# Root canal treatment of a blunderbuss canal in the maxillary lateral incisor with dens invaginatus with apical plug application: a case report

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## ABSTRACT

**Introduction:** The incidence of anterior dental trauma in young adults is high. The impact of this has been previously reported that pulp necrosis occurs in 50% of young fixed anterior teeth so that the process of apex formation is disrupted and in some cases can cause a blunderbuss shape at the tooth root apex. Root canal treatment of blunderbuss teeth accompanied by dens invaginatus poses a challenge for a dentist. Aims of this case report to explain successful root canal treatment of a blunderbuss canal in the maxillary lateral incisor with dens invaginatus with apical plug application using MTA followed by esthetic rehabilitation. **Case report:** A 25-year-old female presented to RSKGM with a complaint of pain and swelling of the gingiva. History of trauma at the age of the patient was 10 years old without treatment. Clinical examination revealed a complete crown with dens invaginatus. Radiographic examination showed a periapical lesion and an open apex blunderbuss shape. Treatment performed was treatment with an apical plug using MTA and restoration using a peg crown. Shape root canal with a blunderbuss is an open apex root canal with the root apex diameter greater than the coronal diameter, hence requiring adequate material to form a cap over the root apex (apical plug). It has been reported that MTA is an apical plug material that has good sealing ability, biocompatibility, bacteriostatic activity and the ability to regenerate periradicular tissues. **Conclusion:** Root canal treatment of a blunderbuss canal in the maxillary lateral incisor with dens invaginatus with apical plug application of MTA material as apical plug is an effective method.

## Kata kunci

apical plug, blunderbuss canal, dens invaginatus, mineral trioxide aggregate

# *Perawatan saluran akar blunderbuss gigi insicivus lateral rahang atas dengan dens invaginatus dengan aplikasi apical plug: laporan kasus*

## *ABSTRAK*

***Pendahuluan:*** *Insidensi trauma gigi anterior pada pasien usia dewasa muda cukup tinggi. Dampak dari hal ini telah dilaporkan sebelumnya bahwa terjadi nekrosis pulpa pada 50% gigi anterior tetap muda sehingga proses pembentukan apeks terganggu dan pada beberapa kasus dapat menyebabkan bentuk blunderbuss pada apeks akar gigi. Perawatan saluran akar gigi blunderbuss yang disertai dengan dens invaginatus menimbulkan tantangan tersendiri bagi seorang dokter gigi. Tujuan laporan kasus ini melaporkan keberhasilan perawatan saluran akar gigi blunderbuss pada gigi insisivus lateral rahang atas dengan dens invaginatus dengan aplikasi apical plug menggunakan MTA yang dilanjutkan dengan rehabilitasi estetik.* ***Laporan kasus:*** *Seorang perempuan, 25 tahun datang ke RSKGM dengan keluhan nyeri dan pembengkakan pada gingiva. Riwayat trauma pada saat usia pasien 10 tahun tanpa dilakukan perawatan. Pada pemeriksaan klinis terlihat mahkota lengkap dengan dens invaginatus. Pemeriksaan radiografi menunjukkan lesi periapikal dan apeks terbuka berbentuk blunderbuss. Perawatan yang dilakukan adalah perawatan dengan apical plug menggunakan MTA dan restorasi menggunakan mahkota pasak. Bentuk saluran akar dengan blunderbuss adalah saluran akar apeks terbuka dengan diameter apeks akar lebih besar dari diameter koronal, oleh karena itu membutuhkan bahan yang adekuat untuk membentuk menutup ujung apeks akar (apical plug). Telah dilaporkan bahwa MTA adalah bahan apikal plug yang memiliki kemampuan sealing yang baik, biokompatibel, aktivitas bakteriostatik dan kemampuan meregenerasi jaringan periradikular.* ***Simpulan:*** *Perawatan saluran akar blunderbuss pada gigi insisivus lateral rahang atas dengan dens invaginatus dengan pengaplikasian apical plug bahan MTA sebagai apical plug merupakan metode yang efektif.*

## *Kata kunci*

*apical plug, blunderbuss canal*, dens invaginatus, mineral trioxide agregat

## INTRODUCTION

Root development and apical closure take 3-4 years after the tooth has erupted. When pulpal trauma occurs during this period there will be damage to HERS cells (Hertwig's Epithelial Root Sheath) so that root formation is incomplete and results in thin dentinal walls in the root and a divergent, open apex.[1,2] One form of an imperfect apex is a blunderbuss apex, where the apical diameter of the root canal is larger than the coronal diameter.[3,4]

Root canal treatment of blunderbuss canals accompanied by dens invaginatus presents a challenge in endodontic treatment. Dens invaginatus is an abnormality of tooth development due to the invagination of the enamel organ into the dental papilla during odontogenesis.[5] In teeth affected by dens invaginatus, the morphology of the crown can considerably, with deviations that in most instances can be easily detected at inspection, such as hypoplastic or hyperplastic appearance and in folds. On a few occasions, the crown can exhibit a normal appearance. Morphologic abnormalities can usually be detected by radiographic examination.[6] The reported incidence of dens invaginatus ranges from 0.04% to 10%, and most often found on the maxillary lateral incisor. Invagination allows entry of bacteria into the pulp tissue. Therefore, dens invaginatus predisposes to dental caries, which can lead to pulpal necrosis and periradicular lesions.[7,8] Root canal treatment cannot be done with conventional endodontic procedures, so it becomes a big challenge for dentists because the root canal walls are thin and prone to fracture.[3]

Mineral Trioxide Aggregate (MTA) is the right material to create an apical barrier in the blunderbuss canal.[1] MTA has been shown to provide an 85% success rate at a 1-year follow-up. MTA provides an apical seal with osteoconductive properties. Al-Kahtani et al (2014) showed that 4-5 mm of MTA should be placed as an apical barrier to prevent apical leakage.[9,10] MTA is one of the most effective materials for sealing both iatrogenic and pathological communication between endodontic and periodontal spaces.[11] MTA has good sealing ability and biocompatibility and it has the ability to induce cementum-like hard tissue and periodontium around it.[12,13]

Due to the uniqueness of this case, there is a blunderbuss canal with dens invaginatus so that is the aims of this case report to explain successful root canal treatment of a blunderbuss canal in the maxillary lateral incisor with dens invaginatus with apical plug application using MTA followed by esthetic rehabilitation.

## CASE REPORT

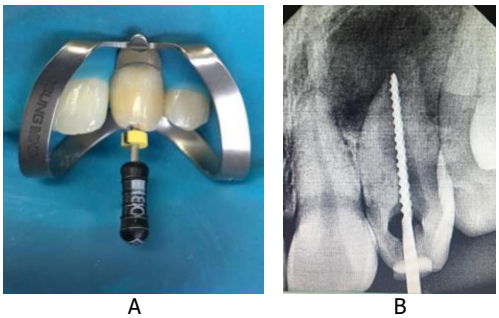
A 25-year-old female patient came to RSGMP Hasanuddin University with complaints of pain and swelling of the maxillary left lateral incisor. The tooth had been hit in a swimming pool since he was 10 years old and had not been treated. Patients want her teeth treated and maintained.

Clinical and radiographic examination revealed an anomaly called dens invaginatus on the crown of the maxillary left lateral incisor. On objective extra oral examination symmetrical face with normal mouth opening, intra oral examination pulp vitality (-), percussion (+), and palpation (+), indicate that there is swelling of the surrounding gingiva. A Radiographic image revealed a radiolucency in the periapical area with the shape of a blunderbuss canal. The diagnosis was pulpal necrosis with an acute apical abscess. The treatment plan is root canal treatment with an apical plug with MTA.

A B C

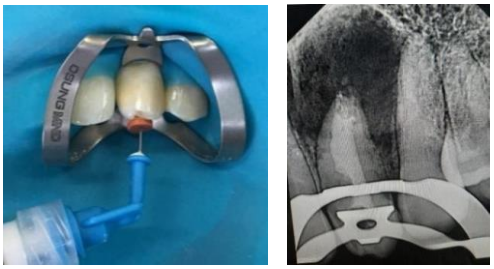
**Figure 1.** A,B. Initial clinical photo; C. Initial radiographic photo

The first visit was carried out with communication, information, and education and informed consent. Perform access opening accompanied by determination of working length using K-file #80 with an apex locator and confirmation with radiography (working length 21.5 mm). Furthermore, root canal preparation was performed circumferentially using K-file #80 irrigation with 2.5% NaOCl, 17% EDTA, and sterile aquadest. Dressing with calcium hydroxide ($Ca(OH)_2$), temporarily sealed.



A B

**Figure 2.** A. Measurement of working length; B. Radiographic confirmation of working length



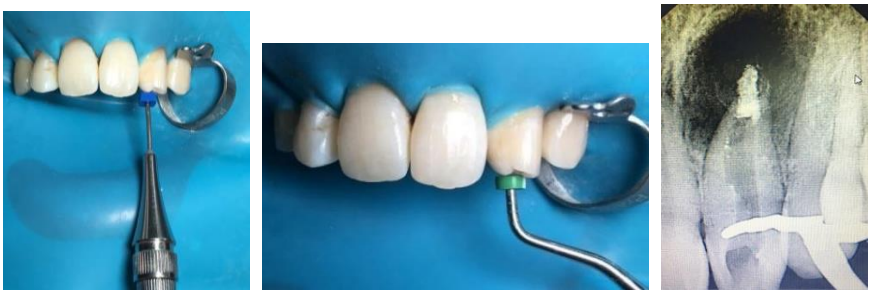
A B

**Figure 3.** A. $Ca(OH)_2$ dressing application$_2$; B. Radiography of $Ca(OH)_2$ dressing application

The second visit resulted in an objective examination of percussion (+), followed by a second dressing with calcium hydroxide $Ca(OH)_2$ and closure with a temporary seal.

**Figure 4.** Radiography of calcium hydroxide dressing application for the second

On the third visit, the results of subjective and objective examinations revealed no complaints. Then, 4 mm of MTA was applied in the apical area using an MTA carrier and compacted with a plugger. Confirm by radiography and cover with moist cotton and a temporary seal.



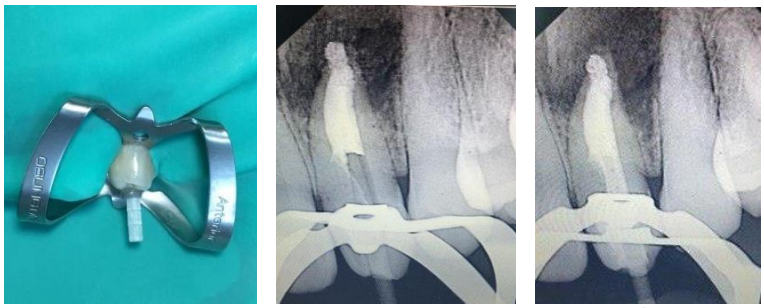
**A** **B** **C**

**Figure 5.** A. MTA application utilizing MTA carrier; B. MTA compacted with plugger; C. 4mm MTA application radiograph

On the fourth visit, the subjective and objective examinations had no complaints. Fill the root canal with the thermoplastic technique 5.5 mm.

**Figure 6.** Radiograph after root canal obturation

The next visit was carried out by inserting a fiber post using dual-cured self-adhesive resin cement. Then do the tooth crown preparation.



**A** **B** **C**

**Figure 7.** A. Fiber post insertion; B. Try-in radiograph of the fiber post; C. Fiber post insertion radiography

**A** **B** **C**

**Figure 8.** A. Preparation of the *crown* tooth 22; B. Determination of tooth color by the shades guide; C. The temporary crow

Two weeks later, the insertion was performed using crown lithium disilicate and dual-cured self-adhesive resin cement.

**Figure 9.** The lithium disilicate crown insertion

After 3 months, the patient came for control, and the subjective and objective examination results had no complaints. The radiographic examination showed that the periapical lesion was reduced in size from before.

**Figure 10.** Radiograph evaluation after 3 months of control

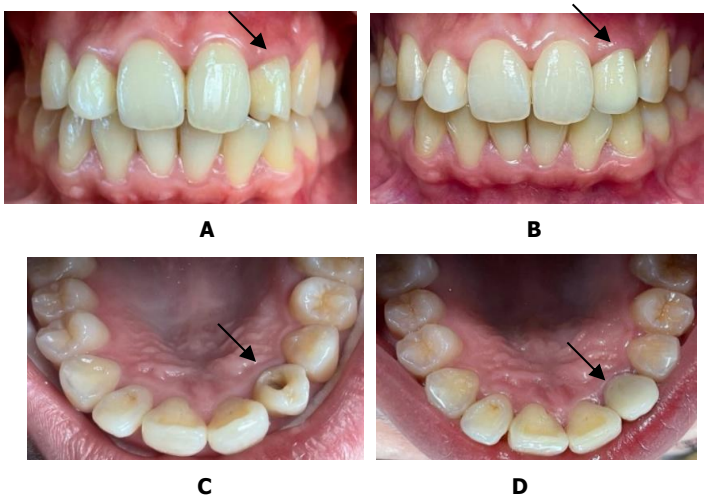


**Figure 11.** A. Before treatment facial view; B. After treatment facial view; C. Before treatment occlusal view; B. After treatment occlusal view

## DISCUSSION

Trauma that occurred to the maxillary left lateral incisor when the patient was 10 years old resulted in the tooth experiencing pulpal necrosis before root development was complete, as a result of which root growth stopped and the root canal took the form of a blunderbuss. The presence of blunderbuss canals makes conventional root canal treatment difficult to perform. Therefore, it requires proper techniques and methods in root canal treatment.[14,15,16,17]

Root canal preparations are used circumferentially because of the shape of the canal, which has a wide root and thin walls to avoid tooth root fracture. Irrigation techniques in blunderbuss canal treatment require a special approach. The irrigation technique used was passive pressure using a needle side-vented or EndoVac, according to the European Society of Endodontology (ESE) and the American Association of Endodontists (AAE). Previously study by Peeters et al (2018) reported irrigation dynamics play an important role in the effectiveness of irrigation and depend on the mechanisms of action of the irrigant and the ability to bring the irrigant into contact with the microorganisms and debris within the root canal space. This technique is used because it is able to develop lateral hydraulic pressure in the root canal to remove debris from the surface of the root canal walls. In addition, because of the turbulence that occurs around the tip of the needle, it has a closed-end tip that is laterally vented. This is in line with a study conducted by Ghivari, et al. showing that side-vented needles allow better removal of debris in the middle and apical third of the root canal when compared with needles single-bevelled. The use of Endovac needles can prevent extrusion of the irrigating solution, does not have a vapor lock effect, provides adequate irrigation volume, and has better cleaning effectiveness.[18]

The irrigation material used was 2.5% sodium hypochlorite (NaOCl). Based on the literature by Kharchi AS, the ideal concentration of NaOCl in open apical treatment management is 1.5-3%. This concentration effectively disinfects and also allows the survival and differentiation of SCAP. Low concentrations are used to avoid the toxic effects of these solutions. It has been reported that sodium hypochlorite has a toxic effect on tissues and increases with concentration.[19]

In this case, there was dens invaginatus type I, where the invagination is minimal and limited to the crown. When performing root canal treatment, there were difficulties in exploring the orifice due to invagination. In

some cases, the invagination may be removed completely to facilitate root canal access.[5,6,7,8]

Disinfection with calcium hydroxide paste is an effective agent with antibacterial properties. The antibacterial mechanism of calcium hydroxide depends on the release of hydroxyl ions, which can damage the cytoplasmic membrane and bacterial DNA.[20]

The use of MTA is very appropriate in this case. Based on the literature by Tabiyar et al (2021) reported the clinical and radiographic outcome of teeth treated by MTA apical barrier placement, a success rate of 90-93% was observed. This method produces a predictable apical barrier, reduces treatment time and is an evidence-based technique for the management of permanent non vital tooth with an open apex. Besides that MTA can form apical plug by artificial means that can rapidly close blunderbuss canals.[21,22,23] MTA has a high pH of 10.2 to 12.5. High pH conditions are one of the factors inducing the formation of hard tissue. According to several studies, the consistency of hard tissue formation produced by MTA material is better when compared to calcium hydroxide which is more porous. MTA can also induce the formation of new cementum and the regeneration of the periodontal membrane, as well as stimulate osteoblasts to produce osteocalcin and interleukins, which are involved in bone deposition and the regeneration of the periodontium.[21,24,25]

Obturation of the root canal with a thermoplastic technique is an option in this case. This technique is used because it has the advantage of being able to fill irregular root canals. In addition, this technique is also easy to insert and saves processing time because it can quickly fill the root canal. Previously study by Bhandi S et al (2021) have shown that thermoplastic techniques achieve a better sealing than lateral condensation technique because this technique manages to reproduce the internal anatomy of the duct better than the lateral condensation technique, obtaining better results in hermetic sealing. Another study by De-Deus el al which compared the filled area in both techniques using microscopic analysis, found that the void area with thermoplastic technique was less than the void area in lateral condensation technique.[26] In strengthening the tooth structure in this case, fiber posts were used. Research by Linsuwanont et al. (2018) stated that the use of fiber posts as intra-radicular reinforcements significantly improved the fracture resistance of teeth. Fiber posts has a modulus of elasticity almost as high as that of dentin, and the pressure is distributed evenly so as to prevent the risk of fracture in the thin root canal walls.[4,27] Final restoration with crown lithium disilicate is recommended because it provides strong, long-lasting, and aesthetically pleasing restorations. [28]

## CONCLUSION

Root canal treatment of blunderbuss canals in the maxillary lateral incisor with dens invaginatus using MTA as an apical plug is an effective method because it has good sealing ability and is able to induce the formation of hard tissue in the apical area. Apart from that, it needs proper preparation and irrigation techniques. Root canal treatment of a blunderbuss canal in the maxillary lateral incisor with dens invaginatus with apical plug application of MTA material as apical plug is an effective method.

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**Informed Consent Statement:** A statement of approval for the case report is provided and signed before the patient is examined

**Data Availability Statement:** The availability of research data will be provided with permission from all researchers via email correspondence with due regard for ethics in research

**Conflicts of Interest:** The authors declare no conflict of interest.

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