

## CASE REPORT

# Role of inflammation in developmental odontogenic pathosis

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Received: 17-10-2014

Accepted: 16-03-2016

## ABSTRACT

Periapical infection in the primary tooth may lead to periapical abscess, granuloma, radicular cyst and even osteomyelitis. The infection in primary teeth can also affect the developing successor teeth leading to hypomineralization, hypoplasia, arrest of tooth development, regional odontodysplasia, delayed eruption etc. The purpose of this article is to report a case of malformed permanent tooth in relation to overlying infected deciduous teeth. The probable role of inflammation in pathogenesis of the present condition is also being discussed.

**Key words:** Deciduous teeth, inflammation, malformed teeth, matrix metalloproteinases, radicular cyst

## INTRODUCTION

The topographic relationship of the apices of primary tooth to the permanent tooth germ explains the potential for the possible developmental disturbances of the permanent tooth after the periapical infection in predecessors. The anatomical, histological and clinical aspects of permanent tooth malformation following periapical infection in primary teeth are described.<sup>[1-9]</sup> Anderson and Ralis studied the histological picture of periapical inflammation in deciduous teeth and concluded that the chronic periapical inflammation influences odontogenesis in permanent dentition after the period of approximately 6 weeks. Till 6 weeks, a thin fibrous barrier between inflammation zone and enamel epithelium remains as a response to short-term infection. Disturbances in odontogenesis due to the overlying inflammatory process are mediated by chemokines, interleukins, etc., which may activate the group of enzymes such as matrix metalloproteinases (MMPs). This may further lead to the destruction of the connective tissue, bone and even the malformation of successional teeth. This article presents a case of a malformed permanent tooth resulting from the infection of the overlying

deciduous tooth. It also studies the effect of inflammation on odontogenesis.

## CASE REPORT

A 4-year-old boy was referred to the department of oral and maxillofacial pathology who presented with the chief complaint of swelling in the upper left posterior region of the mouth for the last 5 months. On extraoral examination, a swelling was seen in the left maxillary region measuring approximately 3 cm × 3 cm and was roughly spherical in shape [Figure 1]. The lesion extended anteroposteriorly from the ala of the nose to the malar prominence and superio-inferiorly, from the left infraorbital ridge to the angle of mouth causing obliteration of the left nasiolabial fold. The swelling was tender on palpation.

On intraoral examination, the bony hard swelling extended anteroposteriorly from 63 to 65 and superio-inferiorly from the marginal gingiva of 63–65, 1 cm above the attached gingiva.

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**How to cite this article:** Gupta SS, Shetty DC, Urs AB, Nainani P. Role of inflammation in developmental odontogenic pathosis. J Oral Maxillofac Pathol 2016;20:164.

## Access this article online

### Quick Response Code:



### Website:

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### DOI:

10.4103/0973-029X.180986



**Figure 1:** Photograph showing extraoral swelling on left cheek region of the face

The patient presented with complete deciduous dentition. Left primary first and second molars were grossly carious and showed Grade I mobility along with slight tenderness on percussion.

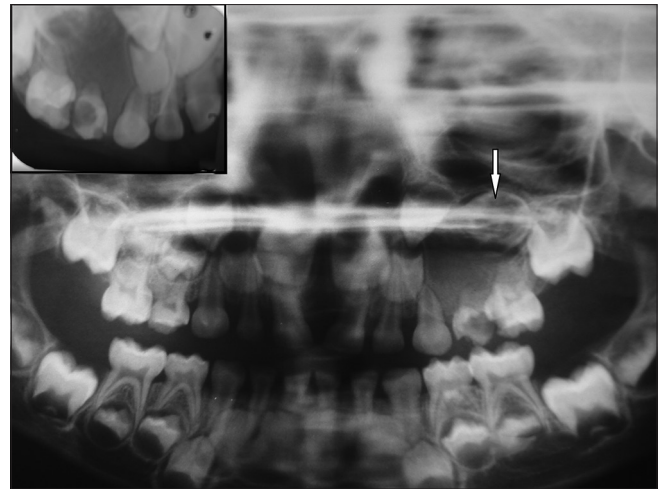
On radiological examination, a well-defined unilocular radiolucency extended anteroposteriorly from the mesial surface of 63 to the unerupted 26 and superio-inferiorly, from developing 23 to the carious 64 and 65 [Figure 2]. The radiolucency was seen in the interradicular area and around the root apices of 64 and 65. There was the presence of an oval ill-defined radio-opacity (approximately 2 cm × 1 cm) lying next to the developing 23 above the mentioned radiolucent area. Gross caries was seen in 64 and 65. There was absence of the developing tooth buds of 24 and 25.

Surgical enucleation of the lesion was performed along with the extraction of 64 and 65. The specimen was sent for histopathological examination.

The gross specimen consisted of multiple bits of soft tissue and a hard tissue [Figure 3]. The soft tissue was pinkish-gray with the largest bit measuring 2 cm × 2 cm. The whitish hard tissue measuring 7 mm × 7 mm × 8 mm in dimension resembled hollow crypt like/domed like structure. The surface of the dome-shaped hard tissue was overall smooth showing thinning in some areas and extensions at opening end. The hard tissue was surrounded by the soft tissue externally as well as internally. Both the hard and soft tissues were submitted for histopathological examination. One piece of hard tissue was subjected to ground sectioning and another for slow decalcification (using formic acid). The sections of various tissues were stained by routine H and E stain.

### Histopathology

Soft tissue surrounding the crypt - consisted of the cystic lumen, cystic lining and connective tissue capsule [Figure 4].



**Figure 2:** Orthopantomogram shows a well-defined unilocular radiolucent lesion extending from the mesial surface of 63 to the unerupted 26, absence of developing tooth bud of 24 and 25, oval radio-opacity (arrow). Intraoral periapical in the inset shows grossly carious 64 and 65

Empty lumen was lined by thin discontinuous nonkeratinized stratified squamous odontogenic epithelium showing arcade like arrangement in many areas. The sub-epithelial connective tissue was cellular constituting of small to medium sized blood vessels and numerous chronic inflammatory cells. The deeper connective tissue was fibro-cellular with collagen fiber bundles and plump fibroblasts thus confirming diagnosis of radicular cyst.

Hard tissue (crypt/dome like structure) (decalcified section and ground section): The inner thickness of the crypt showed predominant presence of longitudinal and cross cut dentinal tubules like structure [Figure 5]. Moving to the outer thickness of the crypt, areas of transversely cut dentinal tubules were seen merging with haversian canal [Figure 6]. The outermost thickness of the crypt showed predominantly lamellated bone like arrangement with the presence of concentric lamellae and haversian canals [Figure 7], thus speculating attempted tooth formation.

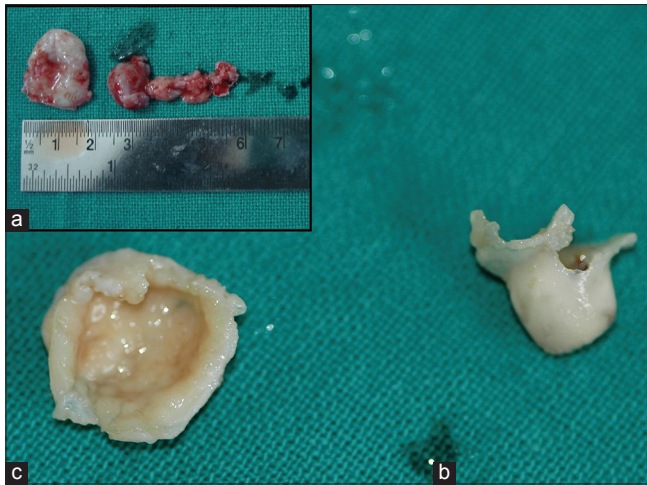
Soft tissue within the crypt: Smaller cystic lesion showed stratified squamous odontogenic epithelium; in some areas ciliated columnar cells were present. The capsule consisted of collagen fibers and loosely held elongated spindle-shaped plump fibroblasts. The presence of hemorrhagic areas was suggestive of localized degeneration [Figure 8].

Above features were suggestive of radicular cyst associated with 64 and 65 along with malformed permanent tooth.

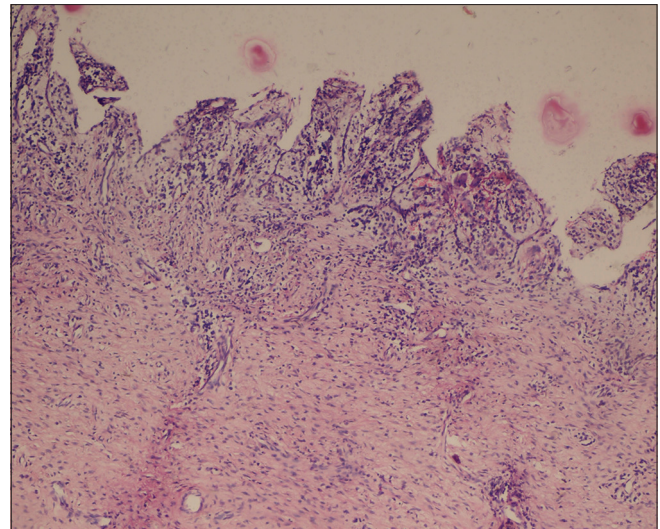
### DISCUSSION

Pulpal and periapical lesions more or less have the same course in deciduous and permanent dentition with an exemption of the fact that the permanent dentition could be

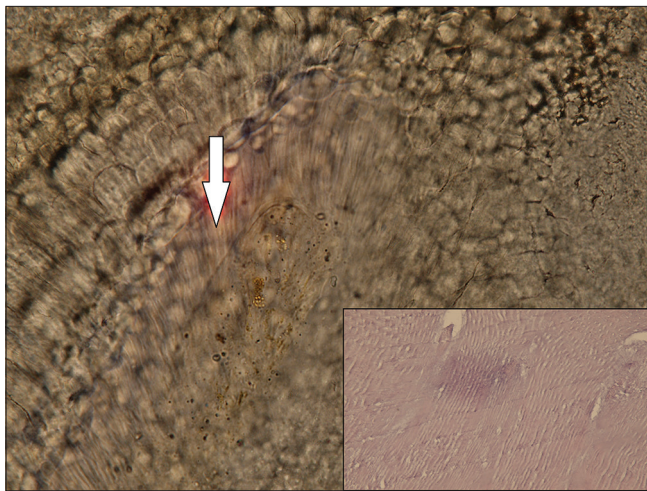




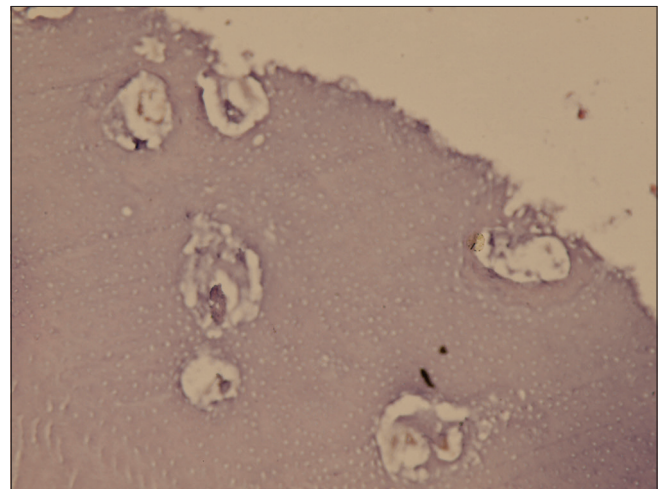
**Figure 3:** Photograph showing gross specimen consisting of (a) inset showing cystic lining, (b) crypt-like malformed tooth structure, (c) malformed tooth covered by portion of cystic lining



**Figure 4:** Photomicrograph showing cystic cavity lined by nonkeratinized stratified squamous epithelium showing arcading pattern (H&E stain, x40)



**Figure 5:** Photomicrograph showing longitudinally arranged dentinal tubules in the ground section (Ground section, x40) and inset showing dentinal tubules in decalcified section (H&E stain, x200)



**Figure 6:** Photomicrograph showing an arrangement resembling dentinal tubules merging with haversian canal (H&E stain, x100)

affected by the infection of the overlying deciduous teeth due to its physiological positioning. Pulpitis in deciduous teeth if left untreated might progress to periapical lesion ranging from acute lesions like periapical abscess to chronic lesions including periapical granuloma, periapical cyst, osteomyelitis, etc., This progression of the lesion not only depends on the virulence of micro-organism, status of immunity of the individual, local predisposing factors but also on last and the most important factor- duration of the disease.

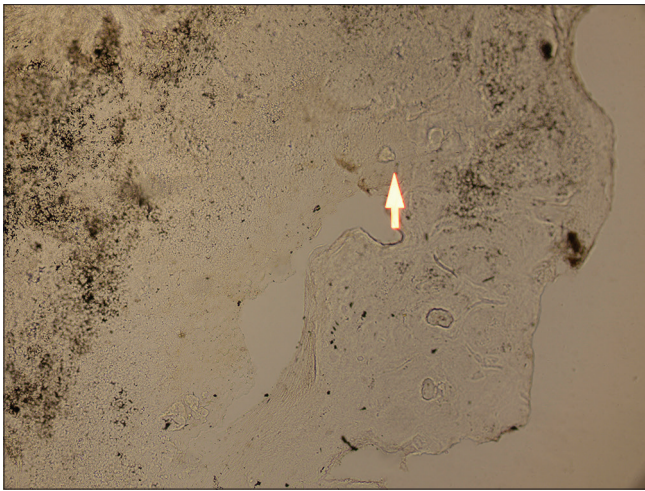
As destined the deciduous teeth are retained in the oral cavity only till the time of eruption of the succeeding permanent teeth, thus the duration of deciduous dentition in the oral cavity is limited. So the onset and progression of pulpitis in deciduous dentition is questionable. Moreover if it happens so, posterior deciduous possess more chances of being affected than the anterior teeth due to their anatomical makeup and

extended duration of stay in the oral cavity. Periapical lesions though rare do occur in deciduous dentition and might leave a permanent mark on successor tooth.

In the present case, the clinical history and examination were suggestive of chronic periapical lesion. In the light of intraoral periapical radiograph and orthopantomogram the differential diagnosis of periapical granuloma and radicular cyst associated with abnormal calcified structures was given. The final diagnosis of radicular cyst associated with malformed permanent tooth was given on excisional biopsy. This is a unique case and warrens patho-physiological discussion.

Radicular cysts are considered rare in the primary teeth<sup>[2]</sup> and are often ignored, comprising only 0.5–3.3% of total number of radicular cyst in both deciduous and permanent dentitions.





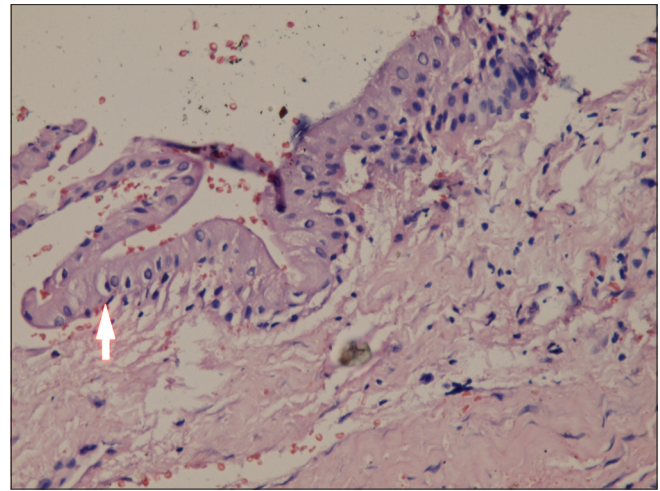
**Figure 7:** Photomicrograph showing lamellar bone pattern (ground section, x200)

This may be due to flaring of the roots in deciduous molars, providing it with more blood supply and immunity. About 73.5% of cases of periapical lesions of primary molars are radicular cysts.<sup>[3]</sup> As seen in our case, most of the radicular cysts associated with primary molars are located in the interradicular area and around the root apices, while in permanent molars it is usually located adjacent to the tooth apices.

Explanation to this lies in the presence of short and sometimes partially resorbed roots of the primary molars and coexistence of the accessory canals. Thus, the term periradicular cyst in the primary molars is more appropriate than a periapical or radicular cyst. If left untreated, the periapical inflammatory lesion including radicular cyst may affect the developing permanent successors. Type of disturbance involving successor permanent tooth depends predominantly on the time of onset of periapical infection, virulence of the invading bacteria and the host immune status. Disturbance mentioned in the literature varies from common findings such as Turners hypoplasia, enamel hypomineralization, pigmentation, dilaceration of crown/root, ghost teeth, premature eruption and crater like bone loss.<sup>[4,5]</sup> It may also lead to discrepancies such as temporary arrest of root/tooth development, delayed eruption of successional permanent teeth and even dentigerous cyst formation in the permanent tooth.<sup>[6-9]</sup>

In this case, histopathology revealed the presence of radicular cyst associated with 64 and 65 along with hard shell like structure. The hard tissue was composed of purely dentine and bone, with the absence of other dental hard tissue including enamel and cementum, thus ruling out odontomas. Absence of pulpal space/tissue and surrounding fibrous connective tissue also support it, thus confirming the diagnosis of a malformed tooth.

The patient was 4-year-old, and the radiograph showed the presence of single malformed tooth like structure instead of



**Figure 8:** Photomicrograph showing odontogenic epithelium with presence of columnar ciliated cells (H&E stain, x100)

the tooth germs of 24 and 25. 64 and 65 erupt in the oral cavity at the age of 16 months and 29 months, respectively.<sup>[10]</sup> Early deep carious involvement of these teeth may lead to a periapical inflammatory lesion within few months, which coincides with the age of early development and initiation of calcification of 24 and 25 [Table 1].<sup>[10]</sup>

Thus, this suggests that the inflammation may be the cause of the destruction of one of the developing tooth buds before the onset of its calcification. Pathological morpho- and histo-differentiation of the other tooth bud undergoing calcification may be the cause of malformed tooth in the present case.

In the development of the tooth, matrix formation and mineralization are closely related, both in normal growth as well as in the pathologic conditions such as infection and inflammation. These pathological factors can alter the early development of the tooth, hence affecting the mineralization of tooth.

The remodeling of connective tissue<sup>[10]</sup> in the normal growth is regulated by complex interactions involving the enzymes MMPs, tissue inhibitors of MMPs (TIMPs), along with other activators, inhibitors and regulatory molecules such as cytokines, growth factors and hormones. These factors are the product of fibroblasts, monocytes and macrophages.

MMPs are required for the normal morpho-differentiation and the mineralization of the tooth. Any disturbance in MMPs level may lead to the abnormal development of the enamel organ.<sup>[11]</sup> For example, MMP-2 is capable of cleaving amelogenin, the most abundant structural protein of the enamel matrix and TIMP-2 can prevent the fragmentation of amelogenin.<sup>[12]</sup> MMP-1 plays a role in bone and tooth resorption during the movement of teeth in the orthodontic treatments.<sup>[13]</sup> In pathologic inflammatory situations, the cells of connective

**Table 1: Chronology of developing permanent maxillary canine, premolars and first molar**

Permanent maxillary teeth	First evidence of calcification	Enamel completion (years)
Canine	4-5 months	6-7
First premolar	1.5-1.75 years	5-6
Second premolar	2-2.25 years	6-7
First molar	At birth	6-7

tissue and inflammation alter the secretion of some MMPs and their inhibitors.

Imbalance in the production of these factors in inflammatory conditions is very important cause of tissue degeneration and mal-development of the tooth.

## CONCLUSION

The very presence of the inflammatory cystic lesion with the circumscribed central fluid reservoir of the nonphysiological composition is in itself likely to provide an inflammatory reaction in the surrounding host tissue. Such inflammation may arise either directly by the mediator substances from the cells in the cyst wall, or indirectly following the accumulation of extraneous agents such as the bacteria or their products in the lumen.

In the deciduous dentition, the inflammatory mediators and the inflammatory cells from the infected periapical conditions such as periapical granuloma, periapical cyst, etc., may invade the underlying connective tissue and affect the developing permanent teeth and its surrounding dental apparatus.

Thus, in this case, radicular cyst involving the overlying primary molars is the causative factor for the aberrant formation of the tooth-like structure mainly consisting of dentin and bone.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

- Andreasen JO, Riis I. Influence of pulp necrosis and periapical inflammation of primary teeth on their permanent successors. Combined macroscopic and histologic study in monkeys. *Int J Oral Surg* 1978;7:178-87.
- Shear M, Speight P. *Cysts of Oral and Maxillofacial Regions*. 4<sup>th</sup> ed. Oxford: Blackwell Munksgaard Publication; 2007.
- Mass E, Kaplan I, Hirshberg A. A clinical and histopathological study of radicular cysts associated with primary molars. *J Oral Pathol Med* 1995;24:458-61.
- Rushton MA. Odontodysplasia: "Ghost teeth". *Br Dent J* 1965;119:109-13.
- Kalra N, Sushma K, Mahapatra GK. Changes in developing succedaneous teeth as a consequence of infected deciduous molars. *J Indian Soc Pedod Prev Dent* 2000;18:90-4.
- McDonnell ST, Liversidge H, Kinirons M. Temporary arrest of root development in a premolar of a child with hypodontia and extensive caries. *Int J Paediatr Dent* 2004;14:455-60.
- Reichart PA, Philipsen OH. *Odontogenic Tumors and Allied Lesions*. 1<sup>st</sup> ed. Landon: Quintessence Publication Co. Ltd.; 2004.
- Yawaka Y, Kaga M, Osanai M, Fukui A, Oguchi H. Delayed eruption of premolars with periodontitis of primary predecessors and a cystic lesion: A case report. *Int J Paediatr Dent* 2002;12:53-60.
- Aguiló L, Gandía JL. Dentigerous cyst of mandibular second premolar in a five-year-old girl, related to a non-vital primary molar removed one year earlier: A case report. *J Clin Pediatr Dent* 1998;22:155-8.
- Ash, Major M. and Stanley J. Nelson. *Wheeler's Dental Anatomy, Physiology and Occlusion*. 8<sup>th</sup> ed. New Delhi: Elsevier Publication; 2003.
- Courson F, Bdeoui F, Danan M, Degrange M, Gogly B. Regional odontodysplasia: Expression of matrix metalloproteinases and their natural inhibitors. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2003;95:60-6.
- Caron C, Xue J, Sun X, Simmer JP, Bartlett JD. Gelatinase A (MMP-2) in developing tooth tissues and amelogenin hydrolysis. *J Dent Res* 2001;80:1660-4.
- Domon S, Shimokawa H, Matsumoto Y, Yamaguchi S, Soma K. *In situ* hybridization for matrix metalloproteinase-1 and cathepsin K in rat root-resorbing tissue induced by tooth movement. *Arch Oral Biol* 1999;44:907-15.