Influence of cone beam computed tomography on dens invaginatus treatment planning

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ABSTRACT

The achievement of endodontic success is associated with the accurate diagnosis. To establish the diagnostic hypothesis based on periapical radiograph is a challenge for all different dentistry specialties. The visualization of three dimensional structures, available with cone beam computed tomography (CBCT), favors precise definition of the problem and treatment planning. The aim of this manuscript is to present a case report of dens invaginatus treatment planning changed by 3-D CBCT images. The complete and dynamic visualization regarded the correct endodontic-periodontal structures, suggesting type 2 dens invaginatus associated with radiolucent areas, and periodontal compromising. The adequate examination using imaging exams should be always made in conjunction with the clinical findings. The accurate management of CBCT images may reveal abnormality which is unable to be detected in periapical radiographs. The choice of clinical therapeutics for these dental anomalies was influenced by CBCT views which showed bone destruction not previously visible in initial periapical radiograph. Based on the necessity of extensive restorative treatment, the option of treatment was the extraction of this tooth and oral rehabilitation.

Keywords: Dens invaginatus. Dental anomaly. Cone beam computed tomography. Endodontic diagnosis.

Decurcio DA, Silva JA, Decurcio RA, Silva RG, Pécora JD. Influence of cone beam computed tomography on dens invaginatus treatment planning. Dental Press Endod. 2011 apr-june;1(1):87-93.

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Received: January 2011 / Accepted: February 2011

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Introduction

Dens invaginatus is an anomaly of development (malformation) of teeth resulting from a infolding of dental papilla during tooth development. The affected tooth shows a deep infolding of enamel and dentine starting from the foramen coecum or even the tip of cusps and which may extend deep into the root.[1]

Every tooth may be affected, but the maxillary lateral incisor is the most affected and the bilateral occurrence is common. The root canal therapy may present severe difficulties and problems because of the complex anatomy of these teeth.[2-6] Since the second period of 19th century the dental literature has published about this malformation with the following synonyms: dens in dens, invaginated odontome, dilated gestant odontome, dilated composite odontome, tooth inclusion, dentoid in dens.[1-7]

Hülsmann,[1] based on several studies, presents seven possibilities about aetiology of dens invaginatus malformation and these etiologies are controversial and still today remains unclear. These theories about etiology of dens invaginatus have been proposed to explain these dental malformation: growth pressure of dental arch results in buckling of the enamel organ; the invagination results from a focal failure of growth of the internal enamel epithelium while the surrounding normal epithelium continues to proliferate and engulfs the static area; the invagination is a result of a rapid and aggressive proliferation of a part of the internal enamel epithelium invading the dental papilla; Oehlers[8] considered that distortion of the enamel organ during tooth development and subsequent protrusion of a part of the enamel organ will lead to the formation of an enamel-lined channel ending at the cingulum or occasionally at the incisal tip; the latest might be associated with irregular crown form; a fusion of two tooth-germs; infection; traumatic dental injury; genetic factors. Alani and Bishop[7] reported recently that the exact aetiology of dens invaginatus is unknown although a genetic cause is probably the most likely factor.

In many cases a dens invaginatus is detected by routine radiograph examination, and it may be easily overlooked because of the absence of any significant clinical signal of the anomaly. This is unfortunate as the presence of an invagination is considered to increase the risk of caries, pulpal pathosis and periodontal inflammation.[2-6]

Cone beam computed tomography (CBCT) has permitted lately the third dimension into dentistry, being a benefit to all the areas of dentistry, up to this time had not used the advantages of medical CT, due to lack of specificity. CBCT is an important tool in diagnostic, with non-destructive and non-invasive characteristics,[9,10] and this diagnosis tool allows visualization of a three-dimensional image, in which a new plane has been added: depth. Its clinical application allows high accuracy and is directed towards nearly.[11-15]

This article discusses a case report in which the 2-D radiography shows a standard aspect of type 2 dens invaginatus in peg shaped lateral incisor that in an initial moment seems to be possible an endodontic treatment. The 3-D images had resulted in additional information which had not been previously seen with the commonly used 2-D radiography.

Case Report

A 20-year-old man was referred to the clinical service of Faculty of Dentistry of Federal University of Goiás, in order to assess and clarify an oral health problem, and sporadic discomfort during mastication. The medical history was negative for concomitant disease, and it was not contributory. Clinical examination revealed presence of periodontal inflammation. There was no spontaneous symptom or edema in the teeth, but it was detected a large mobility in maxillary left lateral incisor. Vitality pulp test showed the dental pulp to be nonvital. Periapical radiographic revealed a type 2 dens invaginatus, associated with periapical radiolucency. Considering the discomfort of patient, periodontal, orthodontics and endodontics problems, it was suggested to perform CBCT imaging with i-CAT Cone Beam 3D imaging system (Imaging Sciences International, Hatfield, PA, USA). The volumes were reconstructed with isotropic-isometric voxels measuring 0.20 mm - 0.20 mm - 0.20 mm. The tube voltage was 120 kVp and the tube current 3.8 mA. Exposure time was 40 seconds. Images were examined with the scanner's proprietary software (Xoran version 3.1.62; Xoran Technologies, Ann Arbor, MI, USA) in a PC workstation running Microsoft Windows XP professional SP-2 (Microsoft Corp, Redmond, WA, USA), with processor Intel® CoreTM 2 Duo-6300 1.86 Ghz (Intel Corporation, USA), NVIDIA GeForce 6200 turbo cache videocard (NVIDIA Corporation, USA) and Monitor EIZO - Flexscan S2000, resolution 1600x1200

pixels (EIZO NANAO Corporation Hakusan, Japan). The maxillary left lateral incisor was focused and scans were obtained in different planes (sagittal, coronal and axial) of 0.2 mm thickness.

In sagittal and axial CBCT images it may be observed the presence of dens invaginatus type 2 of Oehlers, suggesting clearly infolding of the enamel and dentine. Periapical radiolucency with presence of the periapical bone cortical destruction was detected in palatal surface, and loss of buccal bone cortical until apical third could be also visible (Fig 1). Axial CBCT images in apical, middle and coronal thirds from dens invaginatus showed a central position into the tooth (Fig 1). Note apical, palatal and buccal bone cortical destruction in CBCT images reconstructions (Fig 2).

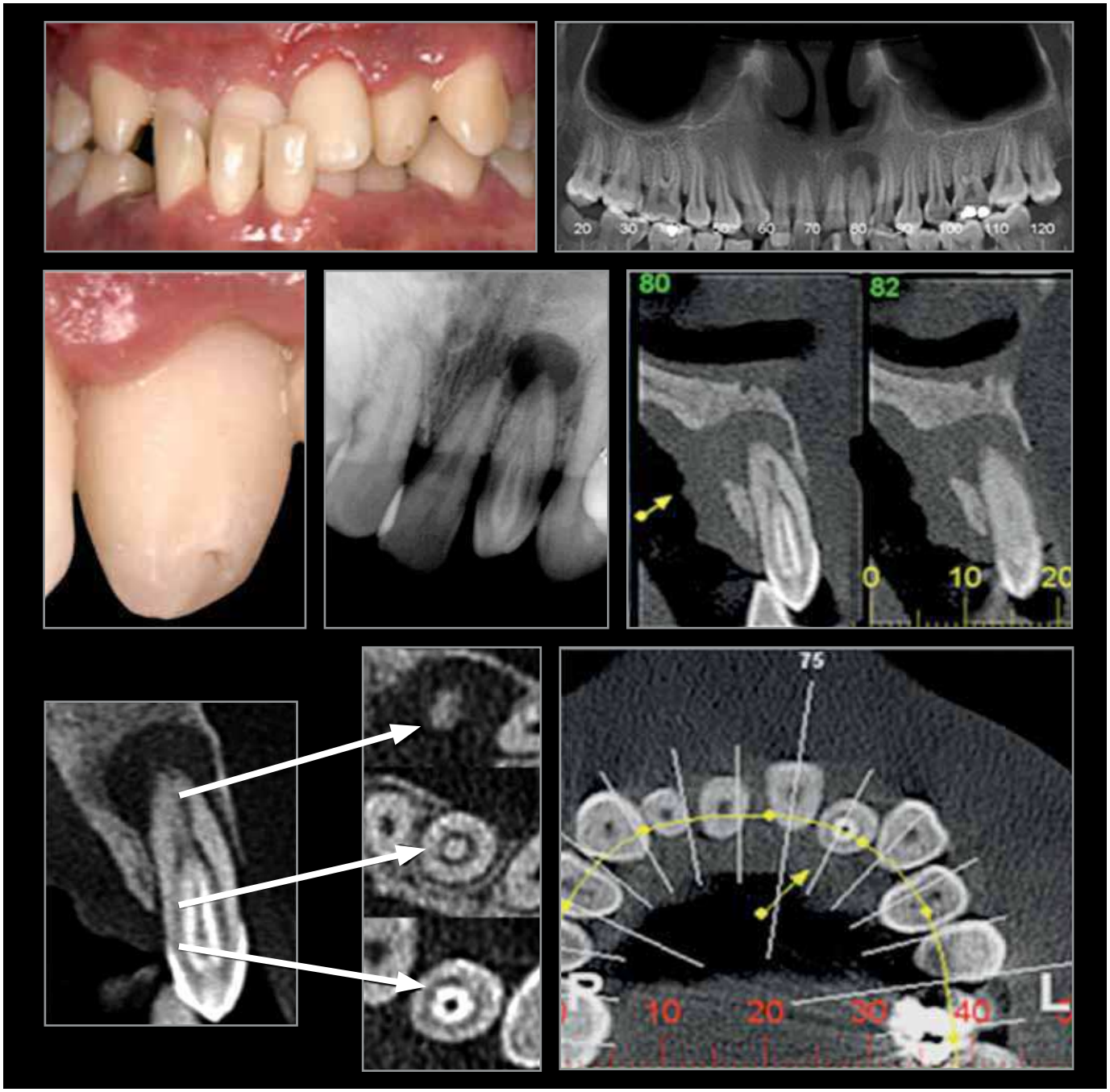

Figure 1. In sagittal and axial CBCT views it may be observed the presence of dens invaginatus type 2 of Oehlers. Periapical radiolucency with presence of the periapical bone cortical destruction was detected in palatal surface, and loss of buccal bone cortical until apical third can be also visible.

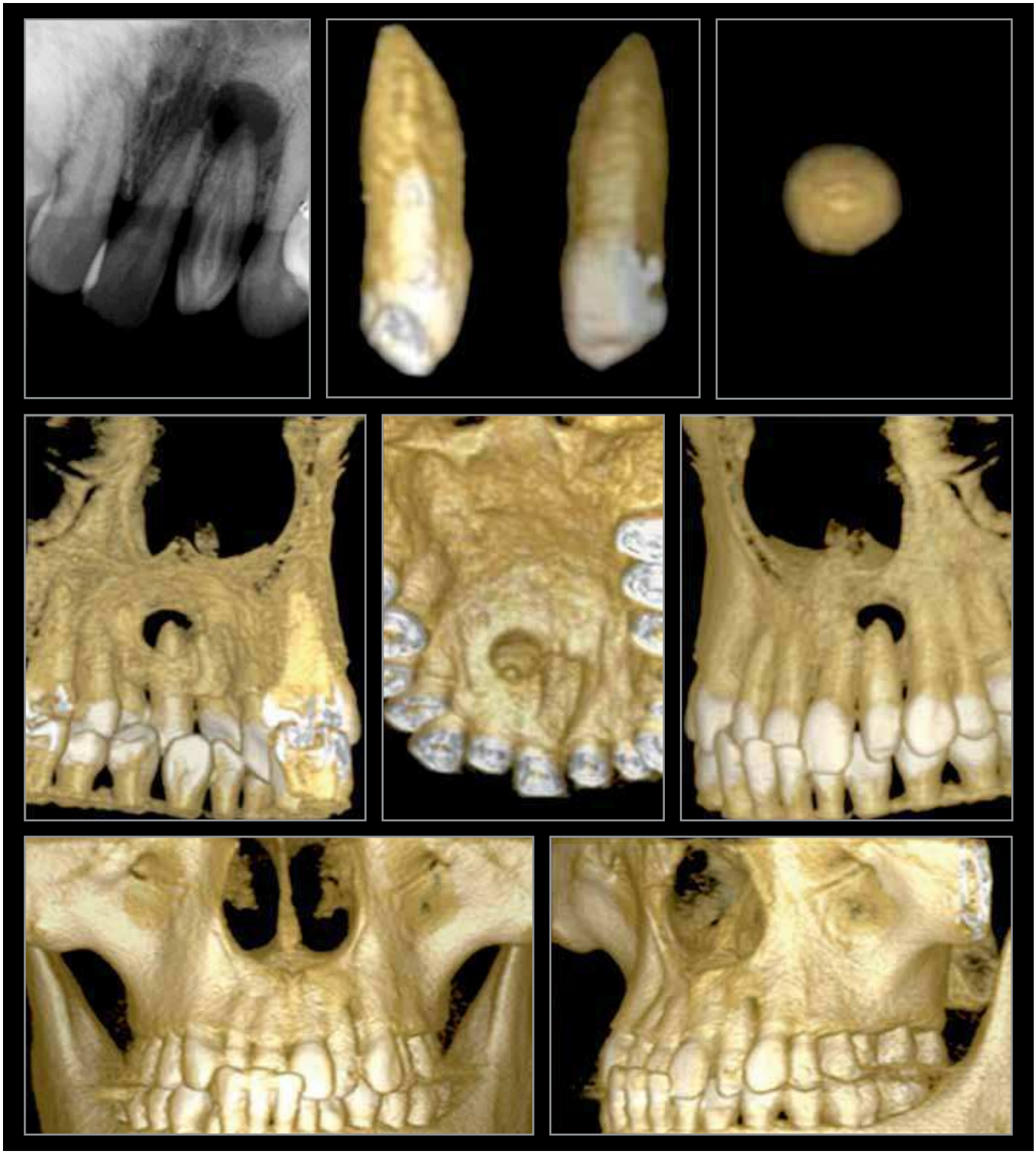

Figure 2. CBCT images reconstructions. Note apical, palatal and buccal bone cortical destruction.

Discussion

In many cases a dens invaginatus is detected by radiograph examination. Clinically, unusual crown morphology (peg shaped) or a deep foramen coecun may be important to indicate the probability of a dens invaginatus.[2] As the maxillary incisors are the most susceptible teeth to present dens invaginatus and these teeth should be investigated thorough clinical and radiographic exams. If one tooth is affected in a patient, the contra lateral tooth should be investigated. It is necessary to acquire radiographs for the maxillary lateral incisors with peg shaped, because Siqueira et al[5] found that 10 per cent of these teeth may be associated with dens invaginatus.

The most commonly used classification was proposed by Oehlers:[8] dens invaginatus Type I - an enamel-lined minor form occurring within the confines of the crown not extending beyond the amelocemental junction; dens invaginatus Type II - an enamel-lined form which invades the root but remains confined as a blind sac (it may or may not communicate with dental pulp); dens invaginatus Type III – a form which penetrates through the root perforating the apical area showing a "second foramen" in the apical or periodontal area. There is no immediate communication with the pulp. The invagination may be completely lined by enamel and frequently cementum will be found lining the invagination.

As pulpal involvement of teeth with coronal invaginations may occur a short time after tooth eruption, the early diagnosis is very important to instigated preventive treatment. The Table 1 describes the summary of treatment of different type of dens invaginatus observed in dental literature.[4,6] Ridell et al[16] evaluated the prognosis for pulp survival in the teeth with dens invaginatus subjected to prophylactic invagination treatment. The dental records of all patients referred to the Eastman Dental Institute, Stockolm, Sweed, with diagnosis of dens invaginatus between the years 1969-1997 were reviewed. Five teeth in 66 patients had been subjected to prophylactic invagination treatment. The retrospective evaluation was based on an examination of the radiographs available from the follow-up. They founded: (a) patients with 1 tooth affected (64.8%); with 2 teeth (29.7%), with 3 teeth (2.2%) and with 4 teeth (3.3%); (b) teeth with dens invaginatus - maxillary central incisors 13%, maxillary lateral incisors 85.5%, maxillary pre-molar 0.8% and maxillary molars 0.8%; (c) dens invaginatus founded according to the Oehlers' classification:[8] Type I (15.35%); Type II (79.4%) and Type III (5.3%). After prophylactic invagination treatment they observed 71% of success and a 9% of failure in an observation period of 6-128 months.

Table 1. Summary of treatment of different type of dens invaginatus.

Dens Invaginatus	Characteristics	Treatment observed in dental literature
Type I (Oehler, 1957)	An enamel invagination is confined within the crown before enamelcemental junct	Prevention and clinical and radiograph control; Application of sealant in invagination; Restoration of teeth
Type II (Oehler, 1957)	The invagination extends to the amelocemental junction and may or may not present a communication with dental pulp	Restoration of invagination if dental pulp is normal; Endodontic therapy; Combined endodontic-surgical treatment
Type III (Oehler, 1957)	The enamel-lined invagination penetrates the entire root usually without a communication with dental pulp	Endodontic therapy; Surgery therapy; Combined endodontic-surgical treatment; Extraction

Hamasha and Alomari,[17] in Jordania, collected 3024 radiographs from a random sample of 1660 patients showing 9377 teeth. A tooth was considered as having dens invaginatus if an infolding of a radiopaque ribbon-like structure equal in density to enamel was seen extending from the cingulum into the root canal. The teeth with dens invaginatus were found in 49 subjects out of 1660 subjects examined. The prevalence was 2.95%. Bilateral dens invaginatus was seen in 12 patients, whereas unilateral dens invaginatus was demonstrated in 37 patients. Maxillary lateral incisor was the most common tooth affected with this condition, which represented 90% of cases.

The introduction of CBCT brings the revolution of information in health area, which have contributed in planning, diagnosis, therapeutic and prognosis of several dental alterations.[9-15] Radiographic image corresponds to a two-dimensional aspect of a three-dimensional structure, which had a potential to bring errors of interpretation.[18] The planning, diagnosis and prognosis of endodontic therapy involve the interpretation of images. New methods using CBCT scans to investigate apical periodontitis and root resorption and a new tool to use in several research areas are suggested.[12-16] In two articles recently published, the authors describe the use of CT[7] and CBCT[17] in the management of the dens invaginatus. Patel[19] reported an interesting case with chronic periradicular periodontitis associated with an infected invagination in an immature mandibular lateral incisor tooth. CBCT images showed absence of communication between the invagination and the main root canal. The endodontic treatment was carried out on the invagination and the root canal with a vital pulp was left untreated, thus allowing the tooth to mature and to continue its development.

CBCT allows visualization of a three dimensional image, in which a new plane has been added: depth. Its clinical application allows high accuracy and is directed towards nearly all the areas of dentistry — surgery, implant, dentistry, orthodontics, endodontics, periodontics, temporomandibular dysfunction, image diagnosis, etc. The real view of the association of these indicators with the clinical aspects projects a fourth dimension, marked by the requirement of time and space.[20]

In the present case report, the real periapical bone cortical destruction was detected in palatal surface, and the loss of buccal bone cortical until apical third can also be visible (Figs 1, 2 and 3). These aspects were not visualized on 2-D initial periapical radiography. In function of periodontal conditions presented (high mobility, big bone loss in buccal, distal and palatal sides), and the necessity of extensive restorative treatment, the option of treatment was the extraction of this tooth and oral rehabilitation.

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