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CASE REPORT

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Maxillary Permanent Canine with One Root and Three Canals: A Case Report

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Abstract

Typically, the maxillary canine possesses a single root and a single root canal. However, anatomical variations have been documented in several in vitro and in vivo studies. The presence of two roots and two canals in maxillary canines is rare, and the occurrence of three canals within one root is even more exceptional. Dentists must have comprehensive knowledge of root canal morphology and its potential variations to ensure successful treatment outcomes. This report presents a rare case of a maxillary canine with one root and three canals. Accurate diagnosis of such uncommon anatomical variations is crucial for the success of endodontic therapy.(**International Journal of Biomedicine. 2025;15(4):763-766.**)

Keywords: maxillary permanent canine • root canal • anatomical variation

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Introduction

Understanding the root canal morphology of teeth is vital for achieving successful endodontic treatment. One of the primary reasons for root canal treatment failure is the inability to detect and properly manage additional canals.[1,2]

Vertucci classified human permanent tooth canal systems into several configurations, ranging from one to three distinct canals.[3] While the maxillary canine typically has one root and one canal,[4] anatomical variations, such as additional roots or canals, have also been reported.

Several cases in the literature have documented maxillary canines with two canals.[5,1,6] Asiry[7] reported the presence of two distinct roots (mesial and distal) in a permanent maxillary canine, emphasizing bilateral differences.

Furthermore, Uchiyama et al.[8] studied 250 extracted maxillary canines in vitro, revealing accessory canals in 40% of the specimens, many of which were difficult to access and treat. Reports describing three-canal maxillary canines remain extremely rare. Vertucci's Type III configurations[3] in maxillary canines are scarcely documented.

The etiology behind such anatomical anomalies is not well understood. Hypotheses include differential development of Hertwig's epithelial root sheath trauma,[9] disturbances in morpho-differentiation,[10] genetic factors,[11] or defects in the dental lamina during root formation.[12]

In the past, various methodologies used to study canal anatomy were histopathological studies,[13] intraoral periapical radiographs, cleaning and demineralizing method,[14] and surgical operating microscopy.[15]

Various methodologies have been employed to study canal morphology, including histological analysis,[13] radiographic imaging, canal staining and clearing, and cone-beam computed tomography (CBCT). CBCT offers non-invasive, three-dimensional imaging and is now considered a valuable tool for detecting rare root canal variations.[16,17]

There were limited studies in the literature evaluating the root and canal morphology of canine teeth in different populations using CBCT.[3,18,19]

The objective of this case report is to present and analyze a rare anatomical variation of a maxillary canine with one root and three distinct canals using CBCT imaging.

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Materials and Methods

A 46-year-old male patient presented with spontaneous, sharp pain in the region of the upper jaw at the Department of Endodontics, University Dental Clinical Center of Kosovo. Clinical examination revealed a deep carious lesion. According to the patient's history, the pain began a week prior, with episodes lasting 20–30 minutes, followed by one-hour intervals. Cold stimuli exacerbated pain. The tooth was not sensitive to percussion, and vitality testing was positive.

Radiographic examination included a periapical radiograph (Sirona Siemens, Germany) and 3D CBCT imaging (Orthophos SL, Dentsply, Sirona, Germany). No anatomical abnormalities of the pulp chamber were detected in the conventional radiograph (Figure 1).

Fig. 1. *Retro-alveolar radiograph with only one root canal.*

Local anesthesia was administered using Articaine HCl 4% with Epinephrine 1:100,000 (Septocain, Septodont, France). Rubber dam isolation was applied, and the access cavity was prepared. Upon entering the pulp chamber, three distinct canal orifices were observed: one palatal and two buccal (mesiobuccal and distobuccal), confirmed radiographically using 3D CBCT. After the instrumentation of the tooth root canals, a 3D radiographic scan (cone beam computed tomography, CBCT) was performed to assess the condition of the canals more accurately. The 3D radiographic scan revealed three entrances to root canals within the pulp chamber. (Figures 2,3,4)

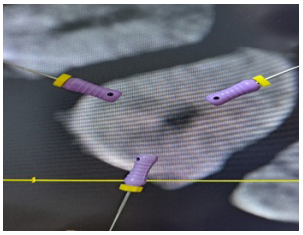

Fig. 2. *Localization of the root canal orifices of the maxillary canine.*

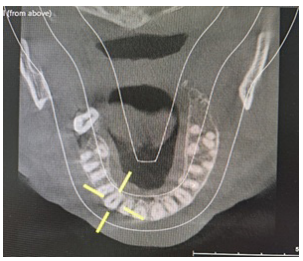

Fig. 3. *The canine in the axial projection.*

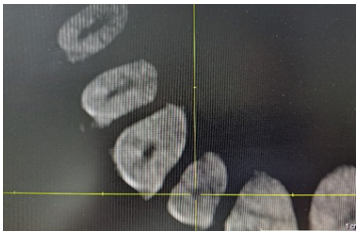

Fig. 4. *The canine in the tangential projection.*

After 3 D radiographic scan, working lengths were determined with an apex locator (DentaPort, Morita, Japan): 19.24 mm for the palatal canal, 17.97 mm for the disto buccal canal, and 15 mm for the mesiobuccal canal. The canals were instrumented with a rotary system (Endo Smart Cordless Endo Motor, Germany). Irrigation was performed with 2.5% sodium hypochlorite (Chlorax, Cerkamed, Poland) to remove organic tissue, followed by 17% EDTA (I EDTA, Lithuania) for one minute to eliminate inorganic components. Final irrigation was done with 0.9% saline solution (NaCl, B. Braun, Germany).

After drying with absorbent paper points (Korea), a trial obturation was performed using gutta-percha cones to confirm the presence of the canal (Figure 5).

Fig. 5. *Test radiograph with gutta-percha.*

Then, the canals were obturated using a bio-ceramic sealer (One-Fil, Korea), confirmed with a final radiograph (Figure 6).

Fig. 6. *Root canal obturation.*

The patient, residing abroad, was monitored remotely at 1, 3, and 12 months post-treatment. No symptoms or complications were reported during the follow-up period.

Discussion

Maxillary canines typically present with one root and one canal, making this case of a single-rooted tooth with three canals a rare anatomical variant.

During the discussion of this presentation, there is one aspect to consider: the presence of unusual morphology in the maxillary canine with one root and three canals.

Our presentation aligns with the clinical research of Supritha et al., who also reported the presence of a permanent maxillary canine with one root and three canals (buccal, mesiobuccal, and palatal).[20]

Such configurations are difficult to detect in conventional radiographs due to two-dimensional limitations.[21] Multi-angled radiographic views and advanced imaging, such as CBCT, are vital tools for accurately diagnosing such complex cases.[22]

Only a few cases have been described in the literature regarding the maxillary canine with three canals based on Vertucci classification.[23]

Kandasamy et al. also reported a maxillary canine with three roots and three canals, considered the first of its kind.[24] Galhotra et al.[25] and Bolla & Kavuri[26] reported multirooted variations in maxillary canines, while Wolf et al. estimated that three canals in maxillary canines occur in just 0.1–0.2% of cases.[27]

Studies by Martins et al.[28] and Masyakhy[29] suggested that 1.4% of maxillary canines may contain two canals, emphasizing the rarity of three canal occurrences. Further highlighted were accessory canals found in 40% of maxillary canines in vitro, many of which were inaccessible for proper cleaning and shaping.[8]

These anatomical deviations may arise from multiple factors, including abnormal root sheath development,[9] trauma,[10] genetic predisposition,[30] and disturbances during root formation.[12]

Given these complexities, CBCT is essential when conventional imaging is inconclusive. It provides accurate, three-dimensional insight into canal configurations, helping to ensure complete cleaning and obturation.[16,17]

Conclusion

Anatomical variations in the maxillary permanent canine, including the presence of one root and three canals, are extremely rare but clinically significant. Precise identification of such anomalies is critical for effective endodontic treatment. While conventional radiographs remain useful, cone-beam computed tomography should be employed in cases where anatomical complexity is suspected or when standard imaging proves inadequate. Accurate diagnosis and management of these unusual cases can significantly enhance the success of root canal therapy.

Conflicts of Interest

The authors declare that they have no competing interests.

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