Mandibular Osteonecrosis Involving Tooth Germ in Children: a Rare Case Report with a 6-year Follow-up

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Osteonecrosis involving the permanent tooth germ in primary dentition is a rare condition that can affect dental and maxillofacial development without correct intervention. This case report presents the successful recovery from drug-induced mandibular osteonecrosis involving the permanent tooth germ in a child. A healthy 4-year-old Chinese girl visited the clinic with an unhealed gingival wound and alveolar bone exposure of the missing primary molar area after 1-day arsenic trioxide sealing during pulp therapy. Radiographic examinations indicated inflammation and sequestrum formation in the jaw. The diagnosis was mandibular osteonecrosis. The treatment plans involved sequestrectomy without extended curettage and removal of the affected permanent tooth germ with systemic antibiotic therapy. A 6-year follow-up revealed no recurrence of the lesion or complications, a gradual increase in bone density of the osteonecrosis area and the development of adjacent permanent tooth germs. A conservative treatment regimen without extended curettage may be an option for young patients with jaw osteonecrosis.

Keywords: *arsenic trioxide, deciduous teeth, osteonecrosis, sequestrectomy, tooth germ*
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Osteonecrosis in children is commonly associated with infection, trauma, radiotherapy, metastatic disease or drugs.[1,2] Due to its low incidence, there is a paucity of data on the long-term effects of osteonecrosis on dental and maxillofacial development in children.[3] It is also important to note that paediatric skeletons not only possess a thicker overlying periosteum and greater osteogenic remodelling potential than adult bone, but also contain a unique structure of permanent tooth germs in the jaws.[4] These physiological differences between paediatric and adult skeletons prevent the direct application of treatment options for adults in children.[5]

Involvement of permanent tooth germ in paediatric jaw osteonecrosis is rare. There has been only one report of Mycobacterium abscessus-induced osteonecrosis, in a 3-year-old American patient.[6] To the best of the present authors' knowledge, this is the first case of drug-induced mandibular osteonecrosis involving the permanent tooth germ in a child. This case is presented following the CAse REport (CARE) Reporting Checklist.

Case presentation

A 4-year-old Chinese girl with an unhealed wound affecting the primary mandibular right first molar visited the Department of Pediatric Dentistry, Shanghai Ninth People's Hospital affiliated with Shanghai Jiao Tong University School of Medicine in 2016. Five months prior, arsenic trioxide had been sealed into the chamber of the affected tooth during pulp therapy in a private clinic. The patient experienced severe gingival pain and swelling 1 day after sealing, so the private dental practitioner removed the substance, perfored resealing with calcium hydroxide and prescribed cefaclor postoperatively. Al-

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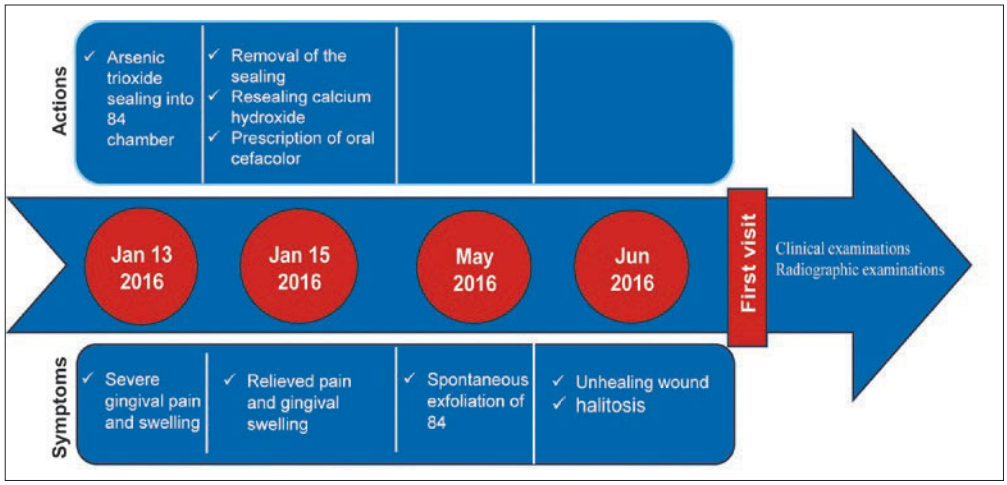

Fig 1 Timeline illustrating the progression of the case.

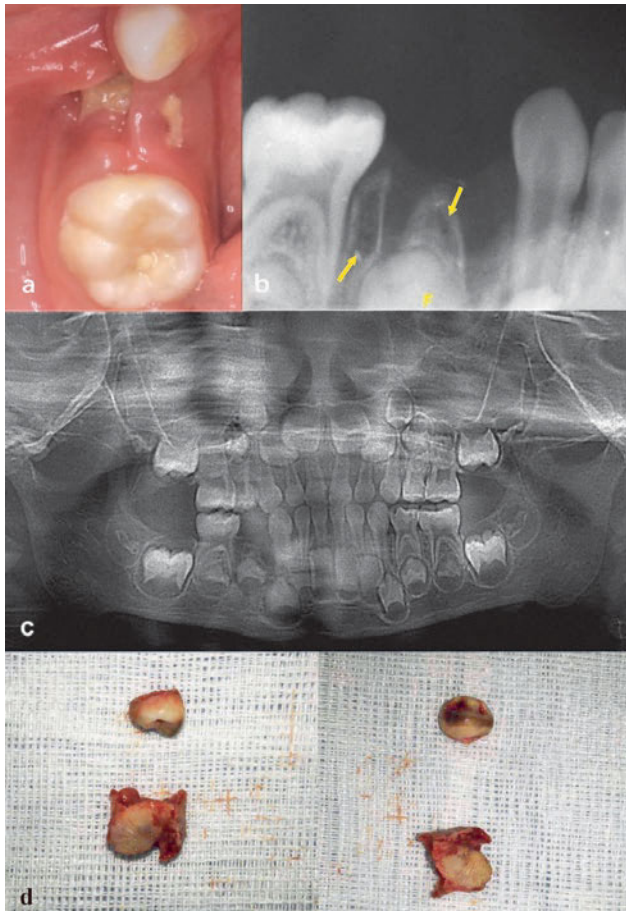

Fig 2a to d Clinical oral examination and radiographic findings at the first visit. Exposed alveolar bone in the primary mandibular right first molar area (white arrows) **(a)**. Periapical radiograph of the radiolucent lesion in the primary mandibular right first molar alveolar bone (yellow arrows) **(b)**. Panoramic radiograph demonstrating radiolucent lesion in the primary mandibular right first molar alveolar bone and the areas surrounding the permanent mandibular right first premolar (blue arrows) **(c)**. Removed sequestrum and permanent mandibular right first molar tooth germ **(d)**.

though the pain and swelling were relieved, the affected tooth fell out spontaneously 1 month before the follow-up examination. The wound remained unhealed and the patient complained of halitosis. The timeline demonstrating the progress of this case is presented in Fig 1.

According to previous medical history and blood testing, the young patient was healthy with no known allergies, systemic diseases or other medications. There was no family history of immunodeficiency disorders.

Clinical oral examinations further revealed poor healing of the socket with alveolar bone exposure in the primary mandibular right first molar area (Fig 2a), and the exposed bone fragment was loose. No fistulae existed in the adjacent mucosa or skin. No other teeth were particularly tender to percussion, and all teeth had a response to dry ice stimulation.

For radiographic examinations, the density of the mandibular right alveolar bone decreased in the periapical radiograph (Fig 2b), and the panoramic radiograph revealed a radiolucent demarcation line between the alveolar socket of the extracted primary mandibular right first molar and permanent mandibular right first premolar germ (Fig 2c).

The clinical diagnosis of arsenic trioxide–induced osteonecrosis was made based on the history of arsenic trioxide sealing, symptom of halitosis, clinical finding of sequestrum and radiographic finding of decreased local bone density. The patient was then referred to the Department of Oral and Maxillofacial Surgery.

The young girl was prescribed a 3-day course of cefaclor and scheduled for a sequestrectomy under general sedation. After the gingiva surrounding the exposed alveolar bone was separated, the loose greyish yellow sequestrum was gently removed with a vascular clamp, and the underlying permanent right mandibular first premolar germ was exposed with a dark yellow

appearance, surrounded by granulation, and detached from the surrounding bone (Fig 2d). Based on the preoperative radiographic examination and changes observed in the colour and mobility of the permanent premolar germ, the surgeon informed the patient's parents that the premolar germ may be affected by arsenic trioxide. After obtaining consent for removal of the germ, the affected tooth germ and granulation tissues were scraped, and the wound was irrigated with chloramphenicol. Histological examination of the removed sequestrum was not performed due to parental refusal.

The postoperative period was uneventful. A soft diet was recommended for the first week, and the patient was prescribed 60 mg cefaclor three times daily for the next 2 weeks after being discharged from hospital. The patient was recalled 1 week later to remove the stitches. Red and swollen gums were observed in the operative area (Fig 3a), so oral hygiene instructions were delivered. One month after surgery, painless healing was confirmed by clinical examination (Fig 3b).

Due to the removal of the permanent tooth germ, two treatment options were considered: maintaining the missing tooth space or allowing mesial movement of the distant molars. The details of each option were explained thoroughly, and the patient's parents chose the latter treatment plan, which involved monitoring the inclination and elongation of adjacent primary teeth, healing of alveolar bone in the operative area and development of adjacent permanent tooth germs.

At the 6- and 12-month follow-ups, intraoral examinations revealed that the primary mandibular right canine and second molar maintained their upright position, whereas the primary maxillary right first molar was slightly elongated without occlusal interference. Panoramic radiographs showed increased bone density in the osteonecrosis area and the development of permanent mandibular right canine and second premolar germs (Fig 3c and d).

The patient did not attend regular appointments for personal reasons until a recent visit for a painful unexfoliated tooth 6 years after surgery. To address the painful symptoms efficiently, only a panoramic radiograph was taken at this visit. In addition to the complete root resorption of the primary maxillary right second molar, the panoramic radiograph also confirmed the complete healing of the mandibular right area and normal development of adjacent permanent teeth germs (Fig 4a). Therefore, the primary maxillary right second molar was extracted, and the patient was recalled 1 week later so the practitioner could check the wound and take intraoral photos. The mesial-distal diameter of the missing tooth area was reduced by 7 mm, with normal gingival colour and texture (Fig 4b). The intraoral examination revealed an acceptable occlusion (Fig 4c). Both the patient and her parents were satisfied with the outcome. Currently, the girl is able to engage in regular activities without any difficulties.

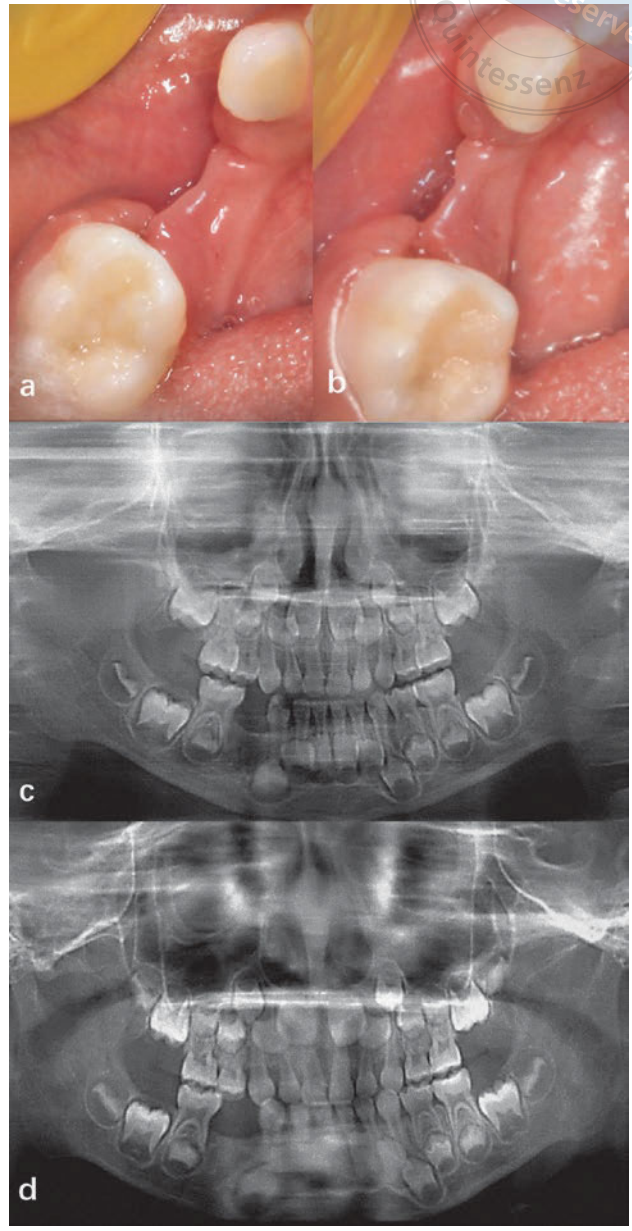

Fig 3a to d Images from 1 week and 1, 6 and 12 months after surgery. Gingival healing observed at the 1-week and 1-month follow-ups **(a and b)**. Panoramic radiographs taken 6 months and 1 year postoperatively demonstrating increased bone density of the lesion site **(c and d)**.

Fig 4a to c Clinical oral examination and radiographic findings at the 6-year follow-up. Panoramic radiograph demonstrating ingrowth of new bone structure and normal development of the permanent mandibular right canine and second premolar germs **(a)**. Complete gingival healing with decreased mesial-distal diameter in the primary mandibular right first molar area **(b)**. Acceptable occlusion of mixed dentition **(c)**.

Discussion

In this case, timely surgical intervention and conservative treatment contributed to a favourable prognosis over the 6-year follow-up period. With regard to the treatment of the involved permanent tooth germ, its removal was necessary due to infection and necrosis of the surrounding bone in reference to the only similar case.[6] The subsequent protocols for space management were formulated in reference to cases of congenitally missing teeth.[7]

Although no reports of osteonecrosis induced by arsenic trioxide used in primary teeth have been retrieved, 27 cases of topical arsenic–induced bone necrosis in permanent dentition have been reported.[8-12] The age range of patients is 14 to 60 years with a gender ratio of 4:5 (male: female). It is noteworthy that the present patient developed symptoms only 1 day after sealing, earlier than all previous cases involving permanent teeth (2 to 7 days). This result aligns with the fact that there are more accessory canals in the pulp chamber floor area of primary teeth than permanent teeth,[13] suggesting that the supporting tissues of primary teeth and their succedaneous tooth germs may be more vulnerable to arsenic leakage from the pulp chamber.

In most cases of drug-induced osteonecrosis in adults, disease-free edges should be exceeded, and healthy bleeding bones should be visible for the resection of necrotic bone, as it is difficult to determine the extent of necrosis.[14] In this case, the surgeons only removed the sequestrum without extended curettage of the surrounding bones. This decision was made based on the physiological characteristics of paediatric jaws, which are more porous, vascularised and resistant to drug invasion than the adult skeleton.[15] The optimal bone repair and normal development of the adjacent permanent tooth germ at the follow-up appointments also support this choice, suggesting that timely intervention for osteonecrosis may not interrupt maxillofacial development.

No histological results for the removed bone were obtained in this case. Although the medical history, clinical symptoms and radiographic findings of this patient all led to the diagnosis of osteonecrosis, histological evidence made it possible to exclude other pathologies.

Conclusion

This is the first case of drug-induced mandibular osteonecrosis involving permanent tooth germ in a child. The sealing of arsenic trioxide in primary teeth may cause more severe damage to the surrounding soft and hard tissues than in permanent teeth. All dental practitioners should be warned against the adverse effects of this agent and avoid using it in practice. For young patients with arsenic trioxide–induced osteonecrosis, timely re-

moval of sequestrum and other necrotic tissue without extended curettage, along with systemic antibiotic therapy, should be considered.

Conflicts of interest

The authors declare no conflicts of interest related to this study.

Acknowledgements

This study was approved by the Ethics Committee of Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine with approval number SH9H-2022-T403-1. The mother of the patient gave written consent for personal and clinical details along with any identifying images of her daughter to be published in this case report.

Author contribution

Dr Yue FEI contributed to the conceptualisation, data collection and manuscript draft; Dr Guang Yun LAI contributed to the writing and editing of the manuscript; Dr Jun WANG contributed to the supervision of the study, revision of the manuscript and funding.

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