IEJ
Iranian Endodontic Journal

Nonsurgical Endodontic Treatment of Type II Dens Invaginatus in A Maxillary Lateral Incisor: A Case Report

Mariana da Cunha Isaltino [a], Natália Gomes de Oliveira [a*], Paulo Maurício Reis de Melo Júnior [a], Carolina Viana Vasco Lyra [a], Pedro Henrique de Freitas Fernandes [a], Diana Santana de Albuquerque [a]

a Dental School, Universidade de Pernambuco (FOP/UPE), Professor Luis Freire Avenue, 700, Cidade Universitária, Recife/PE, Brazil

Article Type: **Case Report**

Received: 08 Apr 2024
Revised: 14 May 2024
Accepted: 23 May 2024
Doi: *10.22037/iej.v19i3.45099*

**Corresponding author*: Natália Gomes de Oliveira, Universidade de Pernambuco, Professor Luis Freire Avenue, 700, Cidade Universitária, Recife/PE, Brazil, Zip code: 50740-540.

E-mail: nataliagomes04@hotmail.com

Dens invaginatus (DI) is one of the developmental dental anomalies that results in an invagination of the enamel organ into the dental papila during odontogenesis. The purpose of this study is to report a case of nonsurgical endodontic treatment of an Oehlers type II DI in a right maxillary lateral incisor with an extensive periapical damage, along with the two-year clinical and tomographic follow-up. A 30-year-old patient was referred for endodontic treatment of tooth #12. On clinical examination, a change in the shape and color of the crown was observed. The tooth responded negative to pulp sensibility, percussion, palpation and mobility tests. After tomographic evaluation, an Oehlers type II DI was visualized, in addition to an extensive periradicular lesion. The diagnosis was asymptomatic apical periodontitis. The treatment was carried out in two sessions, through intense enhancement of the auxiliary chemical substance with passive ultrasonic irrigation, XP-Endo Finisher and the use of hydroxide-based intracanal medication. Appropriate treatment in cases with anatomic variations requires an accurate and early diagnosis based on clinical examination and radiographic images. A two-year follow-up of the present case showed that the correct diagnosis associated with appropriate instrumentation techniques, supplementary disinfection, and adequate three-dimensional sealing of the canal with filling material, resulted in regression of the periradicular lesion and bone repair.

Keywords: Cone-beam Computed Tomography; Dens Invaginatus; Endodontic; Root Canal Therapy

Introduction

Dens invaginatus (DI) is a developmental dental anomaly that is caused by an invagination of the enamel organ into the dental papilla before the calcification of dental tissues [1]. Invagination starts at the crown and can extend into the root, with or without communication with the periodontium [2]. The prevalence of DI in permanent teeth varies based on the population studied and type of tooth, ranging from 0.3% to 10%. The maxillary lateral incisors are the most affected teeth and bilateral involvement can be observed [1, 3, 4]. Several factors can explain the etiology of this malformation, such as failure of growth, abnormal proliferation, distortion or fusion of the enamel organ, genetic factors, infections, and trauma [5, 6].

The diagnosis of DI can be made clinically and radiographically. The clinical appearance of the morphology of the affected crown can vary from normal to an unusual shape, depending on the size of the invagination. The most frequent alteration of the crown is a bifid exaggerated cingulum or a conical shape [2, 7]. Radiographically, DI generally appears as a radiolucent invagination surrounded by a radiopaque area (enamel) that can be limited to the crown of the tooth or extend into the root. Communication between the invagination and the apical and lateral periodontal ligament may also be observed [4]. Cone-beam computed tomography (CBCT) is an essential tool for defining the type of invagination and for treatment planning by providing a three-dimensional image of the entire canal system, thus overcoming the limitations of periapical radiography [8, 9].

The management of teeth with DI varies according to the extent of invagination, pulp and periradicular status, and the stage of root development. If not diagnosed early, affected teeth are prone to the development of cavities and periradicular diseases, a fact that makes treatment more challenging because of the wide range of anatomic variability [10].

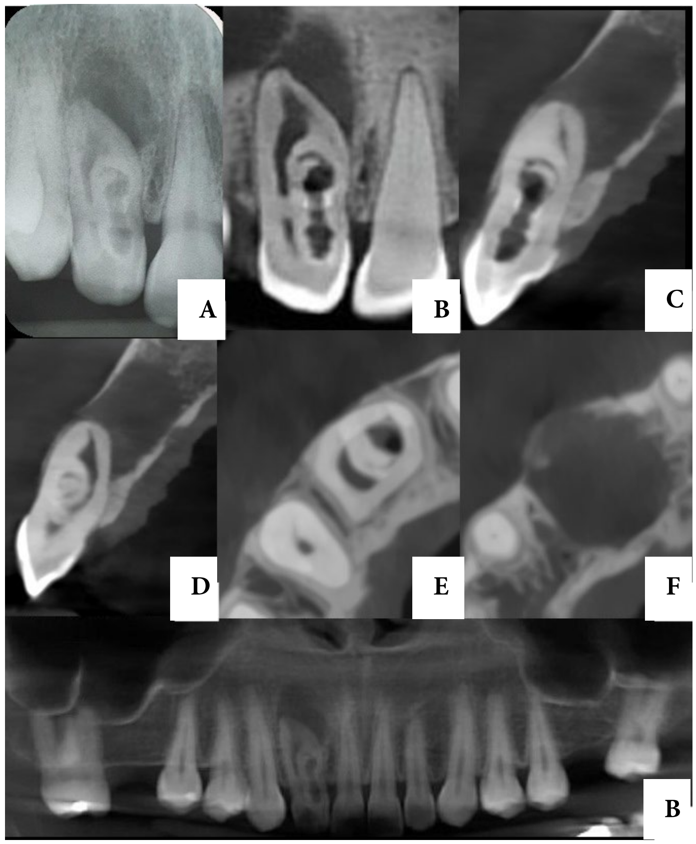

Figure 1: *A)* Initial periapical radiograph of tooth #12 showing the presence of Oehlers type II dens invaginatus, in addition to a radiolucent area in the periapical region; *B)* Coronal CBCT section of tooth #12 showing the anatomy of the dens invaginatus, presence of calcification in the cervical third of the main canal, and a hypodense area in the periapical region; *C)* Sagittal section of the dens invaginatus canal; *D)* Sagittal section of the main canal; *E)* Axial section showing the two canals (left: flattened main canal; right: dens invaginatus canal); *F)* Axial section showing an extensive periapical lesion; *G)* Panoramic view of the upper arch showing the presence of the unilateral dens invaginatus

The aim of the present study is to report a case of nonsurgical endodontic treatment of an Oehlers type II DI in the right maxillary lateral incisor accompanied by an extensive periapical damage, as well as the two-year clinical and tomographic follow-up.

Case Presentation

A 30-year-old female patient was referred for endodontic treatment of tooth #12. During anamnesis, the patient reported a history of orthodontic treatment and pain in the region of the right maxillary lateral incisor. She did not have any systemic conditions. Intraoral clinical examination revealed an absence of edema or fistulas, as well as shape and color alteration in crown of the reported tooth. Cold pulp testing (Endo-ice, Hygenic Corp., Akron, OH, USA), percussion (vertical and horizontal), palpatation, and mobility tests of tooth #12 resulted negative. Periodonal probing (FAVA millimeter probe, São Paulo, SP, Brazil) as a complementation of intraoral examination revealed no periodontal pocket.

Periapical radiography and CBCT (Figures 1) showed a unilateral DI (Figure 1G) in the right maxillary lateral incisor, with the invagination extending beyond the cementoenamel junction, and making no contact with the periapical tissues, consistent with Oehlers type II DI. A periapical hypodense image associated with the affected tooth was also identified (Figure 1). A hyperdense image was detected in the cervical third root, suggesting the presence of pulpal calcification (Figure 1A and 1B). C-shaped flattening was observed in the mesiodistal direction (Figure 1E) and a broad blunderbuss-shaped foramen was found in apical third of the root (Figure 1B). The DI canal was characterized by great anatomic variability (Figure 1B and 1C). The diagnosis was asymptomatic apical periodontitis.

Endodontic treatment in two clinical sessions was proposed. In the first session, after the patient had signed the informed written consent form, antisepsis was performed by a rinse with 0.12% chlorhexidine digluconate mouthwash for one min, followed by local anesthesia with 2% mepivacaine with 1:100,000 epinephrine (DFL, Rio de Janeiro, RJ, Brazil). Absolute isolation was performed

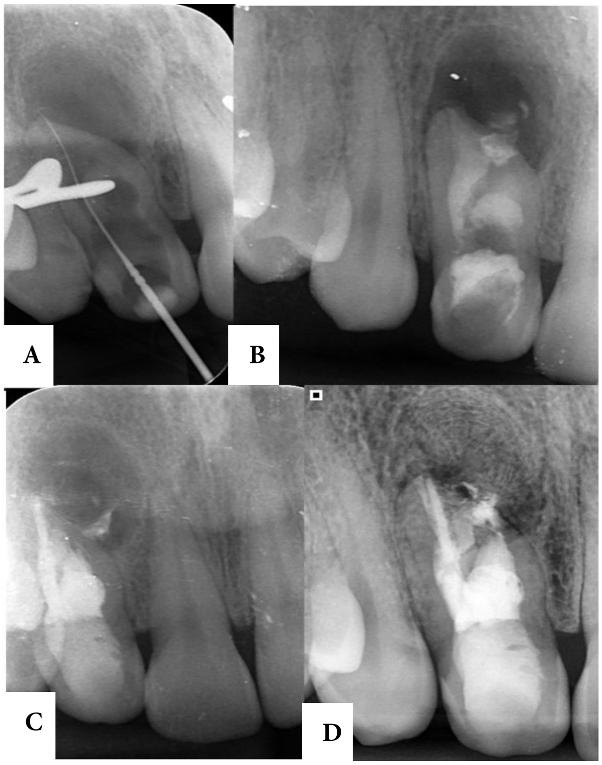

Figure 2. *A*) Periapical radiograph after removal of the calcification in the cervical third of the main canal and confirmation of the working length; *B*) Radiograph of the quality of the intracanal medication (calcium hydroxide); *C*) Final radiograph of endodontic treatment of tooth #12; *D*) Radiograph obtained after two years of follow-up showing complete repair of the periapical lesion

immediately thereafter for subsequent crown access using a spherical diamond bur (#1013), followed by a conical bur (#3081) (KG Sorensen, Serra, ES, Brazil). Cervical calcification was removed from the main canal with a diamond-coated ultrasonic insert (E6D, Helse, Santa Rosa de Viterbo, SP, Brazil) at a power of 30% and cooled with sterile saline (JP Farma, Ribeirão Preto, SP, Brazil) under a surgical microscope (Alliance, São Carlos, SP, Brazil).

Next, the root canal system was disinfected with a 2.5% sodium hypochlorite solution. Employing a hybrid technique, mechanical preparation of the main canal was performed using the WaveOne Gold system (#25/0.07, #35/0.06, and #45/0.05; Maillefer, Ballaigues, Switzerland), complemented with manual K-files (#50 and 55) (Maillefer, Ballaigues, Switzerland). Because of the greater anatomic irregularity of the DI, the chemical solution was activated by various 20-sec cycles of passive ultrasonic irrigation (E1 insert, Helse, Santa Rosa de Viterbo, SP, Brazil) at a power of 20%, combined with XP-Endo Finisher (FKG, La Chaux-de-Fonds, Switzerland). The working length was established with an electronic apex locator (Finepex-Schuster, Santa Maria, RS, Brazil) and confirmed by periapical radiography (Figure 2A).

For removal of the smear layer, passive ultrasonic irrigation was first performed with 5 mL of 2.5% sodium hypochlorite solution for each canal (3 cycles of 20-sec agitation), followed by irrigation with 5 mL saline, 5 mL of 17% ethylenediaminetetraacetic acid (also 3 cycles of 20-sec agitation), and 5 mL saline. Calcium hydroxide-based intracanal medication (Ultracal XS, Ultradent, Joinville, SC, Brazil) was selected, which was also submitted to ultrasonic agitation with an E1 insert for 1 min (30 sec in the buccolingual direction and 30 sec in the mesiodistal direction) in order to increase the penetration into the dentinal tubules and to reduce the microbial load. The medication was left inside the root canal system for 30 days (Figure 2B). The crown was sealed with light-cured glass ionomer cement (Biodinâmica, Ibiporã, PR, Brazil).

In the second treatment session, the intracanal medication in the main canal was removed by irrigation and agitation (passive ultrasonic irrigation) with 2.5% sodium hypochlorite and a #55 K-file instrument inserted to the working length. To further activate the auxiliary chemical substance, the XP-Endo Finisher instrument (FKG, La Chaux-de-Fonds, Switzerland) was applied, reaching 2 mm short of the working length, using the sequence described above (2.5% sodium hypochlorite, saline, 17% ethylenediaminetetraacetic acid, and saline). Next, root canal obturation was performed by creating an apical plug (4 mm) with MTA Repair HP bioceramic reparative cement (Angelus, Londrina, PR, Brazil). The thermoplasticized gutta-percha technique was selected for obturation, along with Bio-C Sealer cement (Angelus, Londrina, PR, Brasil). The tooth was then restored with composite resin (Filtek Z250 XT, 3M, Sumaré, São Paulo, Brazil) (Figure 2C).

After 2 years of clinical, radiographic (Figure 2D), and tomographic (Figure 3) follow-up, complete repair of the periapical lesion was observed and the patient showed no clinical signs or symptoms.

Discussion

The present case initially had an unfavorable prognosis due to the great anatomic complexity of tooth #12 and because it was a DI, the most prevalent dental developmental anomaly associated mainly with the maxillary lateral incisors. This scenario was accompanied by an aggravating factor, the presence of an extensive periradicular lesion that caused rupture of the buccal cortical bone.

Different methods for the classification of DI manifestations have been proposed in order to better understand this anomaly and to establish an approach for the clinical management of the root canal and invagination. The most widely used classification was described by Oehlers [11], which divided the lesions into three categories: type I, type II and type III (the invagination has

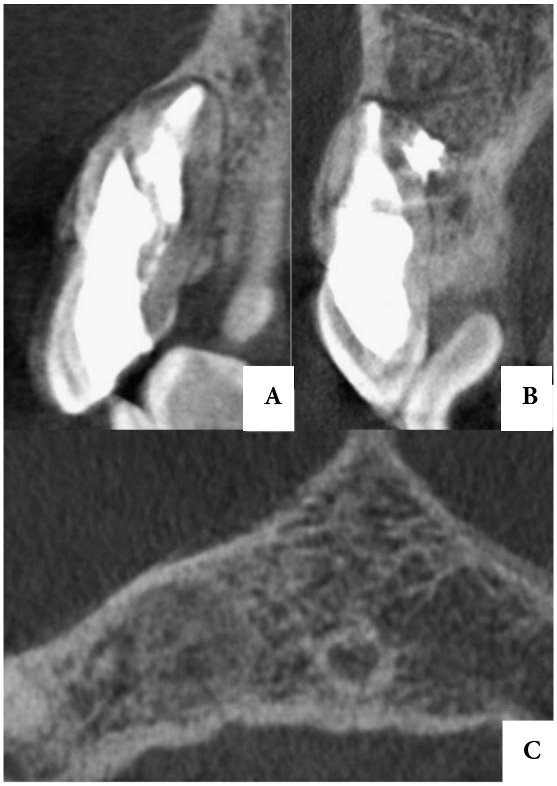

Figure 3. *A*) Sagittal CBCT section of tooth #12; *B*) Coronal; C) Axial CBCT sections showing complete repair of the periapical lesion and bone neoformation

penetrated the root laterally, subtype IIIa, and an apical foramen separate from the main tooth apex, subtype IIIb). The present case was a type II DI, in which the invagination extended beyond the cementoenamel junction but there was no communication with the periapical tissues. It is ideally recommended to treat the root canal and invagination separately for different reasons, to analyze the dental pulp conditions, as well avoiding the excessive removal of tooth structure [1]. However, due to the complexity of the DI, it is necessary to join the canal with the invagination in order to establish a better access to the apical region and to consequently, permit disinfection [12]. Thus, in the present case, endodontic treatment was performed separately on the main canal and the invagination since the DI did not impair the disinfection of the main canal.

The complexity of DI is related to the type of invagination, root canal anatomy, pulp morphology, and morphology of the apical region. Knowledge of these factors is of fundamental importance for treatment planning and diagnosis. Conventional radiologic methods such as periapical and panoramic images are routinely used for this purpose [13]. However, conventional radiographic techniques have numerous limitations, including the overlapping of adjacent teeth and varying degrees of geometric distortion, because they are two-dimensional methods [9]. Cone-beam computed tomography is, therefore, the most recommended method since it offers three-dimensional visualization of structures, better resolution and larger field of view, thus providing more reliable images of anatomic complexities [6, 14-16]. Treatment of this case was planned using CBCT, which enabled the accurate classification of the type of invagination and level of complexity for subsequent endodontic treatment.

Magnification combined with the use of ultrasonic inserts, are essential for crown access and the preparation of teeth with DI [10, 17]. Despite notable technological advancements, which ensured safety and provided better tools for the treatment of teeth with DI, there are still some limitations regarding the effective disinfection of the root canal system. Effective cleaning of root canal systems is a clinical challenge because of their complex features, including anatomic variations, isthmuses, lateral canals, curvatures, and oval-shaped canals. Studies indicate that a significant percentage of the root canal walls remain unprepared even after instrumentation [18].

The present case of DI was associated with extensive apical periodontitis. Extensive periradicular lesions are related to complex and old intraradicular infections that consist of bacterial colonies characterized by greater richness of species and a high population density [19]. With that in mind, adequate disinfection of the complex anatomy of teeth with anatomic variations can be achieved by supplementary steps, such as activation of an auxiliary chemical substance with XP-Endo Finisher and passive ultrasonic irrigation. The purpose of these activation systems is to increase the distribution of chemical solutions and improve disinfection, particularly in difficultly accessed anatomic regions [20, 21].

Another important approach that helps reduce the microbial load and was used in the present case is the application of calcium hydroxide-based intracanal medication. This medication is used because of its properties that include high alkalinity, tissue dissolution capacity, ability to neutralize endotoxins, and antimicrobial activity [22]. Furthermore, strategies such as apical plug with reparative bioceramic cements and the use of thermoplasticized gutta-percha were applied to improve sealing and three-dimensional filling of the main canal and of the invagination.

It is not possible to establish a protocol for the management of teeth with dens invaginatus, due to the great anatomic, pathological and therapeutic challenges encountered. However, the clinician, when faced with cases like these, can base themselves on and find points of similarity between the cases and, therefore, establish a treatment plan.

Conclusions

Appropriate treatment in cases of anatomic variations requires an accurate and early diagnosis based on clinical examination and high quality radiographic images. Follow-up of the present case for two years showed that the correct diagnosis associated with appropriate instrumentation techniques, supplementary disinfection, and adequate three-dimensional sealing of the canal with filling material enabled the regression of the periradicular lesion and bone repair.

Conflict of interest
None.

Funding support
None.

Author contributions
Marina da Cunha Isaltino was responsible for collaborating on the patient's endodontic treatment, in addition to helping with writing the manuscript. Natália Gomes de Oliveira was responsible for the patient's endodontic treatment, in addition to helping with writing the manuscript. Paulo Maurício Reis de Melo Júnior was responsible for writing the manuscript. Carolina Viana Vasco Lyra was responsible for writing the manuscript. Pedro Henrique de Freitas Fernandes was responsible for writing the manuscript. Diana Santana de Albuquerque was responsible for supervising the manuscript.

References

1. Hernández SR, Pérez AR, Baasch AC, Brisson-Suárez K, Sellera DP, Ferrari PHP, Alberdi JC, Carreira CM, Gomes-Azevedo S, Alves FRF, Rôças IN, Siqueira JF, Jr. Management of teeth with dens invaginatus and apical periodontitis: A case series. J Am Dent Assoc. 2022;153(5):470-8.
2. Gallacher A, Ali R, Bhakta S. Dens invaginatus: diagnosis and management strategies. Br Dent J. 2016;221(7):383-7.
3. Shadmehr E, Farhad AR. Clinical management of dens invaginatus type 3: a case report. Iran Endod J. 2011;6(3):129-32.
4. Zhu J, Wang X, Fang Y, Von den Hoff JW, Meng L. An update on the diagnosis and treatment of dens invaginatus. Aust Dent J. 2017;62(3):261-75.
5. Abazarpour R, Parirokh M, Farhadi A, Jalali Z, Kheirabadi N. Successful Ultra-Conservative Management of a Mandibular Premolar with Dens Invaginatus. Iran Endod J. 2017;12(3):390-5.
6. González-Mancilla S, Montero-Miralles P, Saúco-Márquez JJ, Areal-Quecuty V, Cabanillas-Balsera D, Segura-Egea JJ. Prevalence of Dens Invaginatus assessed by CBCT: Systematic Review and Meta-Analysis. J Clin Exp Dent. 2022;14(11):e959-e66.
7. de Oliveira NG, da Silveira MT, Batista SM, Veloso SRM, Carvalho MV, Travassos RMC. Endodontic Treatment of Complex Dens Invaginatus Teeth with Long Term Follow-Up Periods. Iran Endod J. 2018;13(2):263-6.
8. Forghani M, Moghim Farooji E, Abuchenari J, Bidar M, Eslami N. Conservative Treatment of an Invaginated Maxillary Lateral Incisor with a C-shaped Canal Using Cone-Beam Computed Tomography. Iran Endod J. 2015;10(4):281-3.
9. Patel S, Brown J, Semper M, Abella F, Mannocci F. European Society of Endodontology position statement: Use of cone beam computed tomography in Endodontics: European Society of Endodontology (ESE) developed by. Int Endod J. 2019;52(12):1675-8.
10. Siqueira JF, Jr., Rôças IN, Hernández SR, Brisson-Suárez K, Baasch AC, Pérez AR, Alves FRF. Dens Invaginatus: Clinical Implications and Antimicrobial Endodontic Treatment Considerations. J Endod. 2022;48(2):161-70.
11. Oehlers FA. Dens invaginatus (dilated composite odontome). I. Variations of the invagination process and associated anterior crown forms. Oral Surg Oral Med Oral Pathol. 1957;10(11):1204-18 contd.
12. Kritika S, Bhandari SS, Benyöcs G, Villa Machado PA, Bishnoi N, Restrepo Restrepo FA, Karthikeyan K, Ataide I, Mahalaxmi S. Demystifying Dens Invaginatus: Suggested Modification of the Classification based on a Comprehensive Case Series. Eur Endod J. 2022;7(1):73-80.
13. Wei C, Wang D, Shen L, Lu P, Meng Z, Zhou R. Treatment opinions for dens invaginatus: A case series. Exp Ther Med. 2024;27(4):138.
14. Bahmani M, Adl A, Javanmardi S, Naghizadeh S. Diagnosis and Treatment of a Type III Dens Invagination Using Cone-Beam Computed Tomography. Iran Endod J. 2016;11(4):341-6.
15. Norouzi N, Kazem M, Gohari A. Nonsurgical Management of an Immature Maxillary Central Incisor with Type III Dens Invaginatus Using MTA Plug: A Case Report. Iran Endod J. 2017;12(4):521-6.
16. Setzer FC, Hinckley N, Kohli MR, Karabucak B. A Survey of Cone-beam Computed Tomographic Use among Endodontic Practitioners in the United States. J Endod. 2017;43(5):699-704.
17. Rotstein I, Llamosas E, Choi K. Endodontic therapy in teeth with anatomical variations. Ingle's Endodontics: PMPH USA, Raleigh, NC; 2019. p. 866-9.
18. Pérez AR, Ricucci D, Vieira GCS, Provenzano JC, Alves FRF, Marceliano-Alves MF, Rôças IN, Siqueira JF, Jr. Cleaning, Shaping, and Disinfecting Abilities of 2 Instrument Systems as Evaluated by a Correlative Micro-computed Tomographic and Histobacteriologic Approach. J Endod. 2020;46(6):846-57.
19. Boutsioukis C, Arias-Moliz MT. Present status and future directions - irrigants and irrigation methods. Int Endod J. 2022;55 Suppl 3(Suppl 3):588-612.
20. Siqueira JF, Jr., Rôças IN. Optimising single-visit disinfection with supplementary approaches: a quest for predictability. Aust Endod J. 2011;37(3):92-8.
21. Tonini R, Salvadori M, Audino E, Sauro S, Garo ML, Salgarello S. Irrigating Solutions and Activation Methods Used in Clinical Endodontics: A Systematic Review. Front Oral Health. 2022;3:838043.
22. Ordinola-Zapata R, Noblett WC, Perez-Ron A, Ye Z, Vera J. Present status and future directions of intracanal medicaments. Int Endod J. 2022;55 Suppl 3(Suppl 3):613-36.

Please cite this paper as: Isaltino MC, Oliveira NG, de Melo Júnior PMR, Lyra CVV, Fernandes PHF, Albuquerque DS. Nonsurgical Endodontic Treatment of Type II Dens Invaginatus in A Maxillary Lateral Incisor: A Case Report. Iran Endod J. 2024;19(3): 232-6. *Doi: 10.22037/iej.v19i3.45099.*