Aws Alani **Karl Bishop and Jeremy Knox**

Dens Invaginatus as a Microsymptom of Canine Ectopia: A Case Series

Abstract: Canine ectopia is a frequently occurring orthodontic problem that has been previously linked to a variety of dental anomalies. We report a case series where the presence of ectopic canines has occurred in the presence of different severities of dens invaginatus in the adjacent lateral incisor. This observation has not been reported previously. The implications of this possible link are discussed.
Clinical Relevance: Dens invaginatus is a significant threat to pulp vitality and can have serious consequences, especially in the developing dentition. The early diagnosis and treatment of this condition, which could be linked to canine ectopia, is discussed.
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The maxillary canine is a commonly ectopic tooth with a reported incidence of between 0.8% and 2.9%. Ectopic canines are twice as likely in females as males, with palatal displacement (85%) being more common than buccal displacement (15%).[1,2] The aetiology of this problem remains unclear, but it is likely to be polygenic and multifactorial.[3,4] In addition, support for a genetic aetiology can be drawn from the increased frequency in certain racial groups.[5]

The management of ectopic canines can be complicated, frequently requiring extended orthodontic treatment and often involving minor oral surgery. Inappropriate management may be costly in terms of clinical time and resources. For these reasons, early diagnosis and treatment, when appropriate, is considered beneficial.[6]

Buccally ectopic canines are often accompanied by intra-arch crowding. Other dental anomalies, such as missing or peg-shaped lateral incisors, have been associated with palatally ectopic canines.[7-11] For this reason, the presence of an atypical lateral incisor can be used as a predictor of palatal canine development.[12]

Although a number of studies have reported dental anomalies affecting lateral incisors adjacent to ectopic maxillary canines, dens invaginatus does not appear to have been considered.[8-13] This is despite a study by Bäckman and Wahlin which reported that dens invaginatus was a more prevalent morphological anomaly (6.8%) than peg-shaped lateral incisors (0.8%), gemination (0.3%) or taurodontism (0.3%).[14] The study also suggested that the incidence of dens invaginatus was comparable to hypodontia (7.4%) and more common than hyperdontia (1.9%). Furthermore, the maxillary lateral incisor has been shown to be the tooth most frequently affected by dens invaginatus.[15]

Dens invaginatus

Dens invaginatus is an anomaly of development resulting from deepening or invagination of the enamel organ into the dental papilla.[15] A number of methods have been reported to classify dens invaginatus but the most commonly used appears to be that of Oehlers.[15-17] This system categorizes invaginations into three types by their extent from a coronal to apical direction and also in terms of their communication with the periodontal ligament.

Type I

The invagination, which is enamel lined, is of a minor form. It is confined within the crown of the tooth and does not extend beyond the level of the external amelocemental junction.

Type II

The enamel-lined invagination invades the root but remains confined as a blind sac.

Type IIIA

The invagination penetrates through the root and communicates with the peri-apical tissues laterally at a pseudo-foramen. There is no communication with the pulp, which lies compressed within the wall of the invagination process.

Type IIIB

The invagination penetrates through the root and communicates with the peri-apical tissues at the apical foramen. There is usually no communication with the pulp.

According to Ridell and co-workers, Type I invaginations are the most common (79%) with Types II (15%) and III (5%) less frequently observed.[18]

A Alani, BDS, MFDS, MSc, Specialist Registrar in Restorative Dentistry, **K Bishop,** BDS, MScD, DRD, MRD, FDS, FDS RCS(Rest Dent), Consultant in Restorative Dentistry and **J Knox,** BDS, MScD, PhD, FDS, MOrth, FDS(Orth), Professor and Consultant in Orthodontics**,** Maxillofacial Unit, Morriston Hospital, Swansea SA6 6NL, UK.

Figure 1. Anterior view illustrating buccally displaced maxillary left canine. Note the distinct buccal groove affecting the adjacent lateral incisor.

Figure 2. Palatal view of the maxillary left incisor demonstrating the use of methylene blue to highlight the entrance of the invagination. Note the 'shovel' shape of the tooth.

Figure 3. Long cone, intra-oral, peri-apical radiograph of the maxillary left lateral incisor illustrating an Oehlers Type I invagination (arrowed).

An early diagnosis of dens invaginatus is essential since it is associated with an increased risk of loss of pulpal vitality, which may have a significant affect on the prognosis of a tooth, particularly those with immature root development.[15-22] Furthermore, developmental anomalies may also be a predictor of canine ectopia.[12] As such, the presence of an invagination and its early diagnosis is important in both orthodontic and restorative treatment planning.

This paper uses brief clinical cases to suggest the possible association between the presence of a maxillary canine ectopia and dens invaginatus affecting the adjacent lateral incisor. The cases also illustrate the different severities of the anomaly and its variable clinical presentation.

Case 1

A 14-year-old male presented with a history of traumatic avulsion and loss of both maxillary central incisors (Figure 1).

Clinical examination revealed a buccally positioned maxillary left canine. In addition, the adjacent lateral incisor was 'shovel'-shaped with a labial groove extending from the gingival margin to the incisal edge. The palatal aspect of the incisor also had an exaggerated cingulum pit, which was highlighted with the use of methylene blue dye (Figure 2). The lateral incisor returned a delayed response to electric and thermal vitality testing and radiographic examination confirmed the presence of an Oehlers' Type I invagination (Figure 3).

Case 2

A 13-year-old female presented complaining of pain and swelling from the maxillary anterior region.

An intra-oral examination revealed a buccally positioned maxillary right canine (Figure 4). The coronal morphology of the adjacent lateral incisor appeared normal. There was, however, evidence of a fissure sealant on the palatal aspect of the lateral incisor in the cingulum pit area. This tooth was also non-responsive to electric and thermal vitality testing, and tender to percussion.

Figure 4. Anterior view illustrating buccally displaced maxillary right canine and discoloured adjacent lateral incisor.

Radiographic examination revealed an Oehlers' Type II invagination associated with immature root development and a large peri-apical radiolucency (Figure 5).

Case 3

A 14-year-old female presented complaining of pain and swelling from the maxillary anterior region. She had recently completed orthodontic treatment for a buccally placed canine (Figures 6 and 7).

On clinical examination, the maxillary right lateral incisor was found to be non-responsive to electric and thermal vitality testing and there was a buccally draining sinus associated with the tooth.

Radiographic examination revealed an Oehlers Type IIIA invagination with an associated peri-apical radiolucency extending to the lateral border of the root (Figure 8).

Discussion

There is evidence to suggest that developmental dental anomalies are common in patients requiring orthodontic therapy.[23-29] For example, in a study by Thongudomporn and Freer of 111 orthodontic patients, dental

Figure 5. Long cone, intra-oral, peri-apical radiograph of the maxillary right lateral incisor. The presence of an Oehlers Type II invagination is shown, with the blind-ending sac arrowed. The incisor is associated with a large peri-apical radiolucency.

Figure 6. Pre-operative models prior to the start of fixed orthodontic therapy to correct the buccally placed maxillary right canine.

Figure 7. Anterior view at presentation and after orthodontic therapy illustrating the discoloured maxillary right lateral incisor.

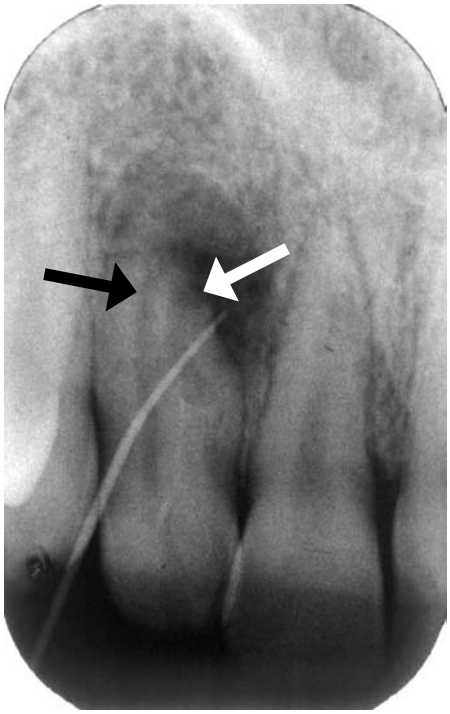

Figure 8. Long cone, intra-oral, peri-apical radiograph of the maxillary right lateral incisor. Illustrating the atypical root shape. Both the root canal (black arrow) and the Oehlers Type III invagination (white arrow) are associated with radiolucencies at their openings into the periodontium. A tracer has been placed to identify the source of the infection.

anomalies were identified in 75%, with dens invaginatus being present in more than a quarter of the subjects.[30] In addition, it would appear that often more than one anomaly may occur in the same patient. For example, Kjaer, in a study of dental anomalies in a group of patients with supernumerary teeth in the premaxilla, reported that additional anomalies such as dens invaginatus, arrested eruption, and root resorption were often also present.[31]The management of such anomalies often requires a joint orthodontic and restorative approach. For example, the presence of a peg-shaped lateral incisor often necessitates an assessment of the condition and dimension of adjacent teeth, as well as space requirements to achieve an acceptable final aesthetic result. Options such as the extraction of the tooth and the movement of the canine into the vacated space, or the potential to modify its shape, are often important considerations.[32-34]

A common developmental anomaly is dens invaginatus which has a reported incidence of between 0.25 and 10% of teeth examined, with one study in a group of orthodontic patients showing an incidence of 26%.[15,30] As with other anomalies, the presence of an invaginated tooth may have a significant effect on orthodontic and restorative treatment planning. This is due to the fact that affected teeth have an increased risk of losing vitality and often have atypical morphology. As such, early diagnosis is important, but this is often not without difficulty owing to the variable presentation of the problem.[16]

For example, the crown of an invaginated tooth can be shovel (Figure 2), barrel, peg or conical in shape or have an increased mesio-distal or labio-lingual dimension.[16,35-37] The tooth can also have an atypical root morphology (Figure 8).[38] Equally, there may be little clinical sign of any underlying problem, with the only indication being an exaggerated cingulum pit or associated groove (Figure 2).

The variation in crown shape can be an important consideration in treatment planning. This is particularly the case when extractions to resolve crowding are being considered or where the final aesthetic result requires changing the dimension of teeth.

The increased risk of losing vitality can be due to caries developing within the invagination, resulting in a direct communication between the anomaly and the pulp (Figures 5 and 8).[15] This provides a direct portal for bacterial contamination of the pulp.[15,16,39] However, the endodontic management of invaginated teeth can be problematic owing to difficulties in successful chemomechanical debridement and obturation of the complex internal anatomy.[40,41] Often, the tooth may need to be extracted as a result of the unpredictability of root canal therapy and restoration.[22]

Dens invaginatus has also been reported as a possible risk factor for root resorption during orthodontic movement.[38] It is unclear whether this risk is associated with the anomaly itself or, as is more likely, due to a loss of vitality.[42]

Since such anomalies may affect any potential orthodontic and restorative management, it would seem advisable to consider the possibility of their presence prior to finalizing any treatment plan.[43] This is supported by reports where late diagnosis of canine ectopia has a negative effect on the success of subsequent orthodontic therapy and there is an increased risk of resorption of the adjacent lateral incisor root.[44]

The cases presented in this paper also suggest, as with other dental anomalies, that there may be an association between invaginated maxillary lateral incisors and canine ectopia.[12] Support for this possibility comes from a number of case reports in the endodontic literature on the management of dens invaginatus affecting maxillary lateral incisors. Further examination of these publications reveals that the adjacent canines were ectopic.[45-50] However, the presence of the displaced teeth or a possible association with the invaginations does not appear to have been commented upon by the authors.

In addition, morphological features of the maxillary incisor, such as a peg shape or coronal hypoplasia, which have been associated with canine ectopia, have also been associated with dens invaginatus.[15,16,51,52]

If an association exists between maxillary canine ectopia and dens invaginatus affecting the adjacent lateral incisor, then this relationship may be a useful diagnostic tool to aid early diagnosis. For example, where dens invaginatus has affected an erupted maxillary lateral incisor, consideration could be given to the possibility that an adjacent unerupted canine may become ectopic. Conversely, patients presenting with canine ectopia should be carefully screened for dens invaginatus, as this is more than likely to affect the vitality of the tooth and, as a consequence, future treatment planning decisions.

Conclusion

Dens invaginatus has a variable clinical presentation and is often associated with loss of vitality and variable tooth morphology. These factors may have a significant affect on the management of

a case, particularly when orthodontic treatment is being considered. This case series also suggests a possible association between dens invaginatus and buccally positioned ectopic canines. However, studies with a greater level of evidence are required to confirm this observation but, if this proves to be the case, then the presence of an invaginated maxillary lateral incisor may be an indicator of adjacent canine ectopia. This may be another important reason to support the early diagnosis of an invaginated tooth.

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