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# Calcifications detection and management in the obliterated endodontic space

A. IANDOLO[1], D. ABDELLATIF[2], A. AMATO[1], M. PISANO[1], F. CARBONCINI[3], D. I. K. PONTORIERO[3], M. CAGGIANO[1]

[1]Department of Medicine and Surgery, University of Salerno, Salerno, Italy
[2]Department of Endodontics, Faculty of Dentistry, University of Alexandria, Alexandria, Egypt
[3]Department of Fixed Prosthodontics and Dental Materials, University of Siena, Siena, Italy

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## ABSTRACT

**Background** Calcifications can partially or completely close the endodontic space, complicating or preventing orthograde endodontic treatment.
**Case reports** The current case series aims to present clinical cases with different degrees of calcification. Calcifications and pulp stones are frequently found in the teeth pulp tissue. Their presence is substantial as they downgrade the total number of cells within the pulp and act as an obstruction to debridement and enlargement of the root canal system during endodontic treatment. It is fundamental to anticipate and recognize calcifications in order to organize a proper treatment plan.
**Conclusions** The use of modern technologies, in the case of root canal calcifications, ensure safe results. Operating microscope, ultrasonic tips, 3D CBCT, rotary files of the new generation, systems enhancing cleansing, and methods used to obtain a valid three-dimensional seal, are essential to avoid iatrogenic damage and achieve success.

KEYWORDS Calcifications, Pulp stone, Endodontics, Endodontic surgery, Root canal treatment.

## INTRODUCTION

The endodontic treatment aims to eliminate the infection, inhibit microorganisms from infecting or re-infecting the endodontic space by filling the 3D chemically cleaned and mechanically shaped systems, and ultimately inhibit imminent recontamination of sealed root canals (1-4).
The endodontic treatment's long-term success is closely linked to adequate three-dimensional (3D) cleaning, shaping, and then complete 3D obturation of the complex root canal system (5-7). A significant percentage of failures are probably caused by the presence of the residual amount of bacteria and an insufficient cleansing of the root canals. Therefore, the endodontic space must be shaped, cleaned, and obturated as promptly as possible. Calcification is one of the numerous complications that can render the shaping and completing of endodontic treatment more difficult.
Pulp stones are generally formed in pulp tissue. As their name signifies, they are isolated calcified masses with calcium-phosphorus ratios equivalent to that of dentine. Pulp stones can be in the singular or multiple form and are present more frequently at the pulp chamber's orifice or within the root canal. They can be categorized as true or false calcifications (8). Histologically, they are generally composed of concentric layers of mineralized tissue made by surface accretion around blood thrombi, dying, or dead cells. They can also form collagen fibers "false pulp stones" (Fig. 1). Infrequently a pulp stone may include tubules and be surrounded by cells similar to the odontoblasts. The later form describes the "true pulp stones." Such pulp stones are unusual and, when they exist, occur near the apex of the tooth. Such stones are categorized as true pulp stones, unlike stones having no cells correlated with them.
Pulp stones are categorized as attached if during their formation coalition between them and the dentine wall occurs, or if secondary dentine deposition surrounds the stone. On the contrary, the freestone is completely surrounded by soft tissue. The presence of pulp stones is a problem, in that they reduce the overall number of cells within the pulp and act as an obstruction to

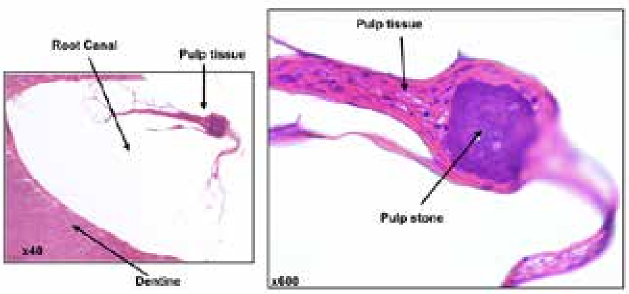


FIG. 1 Free-false pulp stone.

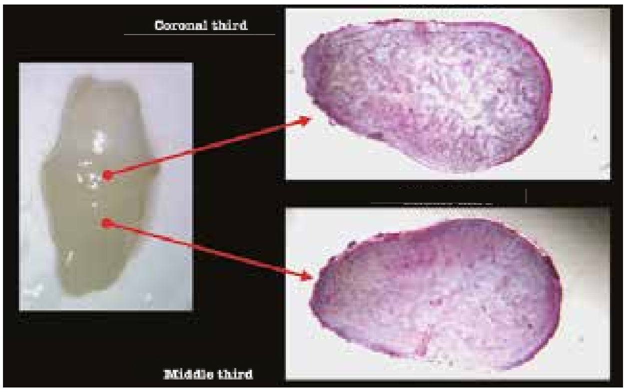


FIG. 2 Extracted maxillary premolar with endodontic space completely obliterated by calcifications. Also, the root canal and dentinal tubules cannot be seen in these histological sections.

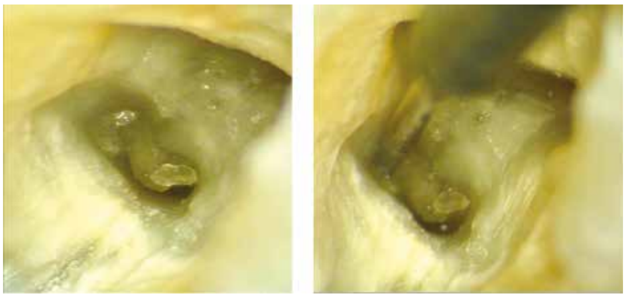

FIG. 5 The big calcification in the coronal third of the distal root canal can be safely removed with an ultrasonic tip and operative microscope.

FIG. 3 Preoperative radiograph of tooth 4.7.

FIG. 4 The cavity after the old restoration removal, where the deep crack is visible.

FIG. 6 Postoperative radiograph.

FIG. 7 Preoperative radiograph of tooth 4.7.

FIG. 8 Tooth 4.7 after performing the access cavity, where a fully calcified pulp chamber can be seen.

debridement and enlargement of the root canal system during endodontic treatment (9). Pulp stones and calcifications from secondary and tertiary dentine can partially or completely obstruct the endodontic space, complicating treatment (Fig. 2).
This work aims to present three cases with different degrees of calcification.

## CASE REPORTS

### First case (Fig. 3-6)

A 42 years old male patient was referred to our clinic with pain in the right mandibular area. Radiographic examination showed a radiopaque area associated with the coronal third of the distal canal of tooth 4.7, but the root canal was visible. The tooth was diagnosed with irreversible pulpitis caused by a deep crack under the previous restoration.
The treatment of choice was non-surgical root canal treatment.
After tooth isolation with a rubber dam, the access cavity was performed, and with the assistance of magnification and light, an operative microscope, a relatively large pulp stone was observed in the coronal third of the distal canal. Thus, using an ultrasonic tip and operative microscope, the pulp stone was removed. Subsequently, shaping, 3D cleaning, and 3D obturation were successfully carried out.

### Second case (Fig. 7-11)

A 52 years old male patient presented at our clinic with pain associated with the right mandibular area. Radiographic examination revealed a radiopaque area associated with the pulp chamber of tooth 4.7, but the root canal was detectable. The diagnosis of the tooth was irreversible pulpitis caused by a deep restoration.
The treatment of choice was non-surgical root canal treatment.
After tooth isolation with a rubber dam, the access cavity was completed, and with the aid of magnification and light, all the orifices were located using an operative microscope. They were fully calcified, and it was impossible to negotiate any of them even by using a small hand file 0.06 K-file. So, using an ultrasonic tip (Start X 3, maillefer, Swiss) and operative microscope, the calcifications that covered the orifices were carefully removed. Afterward, the tooth was successfully shaped, 3D cleaned, and 3D obturated.

## Third case (Fig. 12-15)

A 46-year old male patient was presented at our clinic with pain associated with the right maxillary area. Upon 2D periapical radiographic examination, a previous root canal treatment of 1.5 was observed. The obturation was shorter than the root apex. The canal's area apical to the short obturation could not be visualized, almost certainly because it was calcified. The diagnosis was symptomatic apical periodontitis caused by an improper root canal treatment. Consequently, a 3D Cone-beam computed tomography (CBCT) was performed (small fov and high resolution 75 microns) to analyze the apical third of tooth 1.5. Examining the CBCT, it was not possible to detect the root canal.

The treatment of choice was endodontic surgery. This choice was justified by the difficulty of finding the root canal, even when using the high-resolution 3D CBCT, which means that the canal was completely calcified. Moreover, it can be very difficult or even impossible to perform an orthograde root canal treatment when the calcification is present in the apical third, and the root length is relatively long. It was impossible to locate the root canal during the apicoectomy procedure under high magnification (x24). However, with the operative microscope's aid, a white circular area in the middle of the root was detected, indicating the calcified canal. Following that, the calcification was removed using an ultrasonic tip

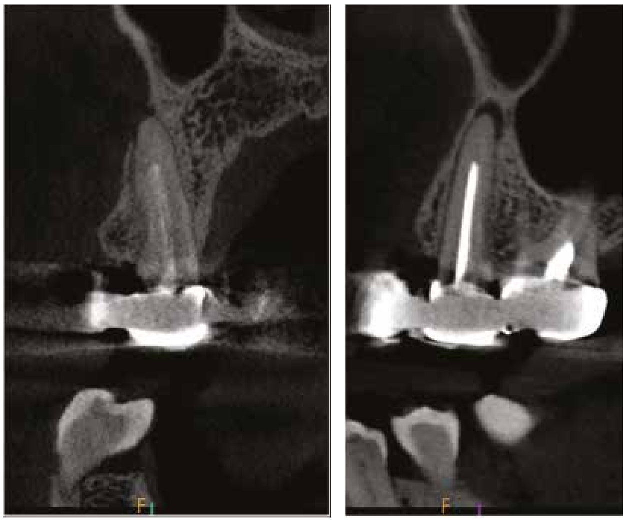

FIG. 12 Preoperative CBCT of tooth 1.5 showing the calcification in the apical third. The root canal was not visible.

FIG. 14 Retro-obturation using MTA.

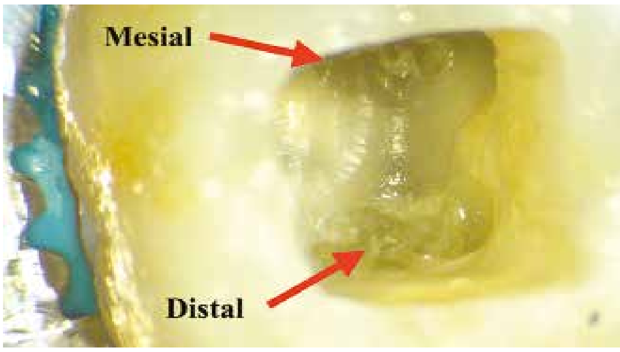


FIG. 9 With the help of high magnification and light, it is possible to see and differentiate the calcifications covering the distal and medial orifices.

FIG. 10 Calcifications can be safely removed by using an ultrasonic tip and operative microscope.

FIG. 11 Postoperative radiograph.

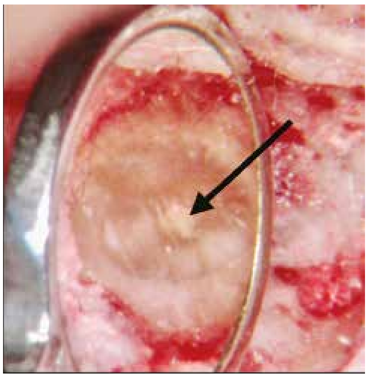

FIG. 13 After apicoectomy using a micro-mirror and operative microscope, it is possible to see the calcified white area in the middle of the root. When the calcification was visualized under magnification, it was removed using a retro tip used to perform the retro preparation.

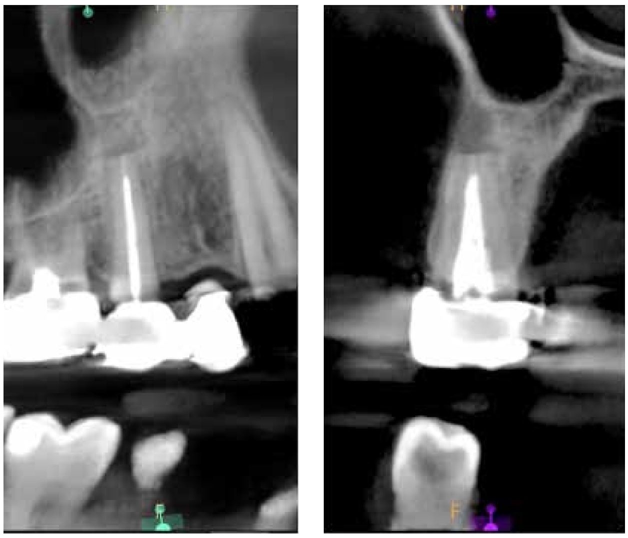

FIG. 15 Follow up at eight months showing healing.

(P 14D, Satelec), and the treatment was performed.
At one year, it was possible to observe adequate healing.

## DISCUSSION

The origin of different types of pulp calcifications is unknown. Although their frequency appears to surge with the subject's age, there is no absolute correlation with pulpal irritation or inflammation resulting from caries or trauma. When pulp calcifications have been reported from unerupted teeth, it is uncertain whether pulpal disease such as inflammation is linked. Kretschmer and Seybold (10) reported an exceedingly high percentage of pulp stones to produce pure streptococci upon culture. Consequently, it has been proposed that microorganisms are the reason for pulp calcifications.
Meanwhile, the pulp of affected teeth was supposedly normal, apart from the calcification, and since it is well recognized that bacteria could be enforced into the pulp tissue during tooth extraction, it is most dubious that bacteria have any impact on the development of these pulp stones (Stafne and Szabo) (11). Data indicate that no clear-cut relation exists between any of these conditions and pulp calcification.
Sundell et al. (12) studied whether the degree of pulp response stimulated by the cutting procedures and restorative materials could aggregate the frequency of pulp nodules and pulp stones. They found no significant correlation of pulp stones or nodules to patient's age and gender. They also found no correlation with the thickness of the remaining dentine underneath the cavity preparation, the time of the preparation, or the traumatic effect of the operative procedures. Furthermore, Sundell et al. suggested a combination of numerous theories from the literature, including thrombosis of vascular wall injury initiating pulp stone formation. An innovative theory is that the development of a true stone is caused by the enclosure of remnants of epithelial root sheath inside the pulp. These remnants stimulate the pulp cells to differentiate into odontoblasts, which will form dentine masses called pulp stones (13). Thenceforth we have secondary and tertiary dentine.
Secondary dentine is formed after the development of the root. Secondary dentine usually forms after tooth eruption and is completely functional. Secondary dentine grows at a significantly slower rate than primary dentine, but maintains its incremental growth trait. Secondary dentine has a similar structure to primary dentine. On the other hand, its deposition is not consistently uniform around the pulp chamber. Lastly, tertiary dentine is a dentine created from a reaction to external stimuli, particularly carious cavities and consistent wear. It can be either reactionary or reparative (14,15).
The presence of pulp stones or calcifications from secondary or tertiary dentine is significant as they reduce the total number of cells inside the pulp and act as an obstacle to debridement and preparation of the root canal system during endodontic treatment (16,17). These calcifications can partially or completely close the endodontic space, complicating or preventing orthograde endodontic treatment. When a root canal is completely calcified, the use of the operating microscope and ultrasonic tips, makes it possible to remove calcifications and continue treatment (18,19). However, the deeper the calcification, the higher the risk of creating iatrogenic damage. Furthermore, if we do not use magnification, light, and ultrasonic tips, the risk of creating damages increases. For this reason, if, through a high-resolution 3D CBCT examination, it is possible to see a calcification in the apical third, and in such cases it is advisable to perform surgical endodontics (19).
With the operating microscope's help, it is possible to carefully examine the dentine and precisely notice the calcifications as having a different color than that of the dentine. With the great aid of ultrasonic tips, it is possible to remove calcifications without causing iatrogenic damage, and then it is possible to continue the treatment by performing shaping, 3D cleaning, and 3D obturation and predict success in the short and long term (20-23).

## CONCLUSIONS

The positive results highlighted by the cases reported demonstrate how the use of modern technologies, operating microscope, ultrasonic tips, 3D CBCT, new generation rotary files, systems enhancing cleansing, and methods used to obtain a valid three-dimensional seal, are essential to avoid iatrogenic damage and ensure safe and reproducible results.

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### Conflicts of interest
The authors declare no conflict of interest.

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