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CASE REPORT/CASO CLINICO

Endodontic retreatment of maxillary first molar: the importance of the fourth canal

Ritrattamento endodontico di un primo molare superiore: l'importanza del quarto canale

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Endodontic retreatment;
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Maxillary first molar.

Abstract
Aim: The targets of the endodontic therapy are damaged tissue and bacteria removal from the canals and dentinal tubules and the prevention of recontamination after the treatment.
Introduction: Correct endodontic treatment has to follow several parameters: proper diagnosis, isolation of operating field, full chemo-mechanical preparation of the complex endodontic system, three-dimensional obturation of the root canals, post endodontic restoration. Respecting all these parameters short and long term success can be achieved.
Materials and methods: In this article an orthograde retreatment of maxillary first molar has been described, which showed at pre-operative X-ray, an incongruous endodontic therapy, the failed finding of the fourth canal and the presence of periapical lesions.
Discussion: A high percentage of failures is due to missed root canals and therefore not cleansed, shaped and it is essential to use modern technologies to achieve safe and reproducible results.

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Conclusions: The endodontic retreatment of this right maxillary first molar was performed with the proper protocols and sophisticated tools, with which we can achieve success in the short- and long-term treatments.

PAROLE CHIAVE
Ritrattamento endodontico;
Microscopio operatorio;
MB2;
Punte ultrasoniche;
Primo molare mascellare.

Riassunto
Obiettivo: La rimozione dei tessuti danneggiati, eliminazione dei batteri presenti nei canali e nei tubuli dentinali e la prevenzione della ricontaminazione post-trattamento sono gli obiettivi della terapia endodontica.
Introduzione: Un trattamento endodontico per definirsi corretto deve rispettare diversi parametri: corretta diagnosi, isolamento del campo operatorio, la più completa possibile preparazione chemio-meccanica del complesso e completo sistema endodontico, otturazione tridimensionale dei canali radicolari, restauro post-endodontico. Rispettando tutti questi parametri è possibile ottenere un successo a breve e lungo termine.
Materiali e metodi: In questo articolo viene descritto un ritrattamento ortogrado di un primo molare superiore, il quale presentava, attraverso radiografia pre-operatoria, una incongrua terapia endodontica, il mancato reperimento del IV canale e lesioni periapicali.
Discussione: Sicuramente una percentuale abbastanza significativa di insuccessi è da attribuire a canali radicolari non individuati e quindi non detersi, sagomati ed otturati.

Oltre ad un adeguata conoscenza dell'anatomia dei denti che trattiamo è fondamentale usufruire delle moderne tecnologie per ottenere risultati sicuri e riproducibili.
Conclusioni: Il ritrattamento endodontico di questo primo molare superiore di destra è stato eseguito con i dovuti protocolli e con strumenti sofisticati, i quali hanno permesso di ottenere il successo a breve e lungo termine.

Introduction

One of the major causes of failure in endodontic treatment is the impossibility of locating and treating the entire root canal system, a result of the lack of knowledge regarding the dental, internal or external anatomy[1,2] and the high complexity and variation of the root canal system, with accessory, secondary, recurrent, and apical delta canals, among others.[3,4]

Maxillary molars are the teeth that contain the greatest number of roots, with diverse shapes and formations, which is why their internal canal system is so variable.[5,6]

Various studies have shown large differences in the detection of the MB2 canal in the maxillary second molar according to the technique used; in in vitro studies it varies between 29% and 100%[7,8] whereas in vivo studies report between 19.7% and 51.1%.[9,10]

Traditionally, most endodontic canal detection procedures have relied on the dentist's tactile dexterity, and mental image of the canal system because the ability to visualize the canal orifices is severely restricted.[11–13] By magnifying and illuminating the grooves in the pulpal floor and differentiating the color differences between the dentine of the floor[14] and walls the operating microscope, has made canal location easier.[15,16]

Using magnification during endodontic treatment has particular advantages. It increases the confidence level of the operator by improving control during troughing and searching in the deep chambers of maxillary molars thereby reducing significant risk of perforations.[17] Moreover, magnification further enhances the ability of the operator to effectively search for the second mesiobuccal canal and as a result leads to higher number of such canals being located and treated.[14,18,19]

The target of endodontic therapy consists in adequate shaping, proper cleansing followed by a correct obturation of the complex system of root canals with thermoplastic gutta-percha.[20–22]

The manual and mechanical files do not have a complete contact with the endodontic surface; for this reason after the shaping step, more time to the cleansing phase has to be applied.[23] Through the modern techniques of three-dimensional cleansing all the endodontic spaces can be achieved.[24,25]

Even if a complete bacteria removal is not achieved, it will be too low to allow the defense system action to proceed to healing and then get the success in short and long term.[26,27]

A significant percentage of failures are because of the presence of not shaped, not cleansed and obtured pulp tissue.[28,29]

Thanks to the knowledge of the endodontic anatomy and its possible variants associated with the use of modern technologies, it is possible to find the root canals and achieve a greater control of all the phases.

Materials and methods

A fifty-five-year old patient was referred to our Department complaining of pain in chewing at tooth 2.6. X-ray exam obtained through the paralleling technique, showed

a previous and incomplete endodontic treatment with periapical lesions (Fig. 1).

Also a Cone Beam Computed Tomography (CBCT) of the tooth was carried out to increase the study.

Cone-beam computed tomography (CBCT) has the capacity to explore the anatomical structures in a three-dimensional reconstruction, from axial, transverse and sagittal planes,[30] and provides adequate information about the root canals in different directions with no anatomical superposition, which cannot be detected clinically or by means of conventional X-rays.[31,32]

At transverse section (CBCT) of the mesio-vestibular root the presence of the fourth canal was not detected (MB2) (Fig. 2).

Because of the presence of root fracture was excluded, a chronic periapical periodontitis was diagnosed.

So an orthograde retreatment of the tooth 2.6 has been carried out.

After the isolation of the operating field with liquid dam, the opening of pulp chamber was performed with magnifying and enlightenment systems (4× operating microscope).

After this phase, the pulp chamber floor was examinated at greater magnification (10×) (Fig. 3).

Figure 1 Preoperative X-ray of 2.6. A previous incomplete endodontic therapy with periapical lesions is shown.

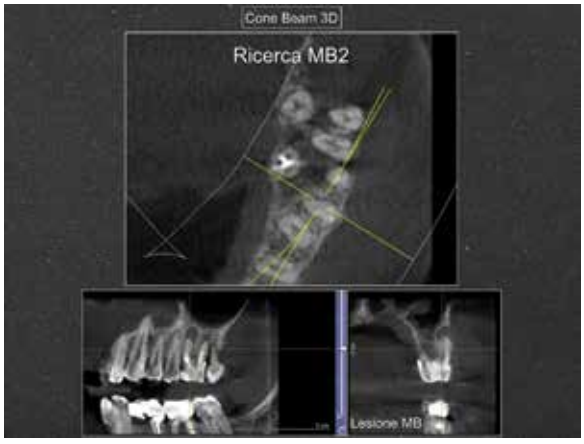

Figure 2 At transverse section (CBCT) of the mesio-vestibular root the presence of the fourth canal was not detected.

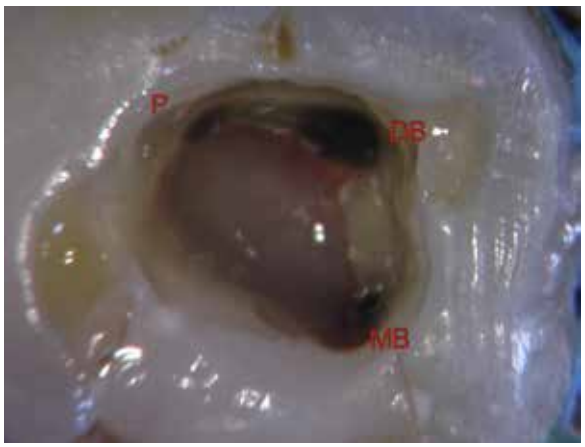

Figure 3 At the pulp chamber floor only the mesio-vestibular, disto vestibular and palatal root canals were detected.

At the pulp chamber floor only the mesio vestibular, disto vestibular and palatal root canals were detected.

At greater magnification the presence of the fourth canal (MB2) was not detected (Fig. 4).

In the maxillary first molar the presence of the fourth canal has a prevalence between 86.1% and 91%[33,34].

These data are critical and stand out the importance of the fourth canal finding, because of its omission would lead to a failure in the short and long term.

The CBCT X-rays have some limits, the maximum detail that can identify is between 76 and 80 microns, so smaller root canals (calcified canals, MB2 and MMC canals of small dimension) are not displayed.[35,36]

Knowing these limits, even after studying the tooth 2.6 at transverse section, in our study we looked for the presence or absence of the fourth canal.

At the opening of the pulp chamber if the MB2 canal founding is not immediately possible, it should be absolutely looked for.

Procedure for fourth canal finding (MB2)

It is essential to use ultrasonic tips designed exclusively for this purpose.

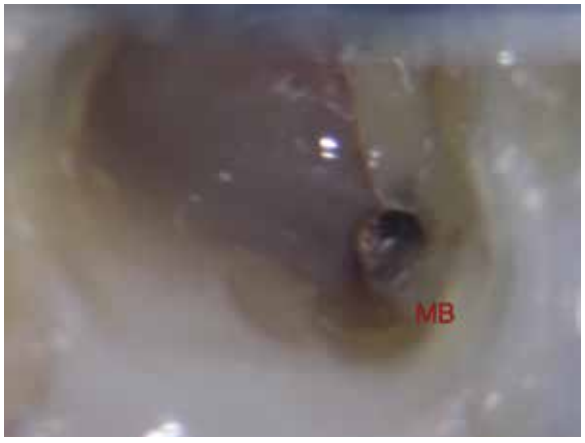

Figure 4 At greater magnification the presence of the fourth canal (MB2) was not detected.

The ultrasonic tips allow to achieve a better view, furthermore are more conservative than the micromotors burs.

The tip that has to be used for the fourth canal finding has to be small, with diamond or micro machined surface, not-pointed to avoid scratches and perforations of the chamber floor and used with a cooling system to chill the tip and to remove debris.

In this way it will be possible to have total control over the finding phase.

After the identification of the vestibular and palatal canals, the magnification has to be increased (8×) and proceed as follows:

The ultrasonic tip, used with a specific ultrasonic source and set on an average power, will be placed at the entrance of the mesio vestibular canal, activated and directed towards the palatal canal.

During this phase the tip must be located mesially, where the thickness of dentin is greater to avoid perforations.

The groove depth will be about 0.5—1 mm, while the extension in palatal direction will be about 1—2 mm (Fig. 5).

After this phase the groove will be cleansed and under magnification and lighting (10×) with files of small size 0.6—0.8 (60—80 microns), the prepared area will be probed finding the entrance of the fourth canal.

If the fourth canal is not found, its search will end and the preparation of the other canals will be done. If the fourth canal is detected, the first thing to do is try to understand immediately the development, independent or flowing into the mesio vestibular canal, in order to avoid fracture of endodontic files.

Another critical point is the location of the fourth canal. If the orifice of MB2 canal is situated closely to the mesio vestibular canal orifice, without magnification the human eye will not be able to identify it.

This because the power of resolution (PDR) of the human eye is around 0.1 mm or 100 microns. So if the two orifices are placed at a distance of less than 100 microns the eye will sum them as a single image.

Even in this case, the use of appropriate magnification systems (operating microscope), increasing the PDR, will guarantee a correct detail's examination.[15]

The operating microscope already at 10× allows to distinguish details far below 76 micron displayed with CBCT.

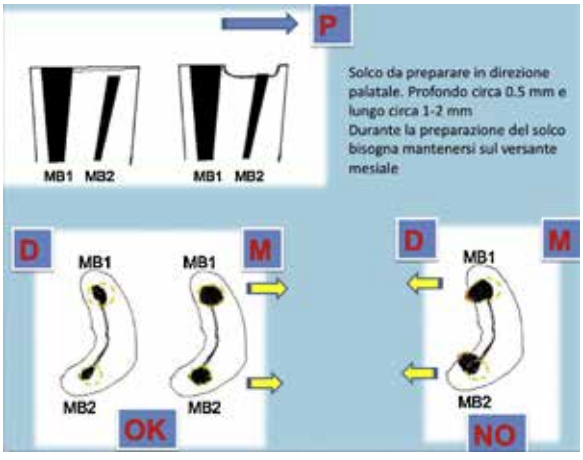

Figure 5 Scheme for the fourth canal founding.

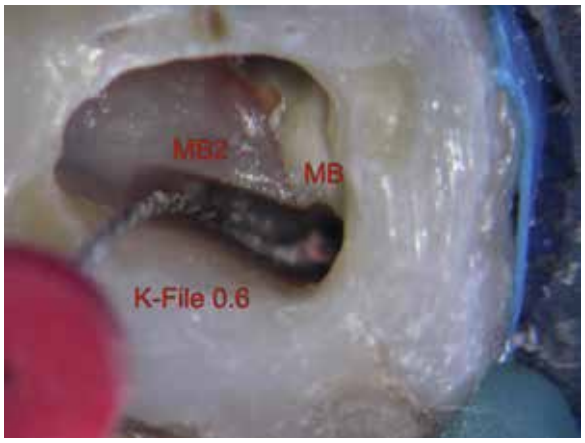

Figure 6 MB2 founded at high magnification with 0.6 mm k-file. The close contact with the entrance of the mesio vestibular canal is shown.

In this study, after groove preparation, at high enlightenment and magnification the fourth canal has been identified with a 0.6 mm file, and it was positioned 1 mm in depth and less than 0.1 mm from the orifice of the mesio vestibular canal (Fig. 6).

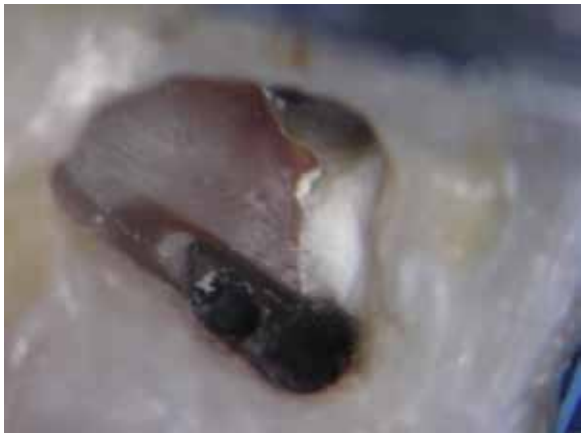

Figure 7 Shaping of MB and MB2 canals.

Figure 8 Obturation of MB and MB2 canals.

Figure 9 Post-operative X-ray of 2.6. It shows a correct obturation of root canals with thermoplastic gutta-percha. The presence of the fourth canal with an independent development is shown.

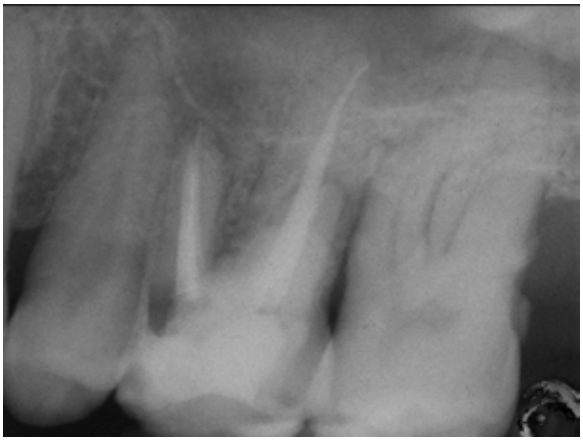

Figure 10 X-ray follow-up at 12 months. The tooth is asymptomatic and a good healing of periapical tissues is shown.

MB2 canal had an independent development, immediately verified by apex locator.

After the correct anatomy identification of this maxillary first molar, the chemo-mechanical preparation of the root canal system was carried out, followed by a correct obturation using thermoplastic gutta-percha (Figs. 7 and 8).

A proper post-endodontic restoration was done and then proceeding to X-ray after treatment and follow-up at 12 months after therapy (Figs. 9 and 10).

Discussion and conclusions

This case shows the limits in endodontics regarding use of CBCT for the founding of the root canals of small size.

The CBCT X-rays can identify details between 76 and 80 microns, so smaller root canals or calcified canals; even if not apparent with these sophisticated diagnostic tests have to be founded, of course performing the correct procedures.

These canals, although with a small size, can contain tissues and bacteria that can certainly invalidate the final outcome of our treatment.

However, thanks to an adequate knowledge of endodontic anatomy and its possible variants, associated with the use of modern technology (magnification systems and ultrasonic tips) it is possible to avoid iatrogenic injuries and ensure correct and reproducible results.

Conflict of interest

The authors declare that they have no financial interest in relation to this paper.

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