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CASE REPORT

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# Treatments of dentition with four dens evaginatus and reverse overbite: a case report with a 6-year follow-up

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## Abstract

**Background** Dens evaginatus is a dental anomaly characterized by a conical cusp or tubercle on the occlusal surface. It is generally believed to be caused by the protrusion of the dental papilla toward the enamel organ during odontogenesis, followed by the formation of enamel, dentin, and dental pulp. Owing to the abrasion of the occlusal surface, the protrusive cusp will be quickly worn off, uncovering the dental pulp tissue and thereby giving rise to pulpal or periapical disorders in the affected tooth. Abnormal occlusion can also exert an impetus in facilitating the wear process of dens evaginatus.

**Case presentation** This article presents a case of a patient possessing dens evaginatus on four first premolars, leading to diverse consequences such as abnormal abrasion, acute apical abscess and periapical cysts. The patient also exhibited reverse overbite on the left side dentition, which potentially accounted for the varying degrees of wear on the dens evaginatus. Regarding teeth with different disorders, we had attained favorable therapeutic outcomes through various approaches including progressive grinding, root canal treatment, and periapical surgery, and had conducted follow-up for 6 years. The results indicated that the treatment effects were stable and the teeth functioned properly.

**Conclusion** This report demonstrates effective therapeutic approaches for the diverse clinical manifestations resulting from dens evaginatus, and suggests that if a tooth was found with dens evaginatus during intraoral examination, other corresponding teeth should also be examined carefully. Occlusion anomalies may exert a promotional effect on the wear of the deformed central cusp.

**Keywords** Dens evaginatus, Premolar, Apical periodontitis, Reverse overbite

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## Background

Dens evaginatus, also known as central cusp deformity, is a dental developmental anomaly characterized by a conical cusp or tubercle centrally located on the occlusal surface [1–3]. It is generally believed that this condition results from the protrusion of the dental papilla toward the enamel organ during tooth development, subsequently leading to the formation of a deformed cusp composed of dental tissues including enamel, dentin, and pulp [2]. It is commonly observed in mandibular premolars, occasionally in maxillary premolars, and rarely in molars [2–3]. Due to occlusal surface abrasion, the protruding structure can be rapidly worn off, exposing the pulp that extends into the cusp and leading to non-cariogenic pulpal or periapical disorders. Clinically, if a patient's teeth, particularly the mandibular premolars, exhibit no evident caries or periodontal destruction but present with pulpal or periapical lesions, for instance the spontaneous pain and discoloration in this case, the possibility of dens evaginatus should be considered. The treatment for pulpal and periapical disorders resulting from the fracture of dens evaginatus should be determined based on the degree of root development. For immature permanent teeth with incompletely formed apices, techniques such as apexification and apical barrier technique followed by root canal treatment or regenerative endodontic procedures (REPs) can be employed to promote apical foramen formation. For mature permanent teeth, treatment approaches include root canal therapy and periapical surgery, depending on the specific circumstances [4–7]. This article reports a case of four first premolars exhibiting dens evaginatus, resulting in varying clinical manifestations, and have been successfully treated through different therapeutic approaches. The 6 years follow-up presents asymptomatic teeth.

## Case presentation

A 24-year-old female presented to the Department of Endodontics at Shandong Provincial Stomatological Hospital with a chief complaint of spontaneous and occlusal pain in the area of right mandibular first premolar for 2 days. The patient's medical history was noncontributory. Extraoral examination revealed no obvious abnormality (Fig. 1F). Intraoral examination revealed a caries-free dentition with reverse overbite on the left side (Fig. 1C-D). It is noteworthy that dens evaginatus was observed on the occlusal surfaces of four first premolars (tooth #5, #12, #22, #28) in this dentition (Fig. 1A-B). Tooth #28, the chief complaint one, was tender to percussion and palpation. The mobility was in normal limits. Pulp sensitivity test with cold spray was negative, and periodontal probing did not show any deepened pocket. A sinus tract was visible on the lingual apical mucosa of the tooth, accompanied by notable swelling and tenderness upon palpation (Fig. 1G). Radiographic examination using panoramic (Fig. 1E) and periapical (Fig. 2A) radiography revealed a distinct periapical radiolucency. Based on the patient's clinical presentation and radiographic examination, tooth #28 was diagnosed with acute apical abscess. Tooth #5 was tender to percussion and palpation, and had normal tooth mobility. Pulp sensitivity test with cold spray was negative and periodontal probing indicated normal findings. The surrounding gingiva exhibited normal coloration and no apparent swelling. Radiolucency was found in the periapical area with a dense white line around it. The diagnosis of tooth #5 was periapical cyst.

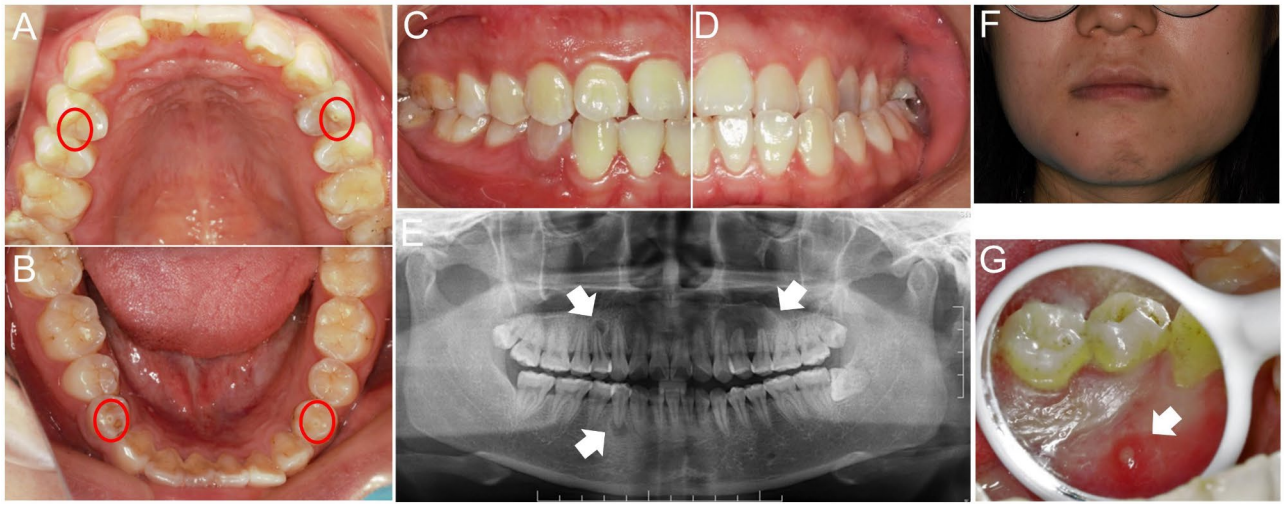


**Fig. 1** **A-F** Preoperative photographs and radiographs. (**A**&**B**) Positions of dens evaginatus (indicated by red circles). (**C**&**D**) Reverse overbite of posterior teeth. (**E**) Panoramic radiograph and periapical radiolucency (indicated by white arrows). (**F**) Front picture of the patient. (**G**) A sinus tract on the lingual apical mucosa of tooth #28 (indicated by the white arrow)

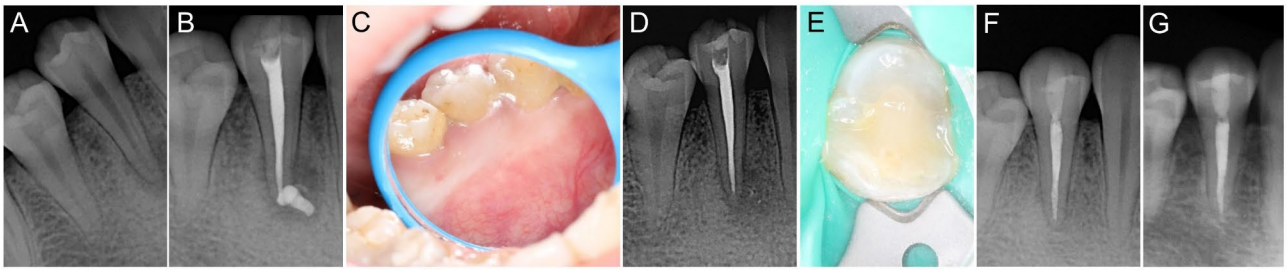


**Fig. 2** **A-G** Treatment process of tooth #28. (**A**) Preoperative radiograph. Tooth #28 showed periapical radiolucency. (**B**) Root canal filled with vitapex. (**C**) One week after using calcium hydroxide paste for root canal disinfection. The sinus tract has disappeared. (**D**) Radiograph after root canal filling. (**E**) Composite resin restoration. (**F**) 6-month follow-up. The lesion had almost healed. (**G**) 6-year follow-up. The situation was stable

**Table 1** The treatment process for each affected tooth

| Tooth | Treatment |
|---|---|
| #28(chief complaint tooth) | Abscess drainage, root canal treatment and composite resin restoration. |
| #5(with periapical cyst) | Root canal treatment and composite resin restoration. |
| #12(with maxillary cyst) | Root canal treatment, composite resin restoration and apical surgery |
| #22(asymptomatic tooth) | Gradual reshaping of the malformed central cusp |

Discoloration was observed on tooth #12 (Fig. 1D). It was tender to percussion and palpation with grade 1 mobility. Pulp sensitivity test with cold spray was non-responsive and no obvious abnormality was observed in the surrounding gum. The panoramic radiograph showed an extensive area of radiolucency surrounded by a dense white line in the periapical area (Fig. 1E). CBCT scan confirmed that and revealed continuous cortical bone plate (Fig. 4A-C). The diagnosis of tooth #12 was periapical cyst. Tooth #22 had no significant tenderness upon percussion or palpation, normal tooth mobility, and negative response to pulp sensitivity test. Periodontal probing results were within normal limits. The panoramic radiograph revealed no significant abnormality. Tooth #22 was diagnosed with dens evaginatus.

The treatment process for each affected tooth is listed in Table 1. For tooth #28, after isolated with a rubber dam, the access cavity was prepared and purulent discharge was observed upon opening. Following the copious irrigation (more than 10mL) of the root canal with 1% sodium hypochlorite solution (NaOCl; Longly Biotecnology, Wuhan, China), a sterile cotton pellet was placed in the pulp chamber to maintain open-drained access. The patient was instructed to avoid chewing on the affected side and to return for a follow-up appointment in 3 days. At the second visit, the patient reported that the spontaneous pain had disappeared. Intraoral examination revealed significant alleviation of gingival swelling and no more purulent pus discharged from the pulp chamber. The tooth was re-isolated and working length determination was completed using an electronic apex locator (Reborn Endo, China) and #10 K-file (Dentsply, Switzerland). #10, #15 and #20 K-files reached working length respectively as the root canal filling with 1% sodium hypochlorite solution. Nickel-titanium rotary files (ProTaper, Dentsply, Switzerland) up to F3 were used by an electric endomotor (Woodpecker, China) for root canal preparation. Irrigation was performed alternately with 1% sodium hypochlorite solution and 17% ethylenediaminetetraacetic acid (EDTA; Longly Biotechnology, Wuhan, China) between each instrument. Calcium hydroxide paste (Longly Biotechnology, Wuhan, China) was placed as an inter-appointment medicament for 1 week and the access cavity was temporarily sealed with glass ionomer cement (GIC; 3 M ESPE, Seefeld, Germany). At the 3rd follow-up appointment, the sinus tract was not present (Fig. 2C). After removing the temporary restoration and calcium hydroxide paste with 1% sodium hypochlorite irrigation, the root canal was filled with vitapex (Morita, Japan) and the coronal temporary restoration was finished with GIC again (Fig. 2B). The patient presented 2 months later and was asymptomatic. After re-isolation and removal of the temporary filling material, the root canal was thoroughly cleansed with copious 1% sodium hypochlorite solution and subsequently dried with sterile paper points. A trial fitting of the master gutta-percha cone was confirmed by a periapical radiograph. Then the gutta-percha cone was placed into the root canal with a small amount of AH Plus sealer (Dentsply, Switzerland) on its tip. The root canal filling was completed using the continuous wave obturation technique to achieve a dense and precise filling (Fig. 2D). And the access cavity was finally restored using the universal composite resin (3 M ESPE Filtek™, Germany) (Fig. 2E). Follow-up at 6 months (Fig. 2F) and 6 years (Fig. 2G) showed that tooth #5 remained asymptomatic and was not sensitive to percussion or palpation.

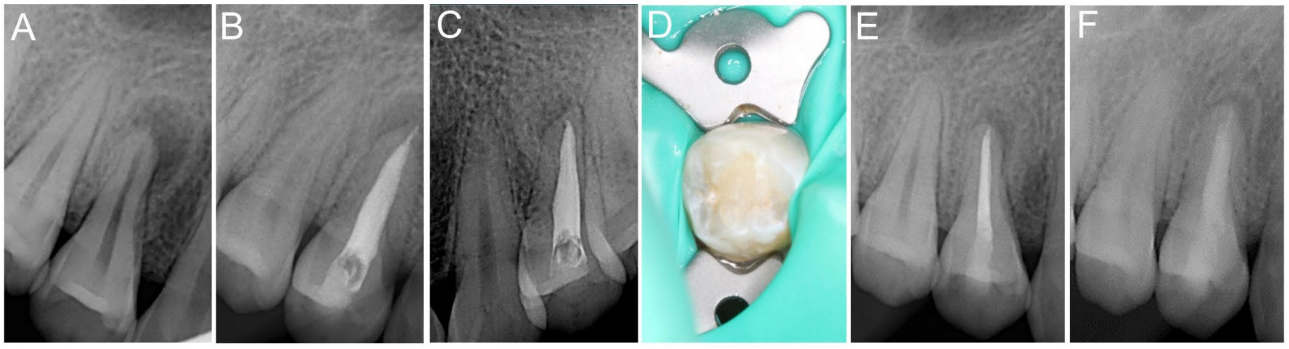


**Fig. 3** **A-F** Treatment process of tooth #5. (**A**) Preoperative radiograph. Tooth #5 showed periapical radiolucency. (**B**) Root canal filled with vitapex. (**C**) Radiograph after root canal filling. (**D**) Composite resin restoration. (**E**) 6-month follow-up. The lesion had almost healed. (**F**) 6-year follow-up. The situation was stable

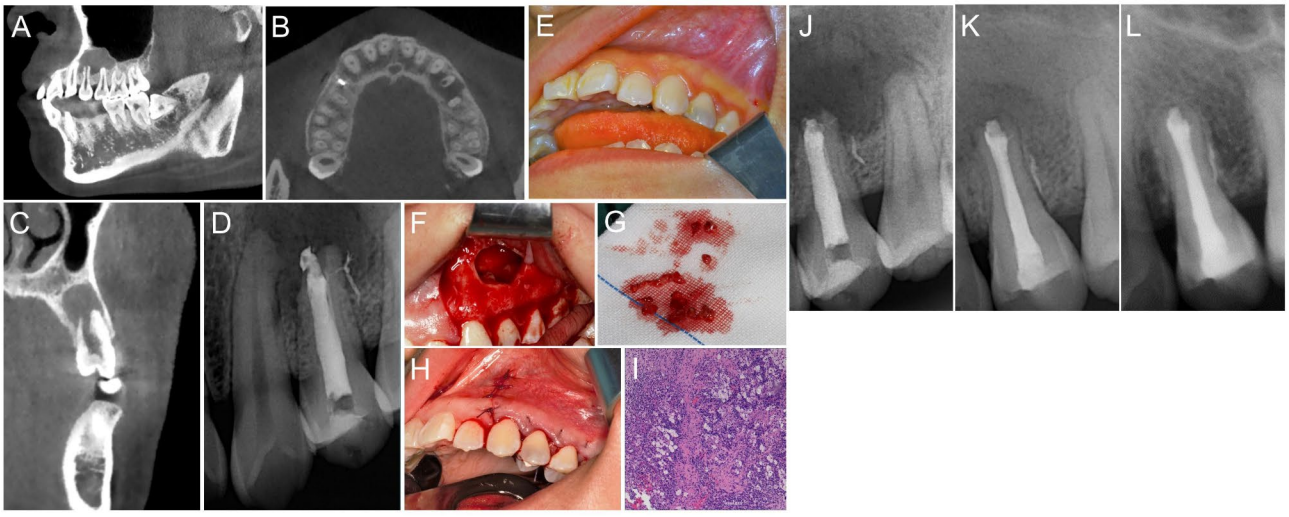


**Fig. 4** **A-L** Treatment process of tooth #12. (**A**-**C**) Preoperative CBCT scan. Tooth #5 showed periapical radiolucency and continuous cortical bone plate. (**D**) Root canal was filled with heated gutta percha. (**E**-**H**) The cyst enucleation. (**I**) Histological examination revealed extensive infiltration of lymphocytes and multinucleated giant cells. (**J**) 2-week follow-up. (**K**) 6-month follow-up. The lesion had almost healed. (**L**) 6-year follow-up. The lesion had completely healed

As for tooth #5, after rubber dam isolation and access cavity preparation, the working length was determined using #10 K-file and electronic apex locator. The root canal was sequentially prepared with #10, #15, #20 K-files, followed by ProTaper nickel-titanium rotary files up to F3 driven by an endodontic motor. Irrigation was performed alternately with 1% sodium hypochlorite solution and 17% EDTA between each instrument. After final irrigation and being dried with sterile paper points, the root canal was dressed with calcium hydroxide paste (Longly Biotechnology, Wuhan, China) for 1 week before replacing it with vitapex (Fig. 3B). GIC was used as a temporary filling material to seal the cavity. The patient presented 2 months later and was asymptomatic. Following the irrigation and drying process, the root canal filling was completed using the continuous wave obturation technique (Fig. 3C). The universal composite resin was used for permanent coronal restoration (Fig. 3D). Follow-up at 6 months (Fig. 3E) and 6 years (Fig. 3F) showed that tooth #5 remained asymptomatic and stable.

For tooth #12, due to the extensive periapical destruction and flared apex (Fig. 4A-C), we opted for a combined approach of root canal treatment and periapical surgery following the patient's consent. The access cavity was prepared under rubber dam isolation, followed by root canal preparation and thorough irrigation with 1% sodium hypochlorite solution and 17% EDTA as periodic alternative. An ultrasonic file (Satelec, France) was introduced into the root canal to activate the irrigation solution. After drying with sterile paper points, the root canal was obturated with heated gutta-percha (Fig. 4D), and the crown was temporarily sealed with glass ionomer cement. One day later, the operation of cyst enucleation, apicoectomy and retrograde filling utilizing Mineral Trioxide Aggregate (MTA; Dentsply, Switzerland) of the affected tooth were carried out under local anesthesia

(Fig. 4E-H). After curettage of the cyst, the lesion was sent for histological analysis that confirmed the diagnosis of periapical cyst (Fig. 4I). The final coronal restoration was finished with universal composite resin 2 weeks later. The 2-week follow-up periapical radiograph showed alleviated lesion (Fig. 4J), and the 6months follow-up showed that the periapical lesion had almost healed (Fig. 4K). The 6-year follow-up showed that the lesion had completely healed (Fig. 4L).

Due to the absence of apparent symptoms or periapical radiolucency related to tooth #22, we carried out progressive grinding on the malformed central cusp in order to reduce the risk of fracture or wear that could lead to corresponding clinical symptoms. The 6 months and 6 years follow-up showed no abnormality.

## Discussion and conclusion

Dens evaginatus is a dental anomaly and primarily affects individuals of Asian descent [8]. It mostly manifests in mandibular premolars, with occurrences in maxillary premolars and molars being relatively rare. This article presents a case involving all four first premolars affected by dens evaginatus, resulting in diverse clinical manifestations. Each tooth was successfully managed using different treatment approaches and 6-year follow-up demonstrated stable outcomes.

Further investigation is required to elucidate the reasons for the varied clinical presentations observed in the four premolars. We hypothesize that these differences may be associated with the patient's reverse overbite on the left side of the dental arch. Specifically, malocclusion may result in significantly greater occlusal wear on teeth #5, #12, and #28 compared with tooth #22. This increased wear predisposes the malformed cusps of the former three teeth to fracture, subsequently leading to pulp exposure and periapical lesions. Conversely, tooth #22 exhibits relatively mild clinical symptoms. In addition, the varying distribution of malformed cusps and the differences in contact points between the upper and lower jaw teeth may also influence this process.

It is currently recommended that for teeth with periapical infection, permanent crown restoration should be deferred for at least one week following root canal filling. Therefore, in this case, permanent crown restorations for teeth #5 and #28 were performed 2 weeks after root canal obturation. A tight occlusal seal is a crucial factor for the success of root canal treatment. For posterior teeth with intact cavity walls, composite resin restoration or inlays can be considered following root canal therapy. In this case, given that the carious lesion on the occlusal surface was relatively small and featured four intact walls, we ultimately opted for a composite resin restoration. The 6-year follow-up results demonstrated that the composite resin filling remained in excellent condition.

Based on the panoramic radiograph and cone-beam CT scan results, the periapical cyst associated with tooth #12 has extended to the periapical regions of teeth#11 and #13. However, given that the pulp sensitivity test indicated normal pulp vitality in these two teeth, root canal treatment was not deemed necessary. The long-term retention of the pulp will depend on the outcomes of subsequent follow-up result. During the 6-year follow-up period, no significant abnormalities were detected in these two teeth, providing valuable reference for the management of extensive periapical lesions in the future practice.

Throughout the treatment process, the patient has not yet made a decision regarding orthodontic intervention to correct the recurrent overbite. Therefore, we will continue to monitor this case. Should the patient opt for orthodontic treatment, we will closely assess its impact on the first premolars, particularly any potential root remodeling and resorption following root canal and periapical therapies.

It is noteworthy that recent studies have demonstrated an association of dens evaginatus between posterior teeth and lateral incisors [2, 9–15]. Therefore, it is imperative to consider this potential co-occurrence during clinical examination. When diagnosing dens evaginatus in premolars or molars, clinicians should carefully evaluate the lateral incisors as well to ensure a comprehensive diagnosis.

In conclusion, in clinical practice, it is imperative to identify and manage dens evaginatus as soon as possible to minimize the risk of pulpal and periapical lesions. Given the symmetrical distribution of dens evaginatus and the documented correlation between anterior and posterior teeth, a thorough intraoral examination of all related teeth is essential. When such lesions do occur, the treatment plan should comprehensively consider the pulp status, degree of root development, patient compliance, and economic factors to ensure the selection of the most appropriate therapeutic strategy. Concurrently, clinicians should focus on identifying and eliminating the factors that promote lesion progression.

### Abbreviations

CBCT Cone beam computed tomography

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### Author contributions

XW and QW contributed to the oral examination and clinical treatment of the patient. ML prepared the manuscript. YF and QW helped to draft the manuscript. All authors were actively involved with their work on this manuscript. All authors read and approved the final manuscript.

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**Data availability**
The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

## Declarations

**Ethics approval and consent to participate**
Not applicable.

**Consent for publication**
Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

**Competing interests**
The authors declare no competing interests.

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