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CLINICAL ARTICLE/**ARTICOLO CLINICO**

Unusual Anatomies: case series

Anatomie inusuali: case series

KEYWORDS
Unusual anotomies, pre-operative radiography, operative Microscope, ultrasonic tips.

PAROLE CHIAVE
Anatomie inusuali, radiografia pre-operatoria, microscopio operatorio, punte ultrasoniche.

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Abstract

Aim: *The aim of this article is to describe three case reports of unusual teeth anatomy, more precisely of a maxillary right central incisor with two roots and two root canals, a mandibular premolar with four root canals and a second maxillary molar with five root canals associated with an extra small root located in the center of pulp chamber.*
Methodology: *A correct diagnosis, the awareness of finding an unusual anatomic root variation in any endodontic treatment, the use of technological equipment like the operative microscope and ultrasonic tips enabled the operator to solve the clinical case in a safe and predictable way. In order to set a correct treatment plan, it is quite important to evaluate a pre-operative radiograph before starting the endodontic treatment. Another step is the thorough examination of the pulp chamber floor, better if carried out under magnification and coaxial light in order to easily locate all the canal orifices. The endodontic treatment and retreatment of the previously mentioned three uncommon teeth will be discussed.*
Results: *All the root canals were found, treated and obturated in the three presented cases and healing was shown in the follow up radiographs.*
Conclusions: *Anatomic root variations should be anticipated in order to be encountered in the daily endodontic practice.A pre-operative radiography must always be done before endodontic treatment in order to make the right diagnosis.*
The operative microscope magnification is useful in order to work in a safe and precise way.

Obiettivo: *L'obiettivo di questo lavoro è descrivere tre casi clinici con anatomie inusuali, precisamente un incisivo centrale superiore con due radici e due canali radicolari, un premolare mandibolare con quattro canali radicolari e un secondo molare mascellare con cinque canali radicolari e un extra piccola radice situata al centro della camera pulpare.*
Metodologia: *Una corretta diagnosi, la consapevolezza di trovare un'insolita variazione anatomica in qualsiasi trattamento endodontico, l'uso di apparecchiature tecnologiche come il microscopio operatorio e le punte ultrasoniche hanno permesso all'operatore di risolvere il caso clinico in modo sicuro e prevedibile. Al fine di stabilire un piano di trattamento corretto è molto importante analizzare una radiografia preoperatoria prima di iniziare il trattamento endodontico. Un altro passo è l'esame approfondito del pavimento della camera pulpare, meglio se effettuato sotto ingrandimento e luce coassiale per localizzare facilmente tutti gli orifizi canalari. Saranno discussi due trattamenti endodontici e un ritrattamento di denti con anatomie inusuali precedentemente citati.*
Risultati: *Tutti i canali radicolari sono stati trovati, trattati e otturati nei tre casi presentati e la guarigione viene mostrata nei controlli radiografici.*
Conclusioni: *Le variazioni anatomiche delle radici dovrebbero essere anticipate perché possono essere riscontrate nella pratica endodontica quotidiana. Una radiografia preoperatoria deve essere sempre eseguita prima del trattamento endodontico per impostare la corretta diagnosi. L'ingrandimento dato dal microscopio operatorio è utile per lavorare in modo sicuro e preciso.*

Introduction

The bacteria and their byproducts are the main causative factor of infection of the pulp and the periapical area (1).
The goal of modern Endodontics aims to achieve adequate shaping, appropriate 3dimensional (3D) cleaning and finally a correct obturation of the complex root canal system with thermoplasticized gutta-percha (2, 3). This is done so as to eliminate or reduce the bacterial load to levels compatible with the healing process (4).
Based on knowing that everything starts with a correct diagnosis and careful eval-

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Figure 1
Pre-operative radiograph of maxillary central incisor.

Figure 2
Pulp chamber after obturation.

Figure 3
Post-operative radiograph showing the two root canals.

uation of the preoperative radiography, it is possible then to anticipate potential variations of the endodontic anatomy.
When the preoperative radiograph is not clear enough, it is possible to perform alterations by filming from different horizontal angles in order to show the real anatomy of the tooth under examination.
Afterward, a correct access cavity follows using magnifying systems and coaxial light. Utilizing the aid of a magnification tool, the Operating Microscope, it is possible to correctly examine the whole floor of the pulp chamber and point out additional or unusual anatomies. Only after having identified all the existing root canals it is possible to continue the endodontic treatment: shaping, 3D Cleaning and 3D obturation. Otherwise, forgetting one or more root canal can cause failure in the short or long term (5, 6).
The aim of this work is to present and discuss three clinical cases with unusual anatomies that with the help of the indispensable technologies such as the operating microscope and ultrasonic tips have been successfully solved.

Case Series

Case report 1: A 23-year-old male patient was referred because of pain and possible root canal treatment. Patient was complaining from pain with thermal stimulus at the upper right side. Using thermal tests, the clinical examination confirmed that the pain was in tooth 1.1, while the periodontal test was negative. Clinically, the tooth under examination was presented with a prosthetic fixed covering with marginal leakage clinically demonstrated by defective cervical seal.
Upon radiographic examination, anomalous configuration of the roots was visible (Fig. 1). The diagnosis was irreversible pulpitis. The endodontic treatment of tooth 1.1 was then performed with the aid of the operating microscope (Som 32, Kaps). After anesthesia, the tooth was isolated using rubber dam

Figure 4
Six Months follow up.

isolation. A modification in the access cavity was performed in the form of further bucco-palatal extension. The access was done using high speed burs and ultrasonic tips (P Tip, Plastic Endo, Buffalo Grove, USA), two blood clots coming from the canal orifices were located on the floor of the pulp chamber. The identified canals were one on the buccal and one on the palatal sides of the access (Fig. 2).
Afterwards the chemo-mechanical preparation was carried out, alternating the use of rotating instruments, ProTaper Universal in crown-down technique, irrigating with 5% sodium hypochlorite (Niclor 5, Ogna, Muggiò, Milan, Italy) and EDTA. Immediately after, the three-dimensional obturation using warm gutta-percha with the continuous condensation wave technique (System B) (Fig. 3) was done. The final precision of the endodontic treatment was checked using a periapical radiograph, and the patient was referred to follow up checks over time to evaluate the effectiveness of the treatment (Fig. 4).

Case report 2: A 32-year-old male patient was referred for evaluation and possible retreatment of his right maxillary second molar (tooth number 17). Clinically the tooth showed pain on percussion. The periapical radiograph revealed improper previous root canal treatment and a periapical lesion. The tooth was diagnosed with failed root canal treatment associated with chronic apical periodontitis and non-surgical endodontic retreatment of this tooth was the treatment of choice.
After isolating the tooth with rubber dam access cavity was done while using the operating microscope (Kaps, Som 32 Karl Kaps GmbH & Co. KG). After finishing the access opening of the pulp chamber the identification of the palatal root canal then the distal-buccal and mesio-buccal was performed. An increase in the magnification of the surgical microscope (10x) with the help of a special diamond coated ultrasonic tip, ET 18D, (Satelec Acteon group) it was possible to locate the second mesiobuccal canal, MB2, and also locate a small canal found almost in the center of floor. Only after identifying the actual anatomy of this tooth was done, the endodontic retreatment began. Each canal was prepared using ProTaper universal files SX, S1, S2, F1 and F2 (dentsply maillefer) to the working length. The working length for all the canals was determined with the help of the apex locator Morita Root ZX (J. Morita) then the it was confirmed with periapical radiograph.
The irrigation protocol used was 5.25% NaOCl (Niclor 5, Ogna) and 17% EDTA (EDTA 17%, Ogna), saline solution and CHX 2% (Cloreximid, Ogna) as a final wash. The irrigation was activated by ultrasonic activation (passive ultrasonic irrigation PUI).
The phase of obturation was performed with thermoplasticized gutta-percha using system-B technique (system-b, Kerr) after application of the endodontic sealer, in this case the sealer used was Pulp Canal Sealer EWT (Pulp Canal Sealer EWT, Kerr) (Fig. 5A, B, C, D).
The postoperative radiograph showed complete obturation of all the five root

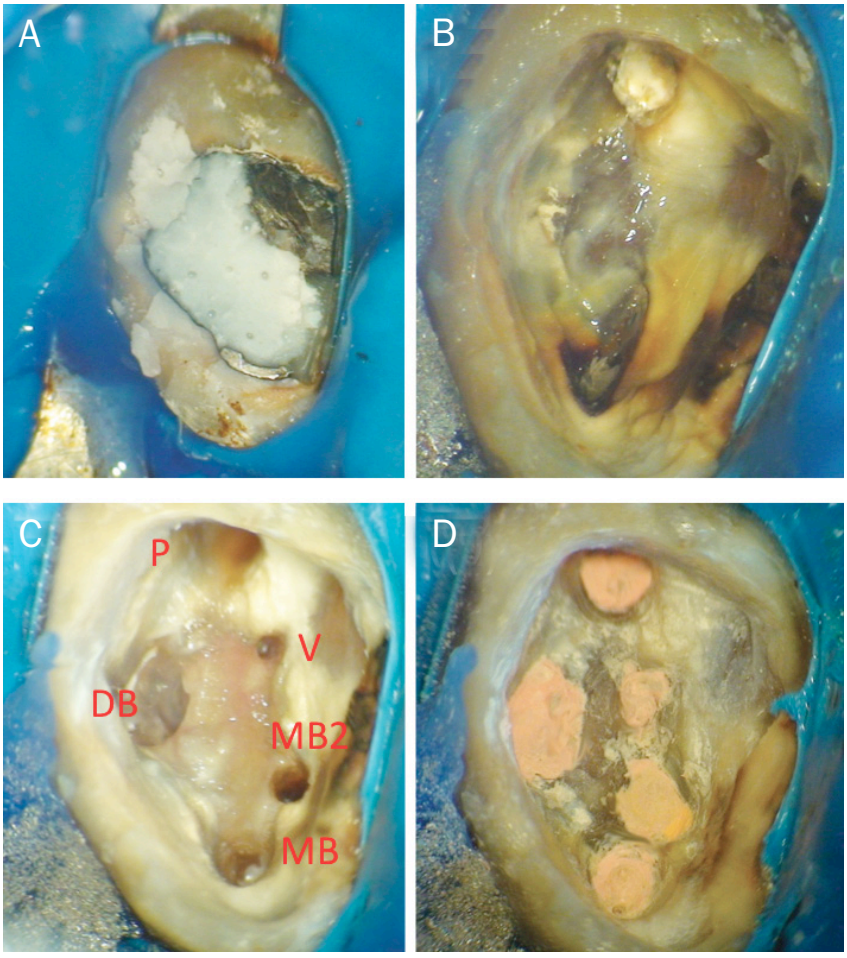

Figure 5
(A) *The maxillary second molar with previous restoration and after rubber dam isolation;* ***(B)*** *pulp chamber after removal of restoration and exposing mesiobuccal MB, distobuccal DB and palatal P canals;* ***(C)*** *the pulp chamber after root canal preparation: locating the accessory canal V also MB2 was found and prepared;* ***(D)*** *all five canals after obturation.*

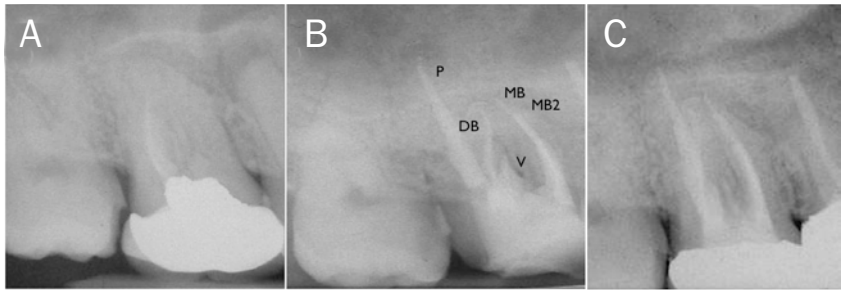

Figure 6
(A) *Pre-operative periapical radiograph of maxillary second molar showing failed endodontic treatment and periapical lesion related to the mesiobuccal root;*
(B) *periapical radiograph after endodontic retreatment and obturation of five root canals including the extra canal in the supernumerary root V;*
(C) *periapical radiograph of 12 months follow up.*

canals, including the small accessory root canal. The first follow up was after 12 months and the radiograph showed healing of the periapical lesion (Fig. 6A, B, C).
Nine years after the retreatment was carried out a CBCT of the upper dental arch was done and by using an endodontic software, 3D Endo (Endo 3D, Sirona Dentsply), it was possible to separate the tooth from the other teeth and rebuild it in three dimensions. This special viewing showed the maintenance of healing and the presence of all 5 of the root canals, including the small central canal (Fig. 7A, B, Fig. 8A, B).

Case report 3: A case of non surgical root canal treatment of tooth number 44 with four root canals. Patient was presented with continuous pain, attrition and cervical abrasion of the affected tooth. Tooth was tender to percussion.
Diagnosis was irreversible pulpitis with apical periodontitis. Root canal treatment was performed under the use of operative microscope (Labomed Prima).
Studying the preoperative radiograph it was possible to see an unusual anatomy of the tooth and with the help of magnification and light all the complex endodontic system was visualized and treated. Utilizing a special diamond coated ultrasonic tip, ET 18D, (Satelec Acteon group) the finishing of the access cavity was performed and the four root canals were exposed.
Afterwards the shaping phase begin, the files used during the shaping phase were as follow hand files 0.8, 10 K and One Flare, OneG and 2Shape TS1, (Micromega, France), as rotary files.
For the 3D cleaning phase Sodium hypochlorite (NaOCl) 5.25%, EDTA 17% and distilled water were used. The NaOCl was activated using 5 Cycles of Internal heating followed by sonic activation for each cycle.
Finally obturation phase was done

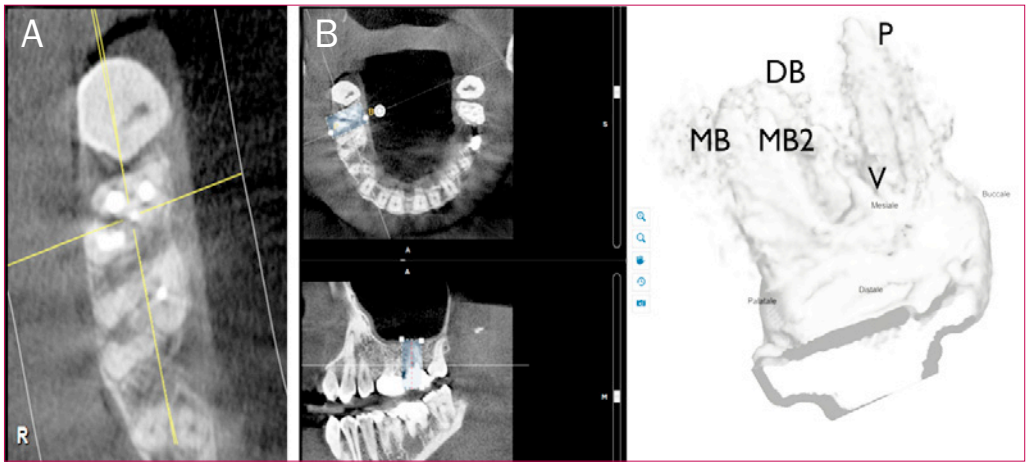

Figure 7
(A) *CBCT showing the five root canals with the fifth canal located in the center of the second maxillary molar;* ***(B)*** *the tooth using software 3D Endo and the small accessory root V can be seen.*

with warm guttapercha using EQV and AH plus as sealer (Fig. 9, 10, 11).

Discussion

Achieving successful root canal treatment is merely dependent on performing proper cleaning and shaping followed by complete obturation in a three-dimensional way of the very complex root canal system (3). Inadequate cleaning of all the existing root canals can lead to leaving remnants of the pulp tissue, which in consequence will lead to failure of the treatment. Even worse results can occur by missing an entire undiscovered root canal.
In order to locate the root canals it's necessary to have proper previous knowledge of the endodontic anatomy and its possible variations.
Equally important is the use of updated technologies such as the dental operating microscope and ultrasonic tips in order to find all root canal orifices and avoid any major causes of treatment failure.
The main use of the operating microscope is to enhance the PDR, or the power of resolution, which means being able to distant two points that are very close to each other in order to be able to distinguish them. The human eye, in fact, can't differentiate between two objects separated by a minimum distance of 0.1 mm (PDR: 0.1 mm): these objects will appear as one to the human eye. The operating microscope is able to increase the power of resolution from 0.1

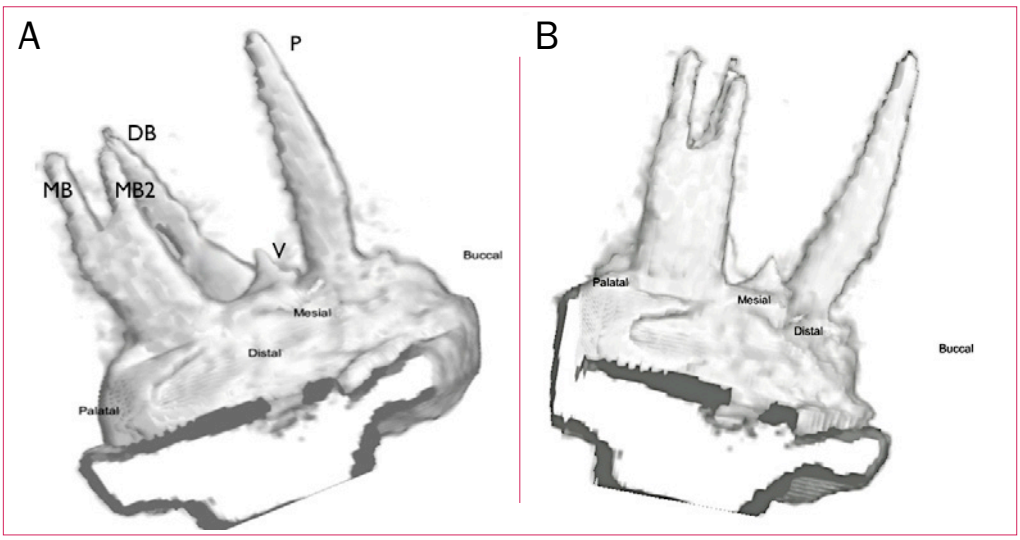

Figure 8
(A) *Another view of the tooth using software 3D Endo and the small accessory root V;* ***(B)*** *different angulation.*

Figure 9
Pre-operative radiograph of second mandibular premolar.

Figure 10
Post-operative radiograph showing the four root canals.

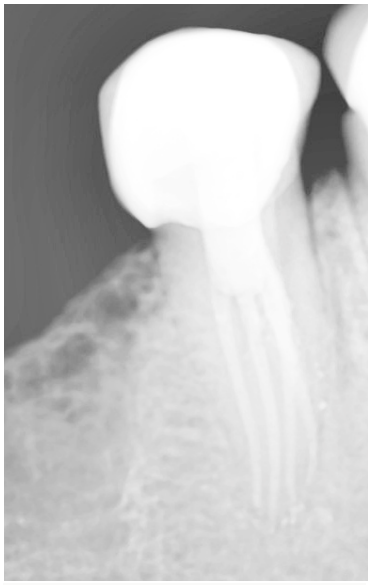

Figure 11
Six months follow up.

mm up to 0.005 mm which is equal to 5 microns, thus making the human eye able to detect more details (7, 8).
The ultrasonic endodontic tips are produced in various types that have different sorts of shapes, length and manufacturing materials. Additionally, utilizing the recent updated ultrasound devices, it is possible to optimize the use of each type of the tips by adjusting the frequency and the amplitude of vibration. The ultrasonic tips offer an improved precise cutting due to their reduced dimensions which permit greater visibility of the operating field when compared to rotary instruments. Such enhanced and more visible field can be optimized by the use of magnification systems as the operating microscope (8).
Therefore, proper knowledge and improved operating field will help in identification of all root canal orifices, only after this, now it is possible to proceed with the phases of shaping, cleaning and finally the 3D obturation.
The maxillary central incisor almost always presents with one root and one root canal.
Reviewing the literature, cases similar to the one presented in this work are very infrequent (9, 10, 11, 12, 13). The shape anomalies may be borne by the crown of the teeth that can be presented in the form of accessory cusps, conical or tubular shape. On the other hand, the anomalies of the root may be in the form of number, shape and size or even of the sole endodontic (14).
The maxillary molars can be presented with different configurations (15): the current case report is describing a maxillary second molar with an unusual root canal morphology.
The particularity of this tooth is the presence of a small auxiliary root localized at the center of the floor. There are similar cases, for example radix mesiolingualis, radix distolingualis and radix paramolaris (16, 17, 18, 19, 20), but never in the litrature a small root in the center of the floor was described even *in vitro*.
Only because of the assistance of magnification it was possible to discover this supernumerary root canal. The encounter of the entire, previously missed, root canal system was the key to ensure the success of the endodontic retreatment of this tooth.
Mandibular premolars can present different root configurations. The most frequent configurations are one root and one

or two root canals or two roots and two root canals. The clinical case shown in this work is very rare because it has four root canals (21, 22, 23).

Conclusions

Achieving short and long term success in endodontics is based on proper knowledge of the root canal morphology of all the teeth and its possible variations. It's also important to use modern updated technology like the operating microscope and ultrasonic tips for aiding in locating all root canals. Only after identifying the actual present root canal anatomy it is possible to proceed to complete and successful endodontic treatment and/or retreatment (24, 25, 26, 2, 3).

Clinical Relevance

The clinical cases presented in this study emphasizes on the importance of the knowledge of the root canal anatomy along with the utilization of recent technologies like operating microscope and ultrasonic tips.

Conflict of Interest

The authors declare that there are no conflicts of interest.

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