canal dressing was removed by irrigation with physiological saline and using K files up to the total length of the tooth. The root canals were dried with paper points and filled with EDTA solution for 3 minutes, irrigated with physiological saline and again dried with paper points. The root canals were then filled with gutta-percha cones and the endodontic sealer by the technique of active lateral condensation using the calcium hydroxide root canal sealer for group I (Sealapex, Kerr, Romulus, MI - 19 root canals) and the zinc oxide-eugenol root canal sealer for group II (Fill Canal, DG Ligas Odontológicas Ltda., Rio de Janeiro, Brazil - 14 root canals). The master gutta-percha cone was placed in the root canal covered with the sealer and also at its end, in an attempt to take the sealer all the way to the apical limit. A zinc phosphate cement was placed over the filling material and the occlusal cavities were restored with silver amalgam. A final radiograph was then taken after the filling. The experimental groups were tested in the same animal.

The animals were sacrificed 270 days after root canal filling and the teeth were individually separated, fixed in 10% formalin for 48 hours and decalcified in formic acid-sodium citrate. After paraffin embedding, the blocks were cut into serial 6-µm sections and stained by the method of Brown and Brenn.

Six histological sections for each root were evaluated by a microbiologist for the presence of microorganisms, regardless of their quantities. The evaluation was performed only in the 2 mm apical region of each root, considering dentinal tubules, cementum and ramifications of the apical delta.

RESULTS

The sections stained by the method of Brown and Brenn only revealed the presence of Gram-positive (cocci and bacilli) bacteria, with no detection of Gram-negative bacteria. The percentage of bacterial presence in the various regions studied for each experimental group is presented in Table 1. In general, the presence of microorganisms was more frequent in cementum (Fig. 1) and in the ramifications of the apical delta, and was less frequent in dentinal tubules. Also, bacterial presence was less frequent in group I (Selapex) than in group II (Fill Canal).

Table 1. Bacterial presence in the various regions studied in each experimental group.

GROUP	LOCATION		
	Cementum	Dentinal tubules	Ramifications of the apical delta
I (Sealapex)	30%	5%	42%
II (Fill Canal)	57,1%	14,3%	78,6%

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Figure 1.
A - panoramic view of the root canal apical region. (X 100).

Figure b.
greater magnification than A (upper circle) shows presence of bacteria next to root dentin. (X 400).

Figure C.
greater magnification than A (arrow) shows the presence of microorganisms in apical cementum. (X 1000).

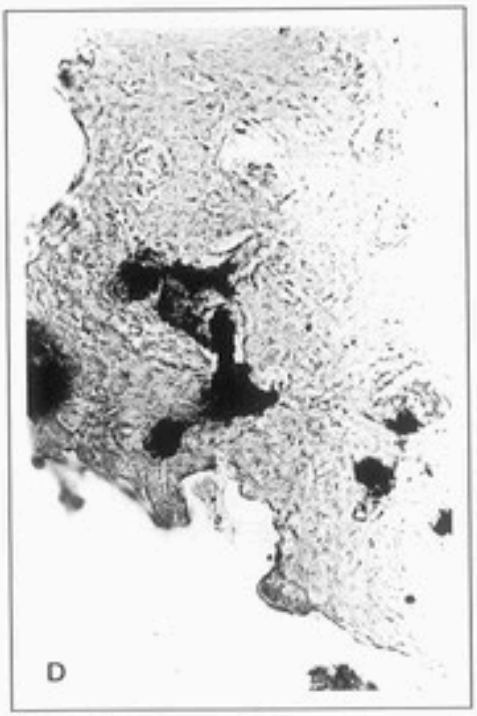

Figure D.
greater magnification than A (lower circle) demonstrates presence of gram-positive cocci in apical cementum gaps. (Brown and Brenn stain; X 1000).

DISCUSSION

The presence of microorganisms in the root canal system is considered to be the major cause of the persistence of periodontitis in cases of unsuccessful endodontic treatment[13,15,24,27]. Thus, the main objective of root canal treatment in teeth with chronic periodontitis is the elimination of infection and the prevention of reinfection by instrumentation in combination with the use of bactericidal solutions, of antiseptic intracanal medication and of hermetic sealing of the root canal with material having appropriate physicochemical and biological properties.

The method of Brown and Brenn permits bacterial staining and differentiation from tissue elements and is used to reveal bacteria in soft tissues and in the root canal system[2,22]. However, it should be pointed out that during the demineralization process for histology large part of the bacteria are disintegrated, especially Gram-negative ones, a fact that impairs their visualization[29].

Calcium hydroxide has been used as intracanal medication for the elimination of bacteria from infected root canals6. In the present stuy, calcium hydroxide was used in combination with pramonochlorophenol in order to obtain a more extensive and prolonged antibacterial action[11,13].

The higher prevalence of bacteria in apical cementum and in the ramifications of the apical delta is probably related to the greater difficulty in access and diffusion of calcium hydroxide in these regions, after filling root canals with calcium hydroxide.

In the present study calcium hydroxide was used for a period of 7 days. However, NERWICH et al[17] observed higher pH values in the apical region after a period of 14 days, suggesting that this period of time is adequate for greater efficacy of the medication.

Microbiologic evaluation showed a lower frequency of bacteria in group I (Sealapex) compared to group II (Fill Canal). LEONARDO et al.[13] demonstrated a significant reduction in the number fo bacteria after the use of a calcium hydroxide dressing and the sealing of root canals of infected dogs' teeth with Sealapex, as well as satisfactory apical and periapical repair[14].

The antibacterial action of the sealer on the bacteria remaining in the root canal also contributes to the success of endodontic treatment. CANALDA and PUMAROLA[4] demonstrated *in vitro* satisfactory antibacterial properties of Sealapex. Other studies, however, have reported lower antimicrobial power for Sealapex compared zinc-eugenol sealer[1,8,20].

The antimicrobial activity of calcium hydroxide sealers mainly depends on the release of hydroxyl ions, which occurs slowly and gradually. *In vitro* studies have demonstrated that the antimicrobial activity of Sealapex on *Streptococcus faecalis* increased significantly over time and with longer contact with the bacteria[9,10,21]. The present results suggest a prolonged antibacterial activity of Sealapex in contact with apical and periapical tissues for 270 days, contributing to the reduction of the number of bacteria in the group in which it was employed.

The solubility of Sealapex[25,28] has been pointed out as a negative factor for its use in infected root canals. However, in the present study, this solubilization due to the gradual release of hydroxyl ions was beneficial and contributed to the elimination of bacteria from the root canal system. This fact is in accord to TANOMARU FILHO et al.[26], who observed better histopathological periapical repair after the filling of dog's teeth with induced periapical periodontitis using Sealapex in comparison with the Grossman type sealer.

Thus, on the basis of the method employed and the results obtained, we may conclude that the presence of bacteria was smaller in the groups sealed with Sealapex compared to the group sealed with Fill Canal after endodontic treatment of teeth with chronic periodontitis.

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PERMANENT MAXILLARY CENTRAL INCISOR WITH GEMINATION: A CASE REPORT

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Gemination may pose a difficult, on occasion, in diagnosis and treatment planning. The similarity of clinical and radiographic aspects with fusion often occurs. This paper reports a case involving a permanent maxillary right central incisor that required endodontic therapy.

Key words: gemination; endodontic therapy, hard tissue barrier.

INTRODUCTION

The maxillary incisors teeth are frequently associated with hard tissue anomalies. Gemination is a malformation of a single tooth bud that had attempted to divide during development[5]. Its etiology is unclear but developmetal defects, chance and heredity have been suggested[2,3]. CALISKAN[1] reported a case where he presumed that the trauma was the cause of gemination.

A large tooth with grooves or depression which delineate two teeth is clinically presented[5,8]. Radiographycally, the tooth presents one large common root canal with a bifid crown[5,8].

LEVITAS[5] and TANNENBAUN and ALLING[8] discussed the definitions of gemination, twinning, fusion and concrescence. The diagnosis of such conditions calls for thorough knowledge of the normal anatomy of the dentition wariness of the existence of anomalies.

Sometimes it can be difficult to distinguish gemination from fusion. Fusion is a union of two separate tooth buds at some stage in their development. This difficult situation happens when the fusion is between a normal tooth and a supernumerary tooth, resulting in a full complement of teeth, giving the clinical appearence of gemination[2,4,7].

It is important to verify the number of teeth in the dental arch to differentiate both anomalies. In gemination, the number of teeth is considered normal; whereas it decreases in the fusion cases.

The incidence of gemination and fusion has been reported in 0,5% in the primary dentition and 0,1% in the permanent dentition. Most of them are observed in anterior teeth[4].

Cases of triple teeth, i.e. combination of fusion and gemination occurring in the same clinical crown have been reported[1,9]. This is an exceedingly rare phenomenon. Bilateral occurence of gemination is another rare situation[6,8].

The purpose of this paper is to report a gemination case involving a permanent maxillary right central incisor that required endodontic therapy. This case is presented for its rarity on the permanent dentition.

CASE REPORT

A ten-year-old white male was referred to the endodontic clinic of the School of Dentistry in Bauru at the University of São Paulo by a general practitioner. The parents reported that he had received a trauma on the anterior maxilla about four months before. The patients medical history was non contributory.

Clinical examination revealed unusual crown anatomy of permanent maxillary right central incisor. The clinical crown was larger than the contralateral tooth and there was a slightly marked groove in the incisal edge (Figure 1). The remaining maxillary and mandibular permanent teeth were both normal in number and shape. The child was under orthodontic treatment which was deferred temporarily to allow the endodontic treatment.

The vitality tests had no answer and the tooth was slightly tender to percussion. There was no mobility and no significant periodontal pocketing. This

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examination confirmed the findings reported by the clinician.

The radiographs of the right central incisor demonstrated a large common single root canal and a large common pulp chamber. In addition, there was an open apex with a small and diffuse apical radiolucency around it.

The clinical diagnosis was gemination with chronic apical periodontitis. Endodontic treatment was performed on the involved tooth.

After isolation, the access was accomplished by an expanded opening to allow better visibility and straight access into the large root canal (Figure 2). After the necrotic contents had been debrided and established the working length, the canal was cleansed and shaped. No hard tissue barrier was encountered on initial exploration of the canal.

Due to the internal anatomy of the root canal, circumferential filling motion was employed in the instrumentation. Copious irrigations with 0,1% sodium hypochlorite solution were made to maximize cleansing. Calcium hydroxide power mixed with iodoform (3:1 ratio) and glicerin was placed into the canal (April 1995) and changed after 1 month (May 1995 - Figure 3). Fortified zinc oxide-eugenol cement temporary filling (IRM) sealed the access.

On August, 1995, the child returned for routine observation. The tooth was isolated and the calcium hydroxide washed out. The apex was probed with a file and indicated the presence of an enough apical hard tissue barrier to allow the obturation.

The canal was obturated by a modified lateral condensation technique. Three 80 master cones of gutta-percha were softened-warmed over a flame and rolled between two glass slabs; then they were introduced and adapted to the shape of apical barrier. Accessory points were laterally condensed using endomethazone (Specialités, Paris, France) sealer.

In the distal area of apical root canal, one accessory gutta-percha point extended beyond apex and a little cement extruded too (Figure 4).

The patient returned after 1 year for a routine control (Figure 5). The tooth was asymptomatic and radiographically the repair process had progressed well. His orthodontic treatment was retaken 6 month later.

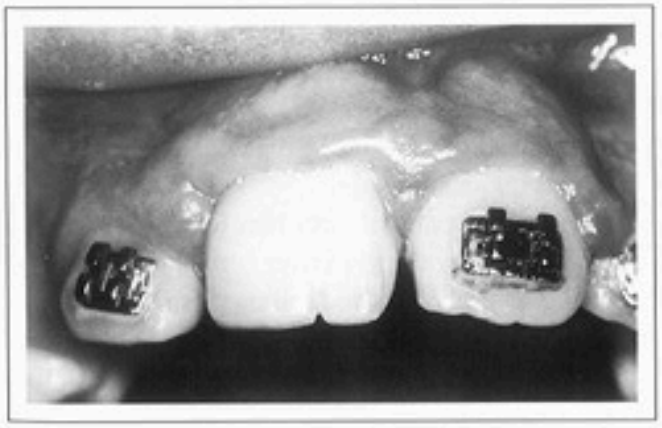

Figure 1.
Permanent maxillary right central incisor with gemination. Clinical view. Note the incisal groove and the wide crown.

Figure 2.
Radiograph showing the root and crown configurations as well as open apex, small and diffuse periapical radiolucency. Note the access to the canal space.

Figure 3.
Calcium hydroxide filling the canal space (May 1995).

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Figure 4.
Radiograph immediately alter obturation of root canal.

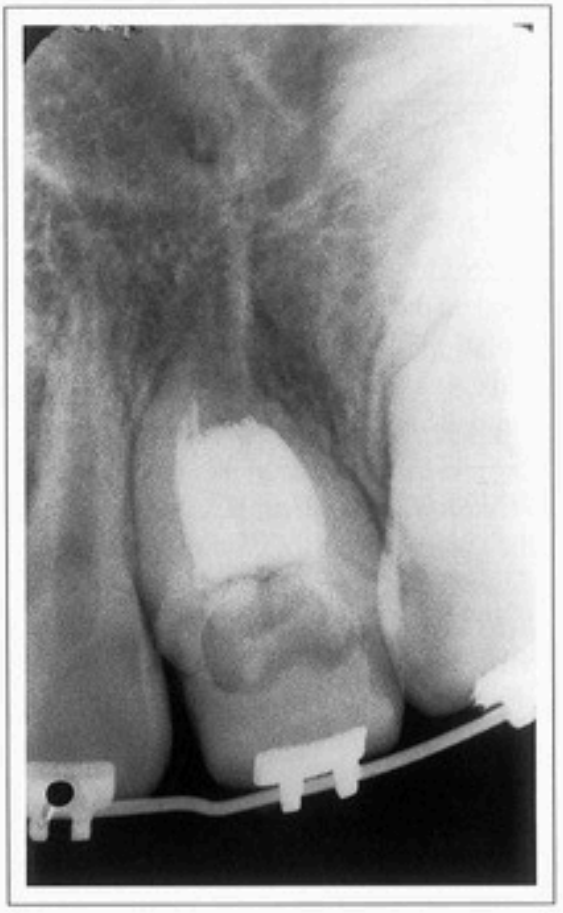

Figure 5.
One-year recall radiograph.

DISCUSSION

At the present case, it was not difficult to diagnose the gemination. The involved tooth was completely according to all gemination definitions[5,8]. However, this is rare, because of its similarity with fusion.

The greatest diagnostic difficulty arises when fusion occurs between a normal tooth and a supernumerary tooth. According to KELLY[4] the supernumerary, often slightly aberrant, cone-shaped tooth shows distinct differences in the two halves of the joined crown. In gemination, on the other hand, the two halves of the joined crown are usually mirror images[6,8].

Endodontic therapy of geminated tooth requires additional knowledge of unusual root canal configurations of this anomaly besides the operator's skill. The wide root canal space may need modified techniques for its chemomechanical instrumentation. In this case, it was employed a circumferential filling motion.

Besides this, geminated tooth always has a large or an open apex. The advantage of using calcium hydroxide as an intracanal medication and intermediate root canal filling material to induce apical closure is unquestionable.

A large cone of guta-percha warmed over a flame or in hot water, a master cone customized by warming several cones and rolling them between two glass slabs, gutta-percha cone softened in solvent, and thermoplasticized gutta-percha are alternative methods of obturation of this anomalous root canals.

Occasionally the management of geminated tooth is a challenge for endodontic therapy, but efforts should be made to perform this treatment satisfactorily to be successful.

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AVAILABLE TECHNIQUES FOR CALCIUM HYDROXIDE PLACEMENT WITHIN THE ROOT CANAL

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A review of the different methods of calcium hydroxide paste placement within the root canal was carried out with the purpose of aiding the clinician in selecting the best alternative in his/her daily practice when this type of temporary dressing is required.

Key words: calcium hydroxide paste, intracanal placement, instruments and devices.

INTRODUCTION

Since the introduction of calcium hydroxide by HERMANN[9], this medicament has become the elected substance for use in a great variety of clinical situations. Literature is replete with clinical articles describing its successful use in many endodontic situations such as indirect and direct pulp capping, pulpotomy, routine intracanal dressing, apexification procedures, endo-perio interrelationships, perforations, resorptions and for the treatment of post-traumatic sequelae.

The description and confirmation of calcium hydroxide benefits has increased the number of calcium hydroxide paste formulations to be employed as a temporary dressing material.

Many reports favor preparation of the paste at chairside mixing the calcium hydroxide powder, a radiopacifier and a liquid vehicle until a desired consistency is achieved to permit its easy and fasy within the root canal system. Other paste-like formulations are commercially available and ready for use. This great variety of paste formulations containing different types of vehicles and other components may create a certain difficulty in chiousing the best alternative for each clinical situation.

Another important point to be considered in calcium hydroxide therapy that also may cause a clinical difficulty is how to carry and introduce the paste into the root canal system because many instruments and devices have been described in the literature.

The purpose of this article was to review the different clinical techniques for the placement of a calcium hydroxide paste into the root canal system.

CHARACTERISTICS OF CALCIUM HYDROXIDE PASTE

From an endodontic standpoint, a substance is characterized as an alkaline paste when[6]:

- it is composed by calcium hydroxide which may be used in a powder form or, as a worldwide preference, mixed with other substances to improve its physical properties lsuch as radiopacity, flow, etc.
- it does not set;
- it may be rapidly or slowly solubilized and resorbed from within tissues and root canals according to its vehicle and other components;
- it may or may not be prepared at the time of use;
- within the root canal system it is employed only as a temporary dressing and never as a definitive filling material.

To prepare a paste at the time of use may be advantageous because the clinician has a new and pure paste and can determine its final consistency. Generally, such a paste is prepared by mixing the components on a glass slab with a sterile spatula. Furthermore, after mixing, the paste can be gently compressed in a sterile

piece of gauze to remove excess liquid vehicle until the desired consistency is achieved[14].

Proprietary brands are commercially available in different forms, such as:

- in a paste form packed in flasks, i.e., Calxyl (Otto & Co., Frankfurt, Germany) or the components are packed in different flasks to be mixed before its use, i.e., L & C (Herpo Produtos Dentários Ltda, Rio de Janeiro, RJ, Brazil);
- in delivery syringe systems, i.e., Hypo-cal and Rootcal (Ellman International Mfg. Inc., Hewlett, NY, USA) (Figure 1-bottom), Pulpdent and Tempcanal (Pulpdent Corp. of America, Brookline, MA, USA) and Calcicur (VOCO, Auxhaven, Germany) (Figure 2);
- in anesthetic cartridges, i.e., Reogan (Figure 1-top) (Vivadent, Liechtenstein), Calasept (Scania Dental, Knivsta, Sweden) (Figure 3) and Calen or Calen + CMCP (S.S. White, São Paulo, SP, Brazil) (Figure 4);
- in disposable aluminium packages, i.e., DT Temporary dressing (Dental Therapeutics AB, Nacka, Sweden) (Figure 5).

INTRACANAL PLACEMENT OF THE PASTE

Many techniques to fill the root canal system with a calcium hydroxide paste have been described; dut, most of them were related to apexification procedures and used to fill large root canals[13,32]. However, in cases of minimally instrumented root canals, the entire system should be homogeneously filled to achieve all benefits of the material[5,25]. Therefore, it is imperative that the clinician is aware of the methods for paste placement into the root canal.

The insertion of a calcium hydroxide paste into the root canal system will depend on if the paste components are mixed together at the moment of usage or if the paste is commercially available and how it is packed.

Pastes that are prepared at chairside may be inserted into the root canal by one of the following methods:

1. Endodontic instrument (Figure 6)

Generally an endodontic K-type file with a smaller diameter than the master apical file is chosen and a stop is fitted at the working length measurement. SIGURDSSON et al.[25] and AGUIAR and PINHEIRO[2] suggest a 25 K-type file, FONSECA[7] uses a K-type file one diameter smaller than the last instrument while STAEHLE et al.[26] carry the paste with a 40 K-type reamer in large root canals.

The endodontic instrument with an excess of paste in its flutes is introduced into the root canal at the working length and rotated counterclockwise three or four times. This procedure is repeated until the paste can be seen at the canal orifice.

SIGURDSSON et al.[25] have demonstrated that the counterclockwise rotation of the endodontic instrument was the least effective method of filling. ULYSSEA et al.[30] also found poor results when a K-type file was used to carry the paste and they do not recommend this method for either straight or narrow/curved root canals.

2. McSpadden compactor (Figure 6)

This device was designed for introducing, thermoplasticizing and compacting gutta-percha within the root canal. This instrument resembles an inverted H-type file which is operated on the principle of a reverse-turning screw in a slow-speed handpiece. The compactor is available in standardized sizes 30 to 90 and, when in use, it softens the gutta-percha and pushes it laterally and apically in order to fill the root canal[12,29].

After the components of the paste are mixed, the paste is inserted into the canal orifice with an amalgam carrier or the compactor itself. This procedure is the same as that of the spiral lentulo. When the handpiece is activated, the compactor pushes the paste laterally and apically at any level the compactor is introduced. After the compactor has been rotating for several seconds, it is withdrawn slowly from the root canal[12].

TEPLITSKY[29] has suggested a combined technique using the compactor and endodontic pluggers. After mixing, the paste is carried to the canal orifice; a prefitted compactor is adjusted 1.5 mm from the working length without binding and started, filling the canal space with paste. A "pumping" action is then necessary to fill the apical and middle thirds. On the glass slab, more calcium hydroxide powder is added to the paste to achieve a more compact and dried paste. This final mixture is carried into the cervical third and vertically condensed with endodontic pluggers. According to the author, this technique is "fast, convenient, effective and reproducible".

In a comparative study evaluating different

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techniques for paste placement, this method has shown good results especially when quality was evaluated at the apical third[7].

3. Spiral lentulo (Figure 6)

Perhaps this is the most convenient method to spin calcium hydroxide pastes deeper into the root canal. As this instrument is available in various sizes, the clinician should select a spiral with a smaller diameter than that of the prepared root canal that goes to the full working length without binding in the dentinal walls to avoid its fracture. For safe use of the spiral lentulo, the canal should have a wide, coronally flared preparation and the spiral should always be tested before use. Generally, a silicone or rubber stop is placed on the spiral and fitted at the working length, indicating the maximum depth it can be safely introduced[5,18].

After mixing, the prepared paste is carried in small portions into the root canal until it is completely filled. Following this procedure, the practitioner must remove and reintroduce the spiral many times to remove air bubbles from within the root canal. Vertical condensation is necessary to better compact the material[3,5,8,13,17,20].

When comparative studies were performed to evaluate the most convenient method to fill the root canal with calcium hydroxide paste, all of them have shown the spiral lentulo as the best method to place the paste both in straight and curved canals as well as in all thirds of the prepared canal[1,2,7,11,23,25,26,30].

4. Amalgam carrier (Figure 7 and 8)

When this method is used, two precautions must be observed. First, a metal carrier with a plastic or teflon sleeve should be used because calcium hydroxide may corrode metal and "contaminate" the paste (Figure 7). If a plastic carrier is used this precaution is not necessary (Figure 8). Second, the paste should have a putty-like consistency to be compacted into the sleeve for further introduction into the pulp chamber and cervical third of the root canal. Small portions of the paste are carried into the tooth and vertically condensed until the canal is entirely filled with the paste[5,18,22,28,32].

5. Messing gun (Figure 9)

The Messing gun was originally designed as an amalgam carrier for retrograde fillings. According to KRELL and MADISON[13], the Messing gun kit has three different nozzles and pluggers measuring 1, 1.25 and 1.5 mm in diameter and is effective for calcium hydroxide powder placement in all maxillary and mandibular anterior teeth as well as selected posterior teeth. The authors suggest the use of a combination of calcium hydroxide powder and barium sulphate powder in a ratio of 1:8. Dense pellets of the mixture are expressed 3-4 mm from the working length and vertically condensed. Additional increments of the mixture are placed by reloading and reintroducing the Messing gun nozzle and gradually decreasing its penetration as the canal is being filled. While KRELL and MADISON[13] use the Messing gun for dry powder insertion, STOCK[28] suggests the use of this device to transport the paste directly to the apical limit of the prepared canal making the procedure simpler and faster.

6. Sonic and ultrasonic devices (Figure 10)

According to FONSECA[7], a sonic, Canal Finder (Endo-Technique Corp., Anaheim, CA, USA) (Figure 10-right), and an ultrasonic, Enac (Osada Eletric Co. Ltd., Japan) (Figure 10-left) devices, both with a n° 30 plug, were evaluated to place calcium hydroxide paste within "prepared" canals in plastic blocks. The results were unsatisfactory with some disadvantages regarding both their efficacy and cost.

7. Gutta -percha cone (Figure 11)

This is an uncomnon method to carry calcium hydroxide paste into the root canal. However, OTANI et al.[21] have suggested a technique to place the paste into the root canal using a gutta-percha cone. First a calcium hydroxide paste is prepared on a glass slab mixing the calcium hydroxide powder with a suitable aqueous vehicle, such as an anesthetic solution, until a putty-like consistency is achieved. A gutta-percha cone is selected and calibrated in a gauge for silver and gutta-percha cones (Maillefer Instruments, Ballaigues, Switzerland) to achieve the same diameter as of the master apical file. Small amounts of paste are carried into the apical third of the root canal using the tip of the calibrated gutta-percha cone and, as the paste is introduced, the same cone is used as a plugger to vertically condense the paste. When the apical third is filled, the same cone is again calibrated in the gauge to

achieve the same diameter as the middle third and the procedure is repeated. A third calibration is performed to carry and condense the paste into the cervical third until the filling is completed.

Commercially available pastes are carried into the root canal system according to the method by which they are packed.

Pastes packed in flasks, like Calxyl, may be carried into the canal by a spiral lentulo after removal from the flask. The L & C paste is composed of a powder and a liquid that must be mixed together before introduction into the canal by a spiral lentulo. The DT Temporary dressing is first homogenized between the clinician's fingers, removed from the aluminium package and then carried into the canal also using the spiral lentulo.

Reogan and Calasept are available in anesthetic cartridges and are delivered by a usual Carpule syringe and a 27-gauge needle. As these pastes have an aqueous vehicle in their formula, their flows are good and there are no difficulties when they are expressed into the root canal[24].

Another paste packed in anesthetic cartridges, but containing a viscous vehicle, is Calen, which is available with or without a small amount of CMCP. The delivery system is composed of two cartridges, one containing the paste and the other containing sterile glycerin, a special Carpule-like syringe with a screw-type handle (ML Endodontic syringe, S.S. White, São Paulo, SP, Brazil) and a usual 27-gauge anesthetic needle. Initially the needle is coupled to the ML syringe with a stop fitted at the working length. The glycerin cartridge is placed into the syringe and the handle is twiste clockwise until the first drop of glycerin appears at the tip of the needle. This procedure lubricates the inner surface of the needle in order to allow an easier flow of the paste. The glycerin cartridge is then removed and replaced by the paste cartridge. The handle is gently twisted until the first drop of the paste appears at the tip of the needle. This drop is discarded because it is saturated with the glycerin that remained inside the needle. The needle is then introduced within the canal at the working length and the handle is twisted again. As the paste is gradually extruded, the needle is slowly removed from within the canal until it is completely filled [15,16].

Besides the Carpule (Figure 12) or the ML syringes[10,11,16,31], other pressure syringes may be used such as Centrix C-R[27], PCA (Figure 13) or Hydron syringes[4] (Figure 14).

When any type of syringe is used, it is important that the needle goes first to the full working length. Then the plunger should be twisted or pressured to deliver the paste. As the paste is being delivered, the clinician should slowly remove the syringe in an apical-to-cervical direction until the tip of the needle reaches the canal orifice. If the procedure is not correctly performed, air bubbles will remain within the paste. Another problem that mat occur is when the paste does not flow to the apical area and the final result is a partially filled canal.

To avoid these problems, especially in minimally instrumented canals, several suggestions are described below.

If the paste is packed in anesthetic cartridges, the rubber stop fitted in its extremity should be removed using the tip of a clinical explorer. Then the paste should be removed by a sterile spatula and spun into the canal by a spiral lentulo.

If the paste is packed in preloaded plastic syringes, a small amount of the paste may be placed on a glass slab and carried into the root canal by a spiral lentulo, as suggested by ANTHONY and SENIA[3]. On the other hand, ROCCA[24] suggests delivering the paste directly into the pulp chamber and cervical third and then using the spiral lentulo to carry the paste deeper into the root canal.

Finally, a mixed technique is suggested by DUMSHA and GUTMANN[5] when any type of syringe and needle are used coupled with the spiral lentulo. Initially, the selected spiral is introduced to the full working length. Then the tip of the needle is placed close to the spiral in the canal orifice. When the plunger of the syringe is pressured or twisted, the spiral is activated and the paste is carried into the root canal. When the canal is filled, the same procedure of removal and reintroduction of the spiral is performed to remove air bubbles.

VERTICAL CONDENSATION

Final vertical condensation is necessary to better compact the paste, independently of the technique employed. This condensation may be performed using a large cotton pellet that closely fits into the canal orifice, pre-selected pluggers, a large gutta-percha or paper point or an endodontic instrument with a small piece of cotton rolled up over its cutting flutes and sterlized in the glass bead apparatus[3,5,8,32](Figure 15).

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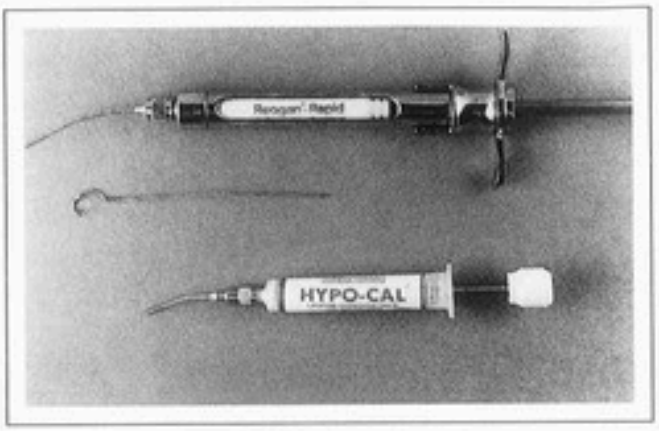

Figure 1.
Top: Calcium hydroxide paste packed in anesthetic cartrigde (Reogan®). Botton: Calcium hydroxide paste packed in preloaded syringe (Hypo-cal®).

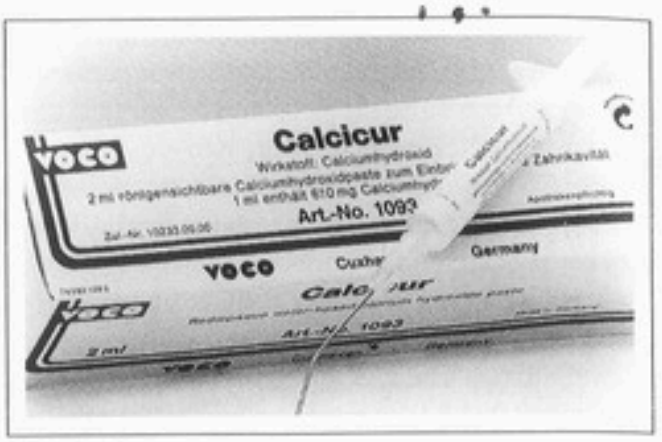

Figure 2.
Calcium hydroxide paste packed in a plastic Luer syringe (Calcicur®).

Figure 3.
Calasept® kit.

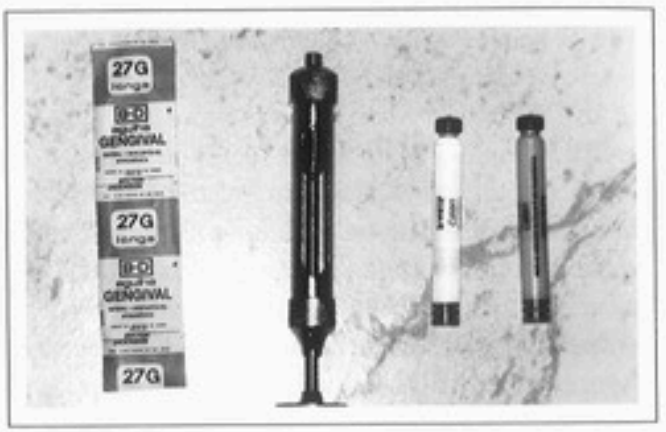

Figure 4.
Calen® kit.

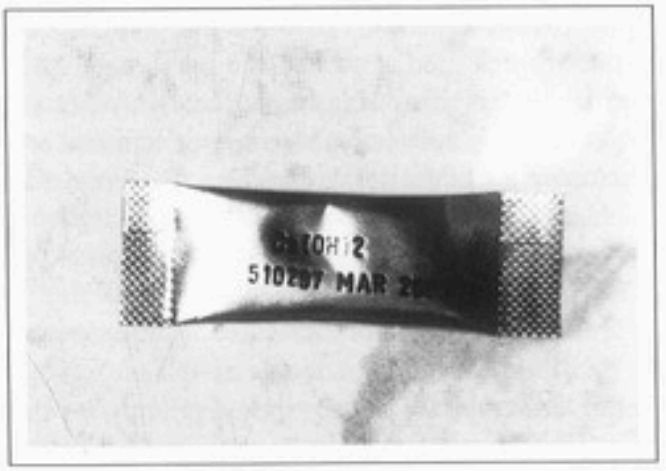

Figure 5.
DT Temporary dressing®.

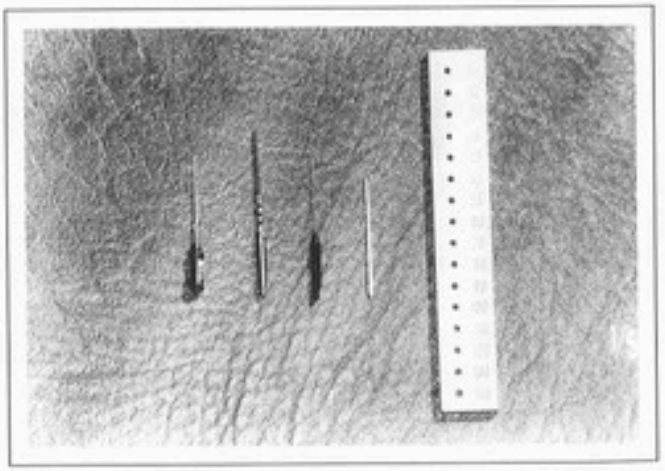

Figure 6.
Different methods for calcium hydroxide paste placement. From left to right: endodontic instrument, McSpadden compactor, lentulo spiral and gutta-percha cone with respective gauge.

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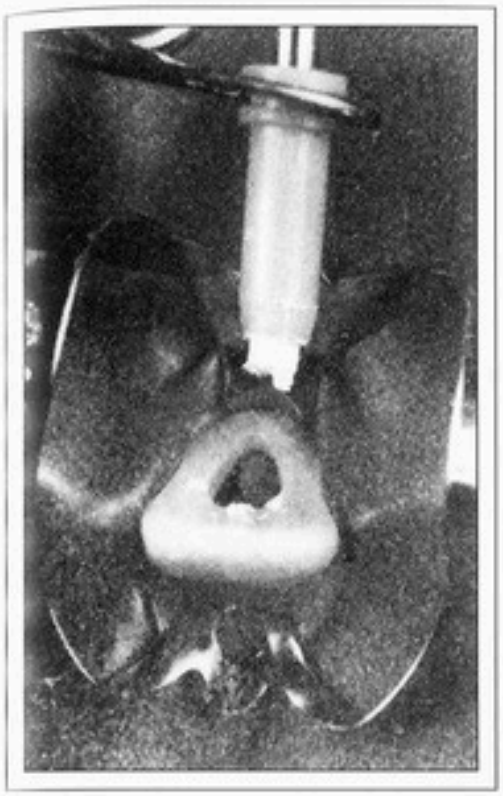

Figure 7.
Amalgam carrier with teflon sleeve.

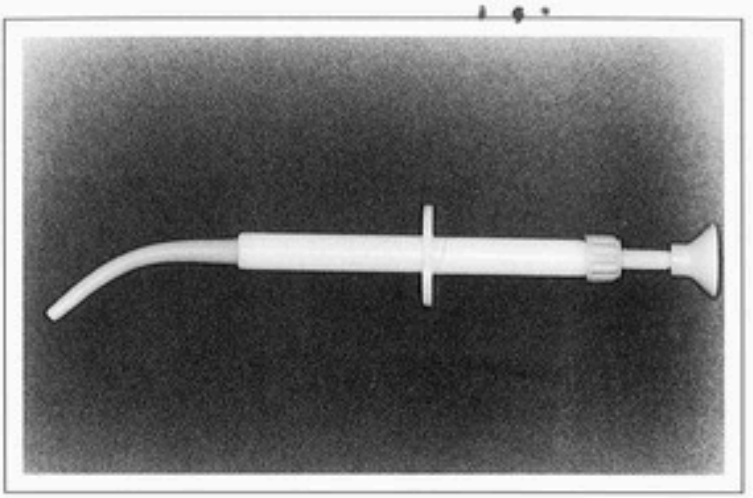

Figure 8.
Plastic amalgam carrier.

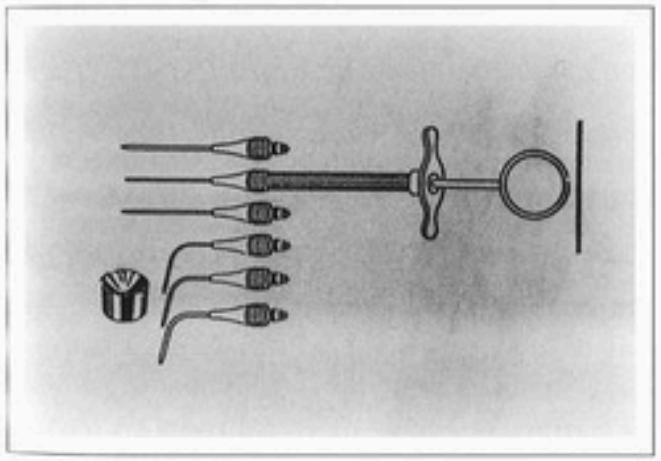

Figure 9.
Messing gun kit

Figure 10.
Left; Ultrasonic device (Enac®). Right; Canal finder handpiece®.

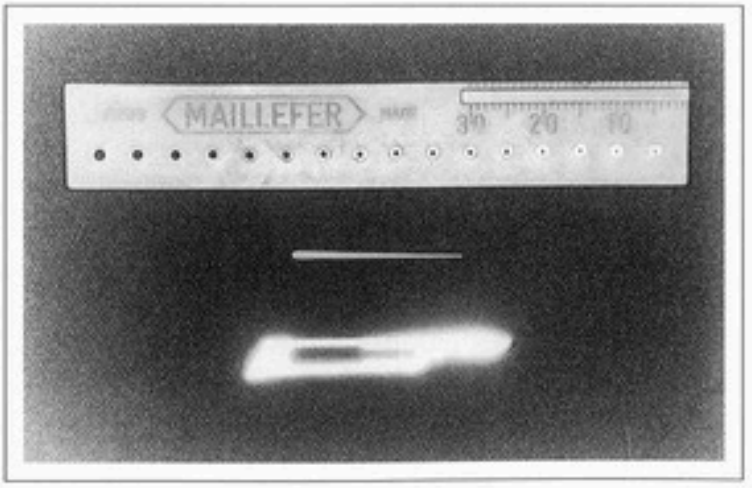

Figure 11.
Schematic representation of Otani et al´s technique.

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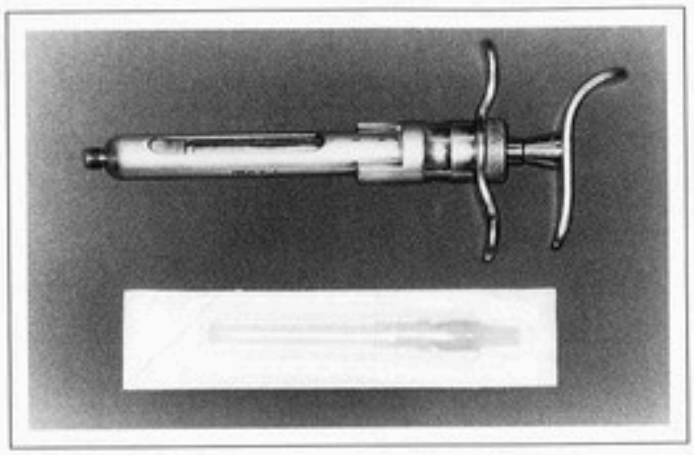

Figure 12.
Carpule® syringe

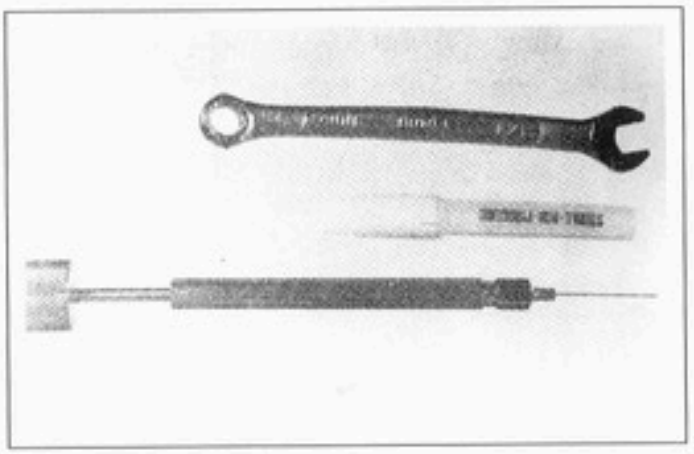

Figure 13.
PCA® syringe.

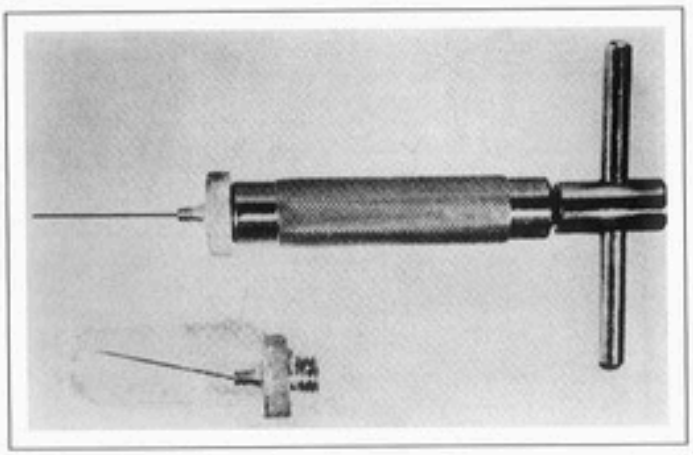

Figure 14.
Hydron® syringe.

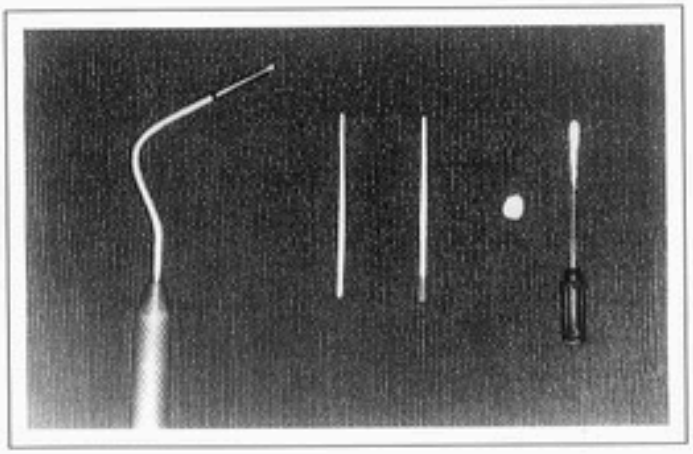

Figure 15.
Different methods for the final vertical condensation. From left to right: pre-select plugger, gutta-percha cone, paper point, cotton pellet and cotton rolled up over the cutting flutes of an endodontic instrument.

CONCLUSIONS

From a clinical standpoint and according to the anatomy and the final diameter of the prepared root canal, some conclusions may be drawn from this study.

Straight or slightly curved canals that have been shaped to at least a 40 diameter can be effectively filled by any instrument, syringe device or mixed technique as described.

For minimal canal enlargement, i.e., a 25 or 30 prepared canal in both straight and curved canals, mainly the mesiobuccal canals of upper and lower molars, the spiral lentulo seems to produce the highest quality fill.

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CLINICAL AND RADIOGRAPHIC EVALUATION OF THE RELATION BETWEEN THE APICAL LIMIT OF ROOT CANAL FILLING AND SUCCESS IN ENDODONTICS. PART 1

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In spite of the fact that the different stages of endodontic therapy are placed on equal terms, it is undeniable the great tendency in considering the root canal filling to be the most important one. There is a general agreement on the sense that, even if there was an unexpected presence of microorganisms in the root canal system, after its preparation, there wouldn't be any reason for concerns since a hermetic sealing could be done. On the contrary, incomplete fillings, which create empty spaces, wouldn't allow the occurrence of repair. The aim of this work is to analyse the existent relation between the apical limit of the root canals filling and the endodontic success. In order to achieve this purpose, teeth with periapical lesions had their canals treated and intentionally filled short of the classical limits. The results show that there is no relation between the apical limit of the root canal filling and the success in endodontics.

Key Words: Apical periodontitis, apical limit, root canal filling, repair.

INTRODUCTION

Nearly 60% of endodontic failures is apparently caused by incomplete obliteration of the canal space4.

There is no doubt that this is the most well-known citation in the endodontic literature concerning to root canal filling [3-7,9,13]. Despite it has taken too long time since its publication, until now it appears that this is the first and main point for endodontists in search for being successful. So, because of this, it has appeared a range of works in which the most important has been the preocupation with the quality of root canal filling as NGUYEN[7] stated that, unless a dense, well-adapted root canal filling is achieved, the prognosis may be jeopardized regardless of how well other phases of the treatment are carried out.

Accordingly SAMPAIO[9], apical repair can take place even in the presence of microorganisms, provided the root canal is correctly filled, confirmed by LEONARDO and LEAL[6] when they state that success in Endodontics depends on the root canal filling. SOARES and ROCHA[13] say it has been proved that under or overfilling influence the final result of endodontic treatment, while INGLE and WEST[5] emphasize that the main objective of Endodontics is to completely seal the root canal space.

As we can see, the great endodontic purpose consists of getting a hermetic seal of the root canal system, that is, to obturate the canal in its all extension. For the clinician, this means to fill untill the radiographic apex or the nearest point of it.

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The aim of this work is to analyse the relation between the apical limit of the root canal filling and success in endodontics.

MATERIAL AND METHODS

Twenty teeth had their canals treated without any preocupation with a criteria of padronization, besides the fact that all of them had periapical lesion. The access to the canals was done in the conventional way, according to the anatomical aspects of each tooth, using # 012 Batt burs (Maillefer, Ballaigues, Switzerland), for better preparing the canals opening.

The canals were prepared according to its necessities and/or possibilities and not enlarged as it could be previsouly determined. This preparation was done 1mm short of the radiographic apex, using Flexofiles(Maillefer, Ballaigues, Switzerland) and completed with Gates-Glidden drills(Maillefer, Ballaigues, Switzerland), but, during all the preparation time, the foramen was kept patent. Every time we changed for a larger instrument, the canals were irrigated with 1 ml of 2% sodium hypoclorite and when we finished, a final irrigation was done with 1,8ml of an anesthetic solution(NOVOCOL - SS White). Then, they were aspirated and dried with paper points(Tanari). Following this, the canals were filled with 17% EDTA that was stirred for the first 0.5 minute, using a spiral lentulo(Maillefer, Ballaigues,Switzerland), and then left remaining in the canal for more 2.5 minutes. After this, they were irrigated with 3ml of a 2% sodium hypoclorite that was also stirred with a spiral lentulo, as previously said, and left remaining in the canals for 5 minutes. After this proceeding, a final irrigation was done with 1,8 ml of the anesthetic solution, the canals were aspirated and dried with paper points.

At this time, we made the intracanal medication, that, the same way as in the canal preparation, was done according to the necesseties of each case and not previously determined, but, at least, 2 medications with calcium hydroxide + physiologic solution was done. The obturation of the canals was done with the lateral condensation technique using Fill Canal sealer(Dermo Laboratório Ltda.), in such a way that we had different limits of obturation.

RESULTS

In a radiographic follow-up, all of the canals treated showed total or parcial decrease of the periapical lesions, depending on the observation time(Figs. 1-4). Figure 1 shows a case of retreatment(Fig. 1A) of the maxila left lateral incisor, an underfilling (Fig. 1B) and a follow-up radiograph of seven years, exhibiting complete periapical healing (Fig. 1C). In another case, Figure 2 shows the file cleanning the whole canal, a short filling and a postoperative radiograph five years later, also showing complete healing(Figs. 2A, B and C respectively). Observe that the "empty space", just up to root canal filling at the apex(Fig. 2B), has been filled with hard tissue(Fig. 2C). Central incisor was also retreated. In Figure 3A, preoperative radiograph of a mandibular left molar with enlargement of periodontal ligament(PDL) of the mesial root and periapical lesion and resorption of the distal root. In a postoperative radiograph (Fig. 3B), one can see dropping-like cement sealer in both roots. In Figure 3C, three years later, repair is going on. On this X-Ray, two canals are seen in the distal root. Just like in the other cases, both canals were cleanned in their whole length, including "inside" and beyond the resorption site. Gutta-percha points of both were seated at the same short length, but some cement has extravasated a few milimeters in the buccal canal. Observe that root canal filling in distal root is about 5mm short of the apex and, despite of this, the root is regainning its contour, with reestablishment of the integrity of the PDL and lamina dura. In Figure 4, a "cystic" lesion with a file into the large apex resorption (Fig. 4A). This case presented a lot of exsudate that took a long time to be controlled. In Figure 4B, the radiograph shows a very short root canal filling and, again, a very few sealer passing by the limit of gutta-percha obturation. In Figure 4C, a nine-month postoperative follow-up radiograph shows a significant reduction in size of the lesion, suggesting that total regression of this periapical pathology may occur over longer follow-up time, what is being done. Note the differences in size and radiolucency of the lesion between Figures 4A and C. Observe the new formation of trabecular bone in Figure 4C.

DISCUSSION

It is a consensus that the root canal filling should be hermetic[3-7,9,13]. On this conditions, the inflammatory exsudate can not get into the canal and so, transform it self in chemical substances that provoke inflammatory reaction in the periapical tissues[3-6]. This is an old belief. However, one of the basic requisites for the ideal time to obturate the canal is that the tooth should be assymptomatic. This preocupation comes from the fact that, after preparing the canal, we may have an acute inflammatory reaction with edema (inflammatory exsudate), which shows the inconvenience of obturating on that moment. After this period, about 48/72 hours, the proliferative phenomenons are going on rather

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Figure 1A.
Retreatment radiograph of the maxila left lateral incisor with periapical lesion, showing the file working in the whole extension of the canal.

Figure 1B.
Underfilling of the same tooth in Figure 1A.

Figure 1C.
Seven-year follow-up exhibiting complete periapical healing of the same tooth in Figures 1A and B.

Figure 2A.
Radiograph of maxila right lateral incisor with periapical lesion. The file works cleanning the whole canal.

Figure 2B.
Postoperative radiograph showing a short filling. Note the "empty space" of the resorbed foramen up to root canal filling.

Figure 2C.
Five-year follow-up radiograph with complete healing. Observe hard tissue deposition in the "empty space" of the foramen of Figure 2B. Central incisor was also retreated. The teeth had been on orthodontics

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Figure 3A.
Preoperative radiograph of mandibular first left molar showing enlarged PDL in mesial root and periapical lesion and resorption of distal root.

Figure 3B.
Postoperative of the same tooth in Figure 3A. Note dropping-like sealer in both roots.

Figure 3C.
Three-year follow-up radiograph. Repair is going on with reestablishment of PDL, lamina dura and contour of the distal root.

Figure 4A.
"Cystic" lesion with a file into the large apex resorption. Root canal system has to be completely cleanned.

Figure 4B.
Observe the intentional very short root canal filling and a very few cement passing by the gutta-percha filling.

Figure 4C.
Nine-month follow-up radiograph showing reduction of the periapical lesion. Note the differences in size and radiolucency of the lesion between Figures 4A and C and the new formation of trabecular bone in Figure 4C.

than the exsudative ones, so maybe we have no more the conditions for exsudate formation, but those ones that bring back the tissue fluid formation. This fluid, penetrating in an eventual empty space left for an incomplete obturation, doesn't appear to be of concern [15,17], since this occurs more frequently than we realize, because many works show that, unfortunately, none obturation technique is able to hermetically seal the root canal system [2].

Infection is the most important isolated cause for delayed repair [8], so, the fundamental condition for cementogenesis is the absence of infection. A few defects in the obturation of clean canals can be biologically tolerated, however, any defect in the obturation of infected canals predisposes the tooth to periapical pathology [10]. The final filling is no better than its preparation and if necrotic dentin and debris are left in the canal, the case stands a greater chance of eventual failure [5]. Kakehashi's study demonstrated that without bacteria and their products, periapical lesions of endodontic origin do not occur [11], therefore, it is important, at this time, to concentrate on better understanding the importance of quality and quantity of microorganisms and/or their metabolites in the pathogenesis of periapical disease [2]. So, if endodontic pathology is a bacterial disease [12], the elimination of bacteria from the root canal is the ultimate aim of endodontic treatment [1], thus, Endodontics is prevention and treatment of bacteria (M. Trope, personal communication 1993).

As we can deduce, the main objective of endodontics is to promote cleanness. Conversely to general thought, we think that the most important phase of root canal therapy is the cleanning process of the root canal system. We do not think that the eventual empty spaces left by incomplete obturations are the responsibles for endodontic failures, but, what was left "inside" them [16], as result of a bad cleanning and shapping. On this conditions, bacterias that have escaped from root canal preparation, may remain in the root canal system with tissue fragments and debris. It should be kept in mind that these same constituents may still remain in the smear layer, tubulis, accessory canals, etc. As the fillings are not hermetics [2], the conditions for apical leakage are created and prognosis is complicated. Tissue fluid, entering the canal, is degraded by bacterias, becoming irritating chemical substances that will produce inflammation in periapical tissues [18]. Therefore, it seems to be the presence of bacteria and their byproducts in the root canal system, what reflects a bad preparation, the major cause for the existence of periapical lesions. So, in treating a root canal system, the endodontist should do everything to eliminate bacteria and, to do this, it is necessary to clean the canal very well. the only way to reach a good cleaning is through a good shaping and that is why the instrumentation time is a very important one in the endodontic therapy [14]. Thus, the main reason for the canal preparation should be its cleaning and not its obturation.

At this moment, it is very important to pay attention on one thing; we are not suggesting negligent fillings. The obturation still deserves all the attention and importance it has usufructed and the reasons for that are too much known. It should be done in the classical limits that endodontics has preconized. the endodontist can not think that now he should fill in any level. This would be a mistake as big as to realize that the obturation can compensate the failures of the canal preparation. Presenting cases of periapical repair, independent of the apical limit of the filling, of course we are not preconizing these limits, but standing out the importance of cleanning the canal. Observe that the complete cleanning of the root canal system was done, including here, foramen cleanning, smear layer removal, intracanal medications with calcium hydroxide, to assure that the empty spaces would be "really empties". In other words, the whole canal extension was cleaned and shaped, but the filling was intentionally done short of the apex, just to show that, giving a major importance to the obturation, as it has been done, the roles are inverted, what we consider a mistake.

At last, we think it is very important to awake the endodontist for the fact that, when he loses 1mm of the working length, for any reason, he should not worry because he is going to fill 1mm short of the apex, but, because HE IS NOT GOING TO CLEAN 1 mm of the root canal.

CONCLUSIONS

Based on the results of this work, we may conclude that:

1 - The apical limit of the filling is not the most important step to obtain success in Endodontics.

2 - Eventual failures in root canals filling do not represent ill success.

3 - Endodontic success is closely associated to the quality of cleaning and shaping the root canal.

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ASSESSING THE QUALITY OF ROOT CANAL FILLING EMPLOYING FOUR DIFFERENT APPLICATION METHODS OF CALCIUM HYDROXIDE

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The aim of this study was to analyse the filling ability of four techniques to place a calcium hydroxide paste (Calen). For this purpose, 32 disto-buccal roots of upper molars were cleaned and shaped using the step-back technique to be filled with one of the following techniques: syringe, filling, Lentulo burs and McSpadden gutta condensador and syringe.

Key Words: Calcium hydroxide, Intracanal Dressing

INTRODUCTION

There are cases in an endodontic treatment where root canal filling in the same session is not indicated. Therefore, it is necessary to temporarily fill the root canal with an intracanal medicament or dressing[2,4,18,19], waiting for the most adequate moment.

The most widely used material as intracanal dressing is currently the calcium hydroxide paste[6,16]. In 1964, KAISER[12] used calcium hydroxide in those cases where apexification was necessary and, later, this technique was widely disseminated by FRANK[4,9] in 1966.

The used of calcium hydroxide in between sessions aims to exploit its therapeutic caracteristics such as:

• Hygroscopic ability - against persisting exudates[23];

• High alkalinity - affects both bacterial enzymatic activity and, consequently, its growth as few species survive in pH below 2.0 or above 10.0[3,7,10];

• Antibacterial effect - as a result of ionic dissociation in calcium and hydroxyl it supresses anaerobic enzymatic activity[5,7,21];

• Mineralizing effect - activates alkaline phosphatase due to its high pH thus prompting mineralization[8,11,14,16,23].

• Filling - a total filling of the full extension of the canal[13,15] is indispensable to avoid bacterial growth[1,4].

*Calcium hydroxide pastes means may be[22]:

Water-soluble - aqueous suspensions (e.g. distilled water, physiological serum and anesthetic) and viscous suspensions (e.g. propylene glycol and polyethylene glycol);

Non water-soluble - oily suspensions (e.g. olive oil, poppy oil and camphorated para-monochlorophenol).

Water-soluble suspension (both aqueous and viscous) have been preferably used due to high calcium and hydroxyl ions release[6].

LEONARDO[16] in 1991 recommended mixing calcium hydroxide and camphorated para-monochlorophenol (2.5 - 7.5) as intracanal dressing in pulpless and infected teeth. This paste-like mixture is placed in an empty anesthetic tube previously sterilized and introduced into the canal employing a special syringe. According to LEONARDO[17] in 1991, calcium hydroxide may also be introduced into the root canal

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employing Lentulo burs.

STANCILL and MADISON[21] in 1992 found that the Lentulo spiral proved to be the most effective in filling the root canal employing a calcium hydroxide paste (Calasept). The technique which injected Calasept followed by its vertical condensation employing bidigital condensers nº 25 was the second most effective method of introducing calcium hydroxide. On the other hand, the method of introducing the paste employing n° 25 k-files proved to be least effective.

The aims of the present study is to assess the quality of root canal filling with calcium hydroxide paste employing four different application techniques.

MATERIAL AND METHODS

The experiments were carried out on 32 extracted human upper molars working exclusively in the disto-vestibular root.

Four operators employing four different application methods of calcium hydroxide paste each handling eight teeth were involved in the experiments.

The application of the paste was carried out with the teeth previously fixed on a dental model and positioned to simulate the work in the upper quadrant.

Chemo-mechanical preparation of the disto-vestibular root was carried out as follows:

1. The pulpal chamber was accessed and prepared employing a spherical, conical-shaft and endo Z bur (Maillefer).

2. The entrance of the canal was prepared on the cervical third employing a n°1 wide bur (Maillefer).

3. The root canal was explored and measured (working length of 1mm) employing the flexible file n° 10 Flexofile (Maillefer).

4. The apical shoulder was prepared up to the n°20 Flexofile (Maillefer).

5. Gates-Glidden E n°.20 burs (Maillefer) were used.

6. The stepback preparation technique programmed at 1mm was employed up to instrument n°45.

NOTE: A solution of 1% sodium hypochlorite was used to irrigate the root canal.

Four methods were employed to apply the calcium hydroxide paste using:

1. The flexible file n°30 Flexofile (Maillefer)

2. The n° 25 Lentulo spiral

3. The n° 35 Mc Spadden condenser

4. The ML endodontic syringe (S.S.White - Artigos Dentários Ltda.,RJ,Brazil)

Paste employed in the experiment - Calen (S.S.White - Artigos Dentários Ltda., RJ, Brazil). This paste was selected to avoid variations in handling. On the first three methods the paste was removed from the tube and placed on a glass dish.

Operator nº1 - Method using file. The flexible file n° 30 Flexofile (Maillefer) was employed to introduce into the root canal small amounts of Calen paste placed at the tip of the file. The paste was applied from the working length of the canal with slow vibrating movements. The stepback preparation technique was used as the dressing totally filled the canal until an overflow could be seen at the entrance of the root canal system.

Operator nº 2 - Method using Lentulo spiral. The n°25 Lentulo spiral (Maillefer) with low rotation handpiece was employed to introduce small amounts of CALEN paste placed at the tip of the spiral. The spiral worked on the straight portion of the canal only. This was repeated until an overflow could be seen at the entrance of the canal system.

Operator n° 3 - Method using Mc Spadden condenser.The n°35 gutta condenser (Maillefer) with low rotation handpiece was employed to introduce small amounts of Calen placed at the tip. The condenser worked on the straight portion of the canal until an overflow could be seen at the entrance of the canal system.

Operator n ° 4 - Method using ML endodontic syringe (Duflex) and 27G long needle. The needle was lubricated with glycerine (S.S.White). After the inicial procedures, calcium hydroxide paste from the tube was placed into the endodontic syringe. This syringe features a twisting plugger so that as it is twisted one can see the paste coming out at the tip of the needle. The Calen paste was introduce 2mm short of the working length and the needle pushed backwards as the root canal was filled until an overflow could be seen at the entrance f the canal system.

Note: In the four methods applied, after the overflow at the entrance of the canal system, a vertical condensation using cotton pellet was performed and the opening immediately sealed with Cimpat Rosa (Septodont).

Upon the application of the paste and sealing of the tooth, periapical radiographs employing Ultra Speed-Kodak film were taken of the 32 teeth with mesio-radial distortion to better observe the disto-vestibular root.

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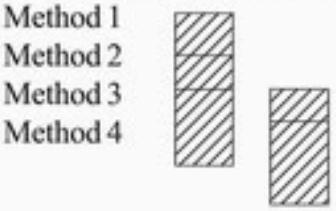
The radiographs were assessed by three endodontic faculty members considering the following criterion:

- Assess the quality of the root canal filling with calcium hydroxide paste according to individual criterion and score the samples as excellent, satisfactory, regular or poor.
- It is also important to mention that such procedures were carried out by four experts in Endodontics and each operator performed one single application technique. They have mastered the technique following extensive training.

RESULTS

X^2 analysis was applied to confirm possible interindividual observation differences. There were no statistically significant differences among the three observers (p=0.01). (Table 1)

Statistical illustration of the results



After analysis of data detailed in Table 2, the X^2 test was applied comparing two by two the methods employed. It was possible to observe that:

1. there were no significant differences among the techniques employing Mc Spadden, Lentulo and Syringe (p=0.01);
2. there were significant differences (p=0.01) between Mc Spadden x File and Syringe x File;
3. the results obtained employing Mc Spadden and Syringe were significantly better than those employing the endodontic file;
4. statistical analysis in relation to the Lentulo and endodontic file techniques suggests that both methods are similar.

Table 1. Assessment of the quality of the root canal filling with calcium hydroxide paste performed by three observers

CRITERION OBSERVERS	EXCELLENT	SATISFACTORY	REGULAR	POOR
Observer A	14	7	6	5
Observer B	7	11	6	5
Observer C	6	7	14	5

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Table 1.ÊAssessment of the quality of the root canal filling with calcium hydroxide paste performed by three observers

1 = Ho = Obs A = Obs B	Reject
2 = Ho = Obs A = Obs C	X2 Cal > X2 0.01 (3)
3 = Ho = Obs B = Obs C	
1 = X2 Cal = 4.68	X2 0.01(3) = 11.34
2 = X2 Cal = 5.62	X2 0.01(3) = 11.34
3 = X2 Cal = 6.40	X2 0.01(3) = 11.34

Table 2. Assessment of the quality of the root canal filling employing four different application methods of calcium hydroxide paste

CRITERION METHOD	EXCELLENT	SATISFACTORY	REGULAR	POOR
Mc Spadden	13	6	5	0
Lentulo	4	8	7	5
File	1	5	12	6
Syringe	9	9	2	4

DISCUSSION

In the present study special care was taken to select the disto-vestibular root due to its anatomic characteristics such as curvature and small diameter of the root canal. Likewise, choosing the first upper molar is also significant due to its location in the dental arc.

On the other hand, the tooth was assembled on a dental model in order to get the closer possible to the endodontic technique performed on a patient.

Calen paste was selected so that material standardization could be achieved and variations in terms of consistency and radiopacity avoided.

The calcium hydroxide placement method employing the syringe was performed as suggested by LEONARDO[16] in 1991.

As to the syringe method our study indicates that 75% of the results scored excellent and satisfactory. These results are not in agreement with STANCILL et al.[21] where this technique achieved 48.3% of results considered acceptable.

Due to great filling and homogenizing ability of Gutta-Percha and Sealer combined employing Mc Spadden condensers, we decided to extend this method to introduce calcium hydroxide into the canal. he results obtained using this technique matched those achieved with the syringe method, i.e. 79% scoring excellent and satisfactory.

Unlike the results obtained by STANCILL et al.[21] where the Lentulo technique proved to be the most effective (86.7%), in our study it obtained 50% of excellent and satisfactory scores ranking it as the third

best technique.

The least effective method of filling the root canal with calcium hydroxide paste employed endodontic files. 25% of the results scored excellent and satisfactory and are in agreement with STANCILL et al.[21] where they found this method (21.7%) to be the most ineffective.

The differences in results found between our study and that of STANCILL et al.[21] is most probably due to the methodology employed in the assessment of the quality of the root canal filling with calcium hydroxide paste.

CONCLUSIONS

1. The methods where the endodontic syringe and the Mc Spadden condensers were employed proved to be the most effective in filling the root canal with calcium hydroxide paste.
2. The technique where the Lentulo spiral was employed scored excellent and satisfactory in 50% of the samples ranking it as the third most effective technique.
3. The worst results were obtained when endodontic files were employed to fill the root canal with calcium hydroxide paste.

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TRIGEMINAL NEURALGIA (TIC DOULOUREUX) MIMICKING TOOTHACHE

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It is presented the case of a 64-year-old male patient with paroxysmal pain, electric-shock- like in the mouth, on the region corresponding to the mandibular division of the trigeminal nerve , on the left side, simulating pain of dental origin. The patient lived with the pain for a period of one year, without a definite diagnosis or adequate treatment. Once confirmed that the pain was due to the Trigeminal Neuralgia TN, carbamazepine 200mg, twice a day was prescribed, which eliminated the painful condition. After fifty months of follow up, the patient remains without any symptom.

Key words: Trigeminal neuralgia, pain, toothache

INTRODUCTION

Evaluation and treatment of orofacial pain has been regarded as a multifaceted discipline, which involves experts of medical, dentistry and biological fields.

The differential diagnosis of the facial pain can be made considering nature, localization and the duration of pain[3].

In order to establish a definite diagnosis, it is often necessary to list the possible pathologies, eliminating one by one systematically through clinical investigation and therapeutical tests[12]. Among these tests, local anesthesia of the nerve involved can be used to temporarily eliminate the existing pain[3]. Another form of diagnose, used for neuropathic pain, is the use of carbamazepine 400mg by day as an initial dose, which can provide relief or total remission of the previous pain, which can disappear in hours or days[16].

This paper reports a case of pain in the mouth that lasted for the period of one year, without a definite diagnosis. As soon as the diagnosis of Trigeminal Neuralgia was established and carbamazepine 200mg twice a day was prescribed, the preexisting painful condition was completely eliminated.

REVIEW OF LITERATURE

Trigeminal Neuralgia TN is a disease characterized itself by a electric-shock like pain, generally, unilateral and short duration (seconds)[2,5,6,14,15,16,18]. It occurs preferentially in females over fifty years old , specially at their sixties[15]. The most frequently affected side and divisions of the trigeminal nerve are the right side and the second division, the maxillary branch. The third and even the first division can be affect however, this latter is rare[5,6,13]

The factors that usually trigger the shock-like bursts are: chewing, speech, tooth brushing, washing the face, smoking, but it can also occur spontaneously[5,12,14]. Such functional activities induce pain because they stimulate some sensitive spots called "trigger- points", that can be single or multiple and are usually located at the wing of the nose, buccal commissure, eyebrow, alveolar brim, buccal mucosa and the teeth[4,7,10].

Besides a careful clinical and neurological examination, which is generally normal, it is advisable to order a Computed Tomography or a Magnetic Resonance Imaging to discard a central or peripheral tumor as the cause of the painful condition.

The diagnosis of the TN can usually be confirmed

by an anesthetic blockade of the nerve, or by the administration of an adequate dose of a neural membrane stabilizer, such as carbamazepine, which is expected to reduce the pain bursts[3,14].

Pain of dental origin, tumors of the head and the neck, atypical odontalgia , neuroma, painful II-type syndrome, atypical facial pain, glossopharyngeal neuralgia, myofascial syndrome, maxillary sinusitis, cluster headache, Eagle's syndrome and Ernest's syndrome must be excluded [3,7,10,16].

The physiopathologic mechanism of the Trigeminal Neuralgia is not yet known[16]. Both central and peripheral causes have been proposed for this disease. As central causes there are the hypothesis of a demyelination of the Gasserian ganglion as a consequence of the compression of a supplementary branch of the upper cerebellar artery; and of the arteriosclerosis of the vases that supply the ganglion. As a peripheral cause, it is mentioned the possibility of a focal demyelination, producing ectopic action potentials which reduced the trigeminal segmental inhibition. This would result in an excessive response from the mechanoreceptors of low threshold the wide dynamic range neurons, expanding the receptive field of the touch, resulting the Trigeminal Neuralgia[2,6,16].

The treatment of TN can be clinical or surgical. The clinical form is based on drugs used separately or in combination, such as carbamazepine, phenytoin, bacoflen, clonazepan, capsaicin, depending on the patient's response[2,8,11,14,15,19].

The surgical form includes neurolysis, gangliolysis with glycerol or alcohol, neurotomy, rhyzotomy, percutaneous microcompression, cryoteraphy, radiofrequency, microvascular decompression[6,17].

CASE REPORT

A 64-year-old male patient was attended in a dental office in Porto Alegre city, in October 1994. He was complaining of an excruciating, electric shock-like pain, of short duration, localized on the left mandible, which appeared with speech or chewing. His painful condition started about one year ago and the pain had an intensity of 9 degree in the visual-analogue scale (VAS).

The patient had already been treated by other 6 professionals who prescribed ASA, diclofenac and piroxicam, without relief.

He also reported that he had already been submitted to Brain Computerized Tomography, periapical X ray of molars 36 and 37 followed by a panoramic radiography, which did not reveal any abnormality (Figure 1). Despite of that, an endodontic treatment of the 37 was done, which relieved the pain for 14 days. After this period, the pain returned and radicular apicectomies were then done, resulting in extraction of the correspondent tooth, without any pain relief.

In the intra-buccal examination, it was verified that the patient had upper total prosthesis and had dental failures in the lower jaw. Next to the left mandibular edge, in the locus corresponding to the 37, there was found a sensitive

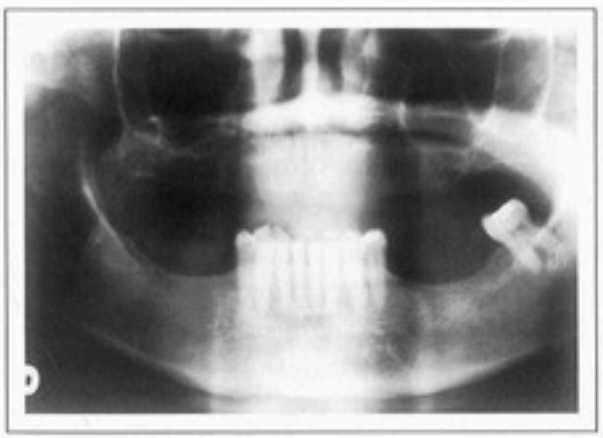

Figure 1A. **Figure 1B.**
Radiograph showing mandibular second molar before (A) and after (B) extraction of mandibular second molar tooth.

area, that when stimulated by soft touch or air gush reproduced the pain.

The interincisal distance was 52,40 millimeters without articular noise, with mandibular bypass, on opening the mouth towards the right side.

Based on the history and present clinic condition, the diagnose of Trigeminal Neuralgia was established and carbamazepine 200 mg twice a day was prescribed. Such medication eliminated his painful condition, abolishing the pain crisis in response to the usual stimulus.

After fifty months, the patient remains pain free.

DISCUSSION AND CONCLUSIONS

In many painful conditions of the face, the patient often massages, scrubs, or applies hot or cold bandages to get some relief. In trigeminal neuralgia, on the contrary, the patient often protects the face, avoiding to stimulate trigger areas for not producing the painful discharges[5].

In the present case, the trigger-point was located in the mouth, in a tooth, what is very uncommon. Therefore, the usual movements did not produce pain. The trigger-factors were speech and chew.

The diagnosis of Trigeminal Neuralgia is based on the nature, quality, duration and localization of the pain[3]. It is reinforced by the normal clinic and neurologic examinations, the maintenance of the corneal reflex and no sensorial impairment in the area innervated by the V nerve, as well as no abnormality of the VII and VIII cranial nerves[6].

When a trigger point is located in the area of a tooth, it is difficult to establish a differential diagnosis between a toothache and a neuralgia. This difficulty is due to the fact that the stimulation of a tooth by percussion, or other physical means (heat, cold) can induce painful discharges. This happens because teeth are part of the sensorial receptor system of the trigeminum nerve (Bell 1991)[3]. Another problem in this case, is that it is impossible to anesthetizes this tooth because of the density of the vestibular bone, and because the involved branch (lower jaw) of this nerve, is situated in the interior of the mandibular canal[9]. In this circumstance, to avoid irreversible treatments, neural membrane stabilizers may be used to treat the neuralgic pain, without any effect on the dental structure.

Until the seventies, it was common to examine patients that had undergone extractions of one or more good teeth, because it was believed that these structures were responsible for the orofacial pain presented by patients. Even nowadays, with better radiological techniques to locate lesions that could be the cause this kind of pain[2], it is still found unnecessary extractions, as in the present report.

To avoid this occurrence, it is advisable to include orofacial pain in the core curriculum of the Dentistry Courses in Brazil, as it is suggested by Attanasio and Mohl (1994)[1], in the United States.

From the analysis of this case, we may also emphasis the following statements:

- The adequate therapeutic response is on the dependence of a correct diagnosis.
- Patients must be seen as a whole, without overestimating the dental examination, and having in mind that there are other causes of orofacial pain other than the teeth.
- Conservative forms of treatment should be preferred. Only in case the patient is not responsive to the treatment, surgical modalities should be considered.
- More research should be done for better understanding the neurophysiological mechanism of the trigeminal neuralgia.

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three or more: FIGUEIREDO et al.[3]

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1. ESTRELA C, SYDNEY GB, BAMMANN LL, FELIPPE JÚNIOR O: Mechanism of the action of calcium hydroxyl ions of calcium hydroxide on tissue and bacteria. **Braz Dent J 6**: 85-90, 1995

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* They must be labeled on the back in pencil, including the figure number and the word "top" at the top of the edge.
* Figure legends must be typed double-spaced on a separate page.

5. Color illustrations are not acceptable for publication at this time.

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CONGRESSO INTERNACIONAL DE ENDODONTIA DO BRASIL CENTRAL FUNDAÇÃO DE ENSINO E PESQUISA ENDODONTICA

A ENDODONTIA DO ANO 2000

Goiânia, 24 a 25 de setembro de 1999

Programação

6ª Feira (24 de setembro)

Matutino

8:00 8:30 Abertura Oficial do Congresso

8:30 12:20 Aspectos Microbiológicos da Endodontia
Prof. Ramanchandran Nair
University Of Zurich Zurich - Switzerland

Vespertino

14:20 18:20 Tratamento do Dente com Necrose Pulpar
Prof. Roberto Roberto Holland
Universidade Estadual Paulista UNESP Araçatuba - SP

Coordenador Prof. Omar Zina
Universidade de Várzea Grande - Cuiabá - MT

Sábado (25 de setembro)

Matutino

8:00 8:50 Obturação do Sistema de Canais Prof. M. R. Leonardo
Universidade Estadual Paulista UNESP Araraquara - SP

9:00 9:50 Retratamento em Endodontia Prof. G. B. Sydney
Universidade Federal do Paraná Curitiba - PR

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10:20 11:10 Biologia do Periápice Prof. J. A. P. Figueiredo
Universidade Luterana do Brasil Porto Alegre - RS

11:20 12:10 Cirurgia Parendodôntica Prof. P. F. E. Bernabé
Universidade Estadual Paulista UNESP Araçatuba - SP

Coordenador

Prof. Paulo Cézar de Azevedo
Universidade Federal De Uberlândia - Uberlândi - MG

Vespertino

14:00 15:00 Instrumentos de Níquel-Titânio Prof. H. P. Lopes
Associação Brasileira de Endodontia do Rio de janeiro - RJ

15:00 16:00 Novos Aparelhos de Preparo dos Canais Prof. S. V. Barbosa
Universidade de Brasília - DF

16:10 17:50 Novas Técnicas de Intrumentação Prof. M. E. Machado
Universidade de São Paulo - São Paulo - SP

Coordenador

Prof. Rinaldo Matar
Universidade de Uberaba - Uberaba MG

Presidente do Congreso
Prof. Carlos Estrela
Universidade Federal de Goiás - Goiânia - GO

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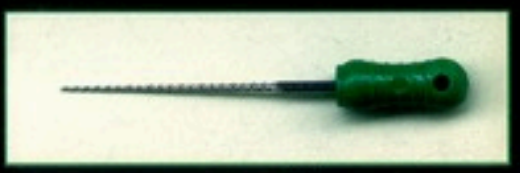

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