Investigation of Dens Invaginatus in a Turkish Subpopulation Using Cone-Beam Computed Tomography

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Abstract
Objective: The aim of this study was to determine the prevalence and distribution of the Dens Invaginatus (DI) using Cone-Beam Computed Tomography (CBCT) in a Turkish subpopulation.

Materials and methods: CBCT images of 2067 patients (1093 males and 974 females; mean age, 34.2 ± 7.4 years; age range, 18-74 years) were retrospectively examined for the presence of DI. The laterality and type of DI, and tooth type were determined using the CBCT images of the patients. Pearson’s chi-square test was used for statistical comparisons.

Results: DI was observed in 122 out of 2067 subjects with a frequency of 5.90%, with no gender difference (p=0.224). A hundred one out of the 122 patients with DI had only one tooth affected by DI, while 19 patients had two teeth affected by DI and one patient had three teeth affected by DI. Nineteen out of the 122 patients (15.6%) with DI had bilateral DI, while the remaining patients (84.4%) had unilateral DI. Maxillary lateral incisors were the most affected teeth (86 out of 3067; 2.80%) and followed by maxillary central incisors (84.4%) and maxillary central incisor and canine. The most commonly observed type of DI was found to be type I (86.6%; 123 out of 142), followed by type II (9.2%; 13 out of 142) and type III (4.2%; 6 out of 142).

Conclusion: DI was found to be in 5.90% of the examined subpopulation with no gender difference. It was the first study using CBCT for the investigation of DI prevalence and distribution.

Key Words: Dens invaginatus, Prevalence, Cone-beam computed tomography

Introduction
Dens invaginatus (DI) is a tooth malformation which most likely results from infolding of the dental papilla during tooth development or invagination of all layer of the enamel organ in dental papillae [1]. Affected teeth show a deep invagination of enamel and dentine starting from the foramen caecum or even the tip of the cusps and which may extend deep into the root. Other names are telescopic tooth, dilated gestant odontome, dilated composite odontome, tooth inclusion, and dens in dente [2].

DI is most frequently found in maxillary lateral incisors, where so many other developmental dental anomalies occur, but can also be found in maxillary central incisors, in mandibular incisors and in other teeth. This dental anomaly has a frequency of 0.04% to 10% in the general population [3]. Oehlerl [4] classified this anomaly according to severity and characteristics: Type I, an enamel invagination in the crown only; type II, an enamel-lined form that invades the root as a blind sac and may communicate with the pulp; and type III, invagination penetrates through the root and forms a second foramen in the apex or along the root, in the periodontal tissues.

Radiographic evaluation is one of the most reliable methods to diagnose such anomalies. However, it is difficult to assess completely the exact anatomical structure of invaginated teeth from conventional radiographs. Cone Beam Computed Tomography (CBCT) is a routine part of dental practice. This new three-dimensional imaging technique has been specially designed for imaging the dento-maxillo-facial structures. Images are obtained using significantly lower radiation doses compared to conventional computed tomography.

No study investigating the prevalence and distribution of DI using CBCT has been published and thus the present retrospective study was performed to investigate the prevalence and distribution of this anomaly in a Turkish subpopulation using CBCT.

Materials and Methods
The CBCT images used in this retrospective study were collected at the Department of Oral and Maxillofacial Radiology at Erciyes University in Kayseri, Turkey. CBCT scans of the patients included in this study were part of the diagnostic records collected for dental implants, orthodontics, maxillofacial surgery, oral pathology, orthognathic surgery; the patients were not exposed to any additional radiation for the present study. All patients had signed an informed consent form allowing using their data for scientific purposes.

According to the inclusion (CBCT showing both mandibular and maxillary teeth with good quality, no large pathologic lesions and no bone fractures) and exclusion (patients aged less than 12 years and inadequate picture quality due to artifacts caused by metallic implants or osteosynthesis plates, low resolution and patient movement during imaging) criteria, 193 images (mostly due to the age criteria) were excluded and finally the study included 2067 adult patients’ (1093 males and 974 females; mean age: 34.2 ± 7.4 years; age range: 12 to 74 years) CBCT images.

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Pearson’s chi-square test was used to compare the potential difference of DI between genders. Statistical analysis was performed using SPSS 16.0 for Windows (SPSS, Chicago, IL). The level of significance for all tests was set at P < 0.05.

**Results**

A total of 2067 adult patients (1093 males and 974 females; mean age: 34.2 ± 7.4 years) and their 49198 teeth (24319 maxillary and 24879 mandibular) were examined for the presence of DI. CBCT images showed that 5.90% of the subjects (122 out of 2067) included to the study had at least one DI. It was detected in 5.31% of the males (58 out of 1093) and 6.57% of the females (64 out of 974), with no statistically significant gender difference (P=0.224) (Table 1).

101 out of the 122 patients with DI had only one tooth affected by DI, while 19 patients (18 had bilateral DI) had two teeth affected by DI and one patient (bilateral occurrence of DI) had three teeth affected by DI. Maxillary central incisors (1.70%; 54 out of 3177), lateral incisors (2.80%; 86 out of 3067) and canine (0.06%; 2 out of 3127) were found to be affected by DI, while none of the other teeth in the maxilla and in the mandible were affected. The most commonly observed type of DI was found to be type I (86.6%; 123 out of 142), followed by type II (9.2%; 13 out of 142) and type III (4.2%; 6 out of 142) (Table 2).

**Discussion**

There have been no studies published investigating the...
prevalence and distribution of DI using CBCT. The studies [5-7], published in our country, evaluated only anterior teeth and thus not representing the complete assessment of the mouth. The reported prevalence of patients with DI was 1.3-12.0% of the examined patients in Turkey [5-7]. In the present study, it was found to be 5.90%, with no gender difference. Although no statistically significant gender difference was also reported by several authors [5,7,8], the findings of Gunduz et al. [6] showed that females presented statistically higher prevalence of DI.

Kirzioglu and Ceyhan [7] and Gunduz et al. [6] reported that 82% and 67.5% of the cases were bilateral, while this frequency was 23.1% in the study of Cakici et al. [5]. In the present study, 19 out of the 122 patients (15.6%) with DI had bilateral occurrence, while the remaining patients (84.4%) had unilateral DI. Since the bilateral occurrence of DI was reported to be high in the literature, the clinicians to treat these patients should examine the teeth bilaterally. In addition, bilateral DI was reported to be related with other dental abnormalities such as taurodontism, microdontia, gemination and dentinogenesis imperfecta [9,10]; however, no associated dental anomaly was observed in the present study.

Oehlers’ classification was the most commonly used classification method for DI, based on a two-dimensional radiographic image and might underestimate the true extent and anatomy of invagination [11]. Using Oehlers’ classification, type I was the most common type of dens invaginatus with a prevalence of 86.6%, followed by type II (9.2%) and type III (4.2%). Type I was the most commonly observed type in previous studies [5-7,11-13], and our finding was very close to the type I prevalence reported by Cakici et al. [5] (81.25%) and Alani and Bishop (79%) [11].

The results indicated that maxillary lateral incisors (86/3067; 2.80%) were the most commonly affected teeth by DI and followed by maxillary central incisors (54/3177; 1.70%) and canine (2 out of 3127; 0.06%). It was comparable with the previous studies [5-8], which reported the maxillary lateral incisors to be mostly affected by DI. Controversy, no DI was observed in the maxillary central incisors by some authors [12] and rarely in the mandibular teeth [5-8,10,12] and the present study found no mandibular tooth affected by DI. According to the findings of Colak et al. [12], which assessed the panoramic films of 6912 adult patients for DI prevalence and distribution, maxillary lateral incisors (80%) were followed by maxillary canine teeth (20%). However, maxillary canine teeth affected by DI were rarely found in the present study (0.06%).

The reported differences even in the same country might be due to the several factors including the differences in the study samples, geographic locations, distribution of genders and chronological ages, and radiographic methods. The previous studies used periapical and panoramic radiographs, while the present study used CBCT data. Although previous case reports [14-17] showed the importance of CBCT in the treatments of invaginated tooth with different types, these images were firstly used to determine the prevalence and distribution of patient and teeth with DI in the present study.

**Conclusions**

DI was found to be in 5.90% of the examined subpopulation with no gender difference. Maxillary lateral incisors were the most affected teeth and followed by maxillary central incisor. The most commonly observed type of DI was found to be type I (86.6%), followed by type II (9.2%) and type III (4.2%).
References


