Case Report

Management of a bulbous blunderbuss maxillary central incisor with one root and three canals in a patient with cleft lip and palate

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Abstract

Unique anatomical deviations in canal structure are rare in anterior teeth, especially central incisors, and thus risk being overlooked. For successful intervention, a meticulous diagnostic procedure and treatment plan, significantly aided by cone-beam computed tomography (CBCT), are crucial. The case at hand explores the management of a maxillary left central incisor in a cleft palate patient, characterized by multiple developmental lobes, a bulbous crown, and an atypical root anatomy. The primary symptom was pain, accompanied by a history of trauma at age 8 years and ensuing tooth discoloration. Initial evaluations, augmented by CBCT, revealed pulpal necrosis in a single-rooted tooth with three distinct canals. Initial clinical examination was supplemented by electrical pulp testing, RadioVisioGraphy (RVG), and CBCT, after which the root canal therapy was initiated. Informed consent was obtained from the patient. The access cavity preparation resulted in a three-orifice cavity. Subsequently, the canals were enlarged and sufficiently debrided. Calcium-hydroxide was applied for 2 weeks before the commencement of apexification and obturation, followed by esthetic rehabilitation. This case highlights the importance of recognizing rare anatomical variations in anterior teeth and demonstrates the invaluable role of CBCT in both diagnosing and managing such complexities.

Keywords: Anatomy; apexification; cleft lip-palate; cone-beam computed tomography; dental esthetics; tooth abnormalities

INTRODUCTION

Every tooth is unique. Their root canal morphology can vary widely, making it impossible to predict a fixed pattern for any tooth.[1] While molars and premolars present with complex canal networks, anterior teeth show a variety of developmental defects. There are many recorded cases of the management of developmental defects and the management of complex canal anatomy, but it is important to consider the possibility of the combination of the two as well.

The developmental defects of the teeth that are commonly observed include fusion, supernumerary teeth, dens invaginatus, dens evaginatus, and multiple root canals to name a few. The developmental disturbances can occur either as stand-alone conditions or in combination with other birth defects.[2] Dentinogenesis imperfecta is commonly associated with Ehler–Danlos syndrome, and supernumerary teeth are frequently seen in Gardner syndrome. Taurodontism is a common presentation in Klinefelter syndrome. Another commonly occurring birth defect is unilateral cleft lip with palate. Unilateral cleft lip with palate is considered to be the most common type of cleft lip and cleft palate with an incidence ranging from 9.8%[3] to as high as 44.3%.[4]

Patients with cleft lip and palate typically show developmental defects of the teeth such as enamel hypoplasia, dentin dysplasia, peg-shaped teeth, microdontia, and taurodontism.[5]

The canal morphology of anterior teeth is recorded as a single root with a single canal in 100% of the cases, but

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there are exceptions recorded to this observation with anterior teeth presenting two or more canals.[6]

Considering the anatomic variations that occur in a patient with cleft lip and palate, it is of utmost importance to understand the probable canal variations in these teeth. The present case showcases the rare occurrence of multiple canals in the maxillary central incisor in a patient with cleft lip and palate.

When these morphologically variant teeth develop pulpal inflammation, they require endodontic therapy. Successful endodontic therapy in such challenging cases hinges on knowledge of anatomical variations, imaging systems, precise planning, and seamless execution.

Advanced imaging plays a vital role in this context. Cone-beam computed tomography (CBCT), along with other advanced imaging techniques such as computer tomography, magnetic resonance imaging, and digital radiography, is essential for gaining a clear understanding of these complex cases.

Another noteworthy clinical endodontic condition is the manifestation of an open apex. When the natural progression of development of the tooth is hindered and the tooth is deemed nonvital before the closure of the apical foramen, it is considered to be an open apex or a blunderbuss canal.[7] This condition often prompts consideration of two common modes of treatment, apexification,[8] and apexogenesis,[9] which differ based on the clinical findings of the tooth and periodontium.

In the present case, we delve into the treatment of a bulbous multilobed central incisor in a unilateral cleft lip and palate patient, characterized by an unusual root canal anatomy of three canals within a single root and a blunderbuss canal apex. We emphasize the importance of identifying these root canal intricacies and its role in ensuring the dual objectives of preserving esthetics while ensuring functional rehabilitation of our patients.

This case report not only adds to our understanding of endodontic challenges but also underscores the critical link between precise diagnosis and effective treatment execution.

CASE REPORT

This case report documents a distinctive clinical scenario involving a 17-year-old female patient who presented with a symptomatic maxillary left central incisor. The medical history reveals unilateral cleft lip and palate, with surgically corrected cleft lip.

Clinical examination

Clinical evaluation revealed a conspicuous bulbous coronal morphology of the maxillary left central incisor, with multiple lobes, with the right central incisor appearing anatomically typical. The tooth appears discolored and shows a negative reading to electrical pulp testing. The adjacent gingival tissue shows thick fibrous scar tissue extending into the labial vestibule. The symptomatic tooth exhibited tenderness upon percussion. Orthodontically, the patient exhibited Class 1 malocclusion with an anterior deep bite. No mobility was observed in relation to the tooth in question [Figure 1a and b].

Radiographic findings

Radiographic assessment shows an open apex and radiolucency extending longitudinally, adjacent to the involved central incisor. No periapical changes were evident. Given the enigmatic nature of these radiographic findings, a CBCT was deemed necessary [Figure 1c].

Cone-beam computed tomography analysis

CBCT imaging conclusively revealed three canal configurations at the middle third of the maxillary central incisor. These three distinct canals subsequently converged and coalesced within the apical third of the tooth, thereby elucidating the intricate root canal morphology [Figure 1d-f].

Diagnosis

After thorough examination, the diagnosis of the tooth in question was concluded as symptomatic irreversible pulpitis of the maxillary left central incisor. With multiple problem areas such as blunderbuss canal, pulpal inflammation, multiple canals, bulbous unesthetic clinical appearance, deep bite, and a rotated adjacent lateral incisor, it is crucial to have a well-devised treatment plan.

Clinical management

The present study protocol was reviewed and approved by the institutional review board. Prior consent was recorded from the patient as well as the guardian and the treatment plan was explained.

Subsequent to local anesthesia administration, root canal therapy was initiated under rubber dam isolation. The initial step involved the identification of a central canal orifice situated in the middle of the "incisor." Subsequent exploration led to the discovery of two additional orifices, located mesially and distally in relation to the central canal orifice [Figure 1g]. The working length was determined, followed by biomechanical preparation of all three canals [Figure 1h]. The central canal was prepared up to a #60 file, whereas the lateral canals were prepared up to a #45

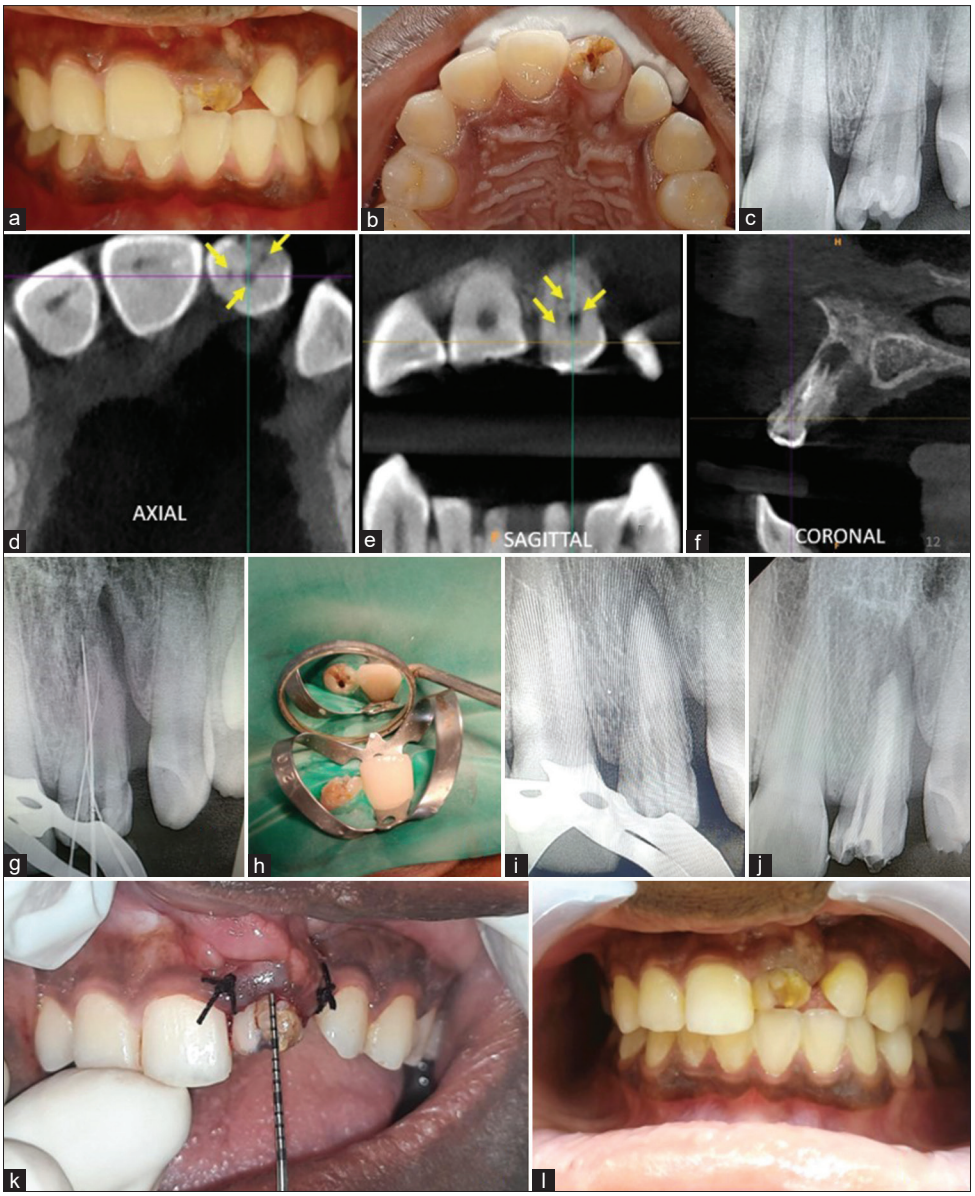

Figure 1: (a-c) Preoperative images, (d-f) cone-beam computed tomography images indicating the three canals, merging into one and an open apex, (g and h) access opening and working length determination, (i) mineral trioxide aggregate apexification (j) obturation (k and l) crown lengthening surgery with osseous reduction (immediate, after 6 weeks) (yellow arrows denote the three separate canals within a single root)

file. Calcium hydroxide intracanal medicament (RC Cal, Prime Dental Products, Mumbai, India) was placed for a period of 2 weeks.

Upon achieving asymptomatic status, an apical plug was created utilizing mineral trioxide aggregate (MTA) from Angelus Dental Solutions (Brazil) [Figure 1i].[10] The three canals were obturated with the warm vertical compaction technique. The canal orifices were sealed using composite restorative material [Figure 1j].

To enhance the coronal length and facilitate coronal restoration, a crown lengthening procedure, with osseous reduction, was performed. The patient remained under postoperative observation for a duration of 6 weeks before the crown preparation phase [Figure 1k and l].[11]

Composite restoration was done using nanohybrid composites and crown preparation was done to closely resemble a typical central incisor. The tooth was then prepared to receive an endocrown, following a modified preparation of the Bindl and Mormann technique, with intracanal preparation of 3 mm.

The cavity preparation was scanned using an intraoral scanner, computer-assisted design-computer aided

manufacturing milling was done on a zirconia blank in a 20 shade. The crown was cemented using dual cure cement (ParaCore Coltene, Whaledent, USA) in dentin shade [Figure 2a and b]. After radiographic confirmation, the adjacent tooth was addressed.

Smile designing and restoration

Since the adjacent tooth #22 was rotated, giving an unesthetic smile, a smile design was planned and was consequently executed using nanofilled composites [Figure 2c and d].

The final outcome presents a complete smile line, which follows principles of both form and function [Figure 2e and f].

Follow up

A 3-month, 6-month, and 1-year follow up was maintained, with polishing of the composite restoration after a period of 1 year [Figure 2g and h].

DISCUSSION

Dental anomalies, encompassing deviations from the norm in tooth morphology, are commonly seen in individuals affected with cleft lip and/or palate, specifically with relation to the teeth on the affected side. These variations span a broad spectrum, including variations in tooth shape, size, number, positioning, and even structural characteristics.

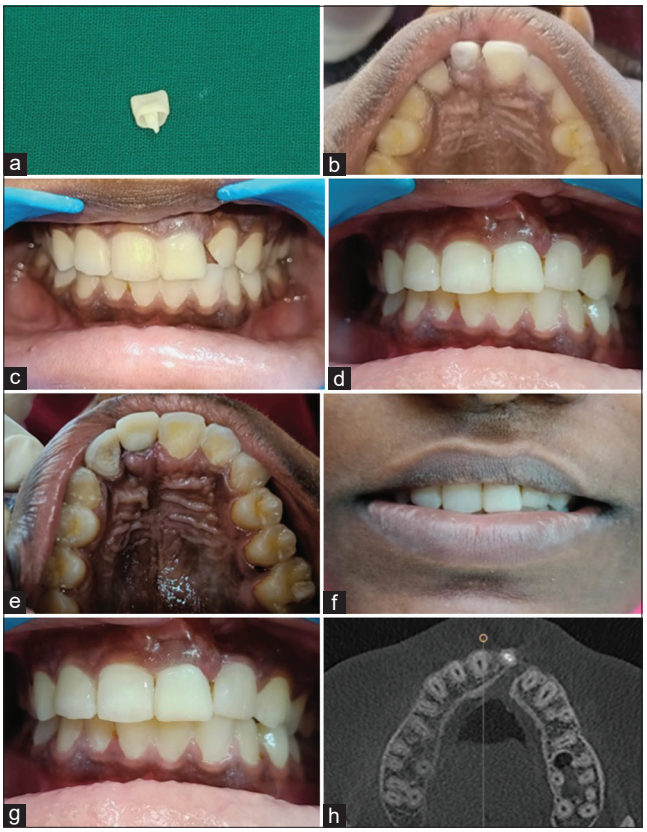

Figure 2: (a) fabricated endocrown, (b) crown preparation, (c) after endocrown cementation, (d) esthetic rehabilitation of #22, (e and f) final postoperative view (palatal, smile line), (g and h) 1-year follow-up

To understand the intricate anatomical variation of the affected tooth, a radiograph along with cone-beam computer tomography was advised. The sensitivity and specificity of the detection of a second canal anatomy are 94% and 93.1%, respectively.[12] The use of CBCT follows the ALARA principle of "As Low As Reasonably Achievable" as the radiation dose of a small volume CBCT is comparable to around 2–7 periapical radiographs.

For the restoration of the blunderbuss canal, MTA was the choice of material. MTA is a hydrophilic and biocompatible material that is known for its ability to stimulate healing and osteogenesis. When used as an apical plug, it provides an excellent seal, encourages the formation of a calcific apical barrier, and sufficient radio-opacity for adequate visualization.

Yet, another challenge faced in this case was identifying an ideal coronal restoration. The reduced clinical crown length did not prove ideal for a complete crown. The complex root canal anatomy prevented the placement of a fiber post system. Moreover, the post and core only ensure the retention but no support to the existing tooth structure.[13] Preparation of space for placement of a post would further weaken the tooth as a large amount of radicular dentin is removed.[14] It has been noted that the remaining dentin thickness after post space preparation in maxillary central incisors ranges from 0.2 mm to 1.5 mm, rendering the tooth extremely prone to fractures.

Considering these factors, a modified endocrown preparation was done, following the basic principles given by the Bindl and Mormann technique.[15]

The final challenge was in the correction of the unesthetic smile into a natural and presentable one. This included the restoration of the left lateral incisor which was rotated and also smaller in size. The lack of a palatal bony shelf made it unsuitable for an implant. Bearing in mind the minimally invasive nature and single appointment solution, direct esthetic composite veneering was done for #22 to closely resemble #12.

Follow-up was maintained at the intervals of 1 month, 3 months, 6 months, and 1 year, with polishing of the composite restoration after 1 year for periodic maintenance.

CONCLUSION

This case delves into the potentially ideal treatment plan

for an unusual case of bulbous maxillary central incisor with three canals and a blunderbuss apex in a cleft lip and palate case. This case report brings to light the emphasis on interplay between the developmental disorders and anatomical variations. The use of advanced imaging for endodontic management, application of minimally invasive procedures, root canal therapy, apexification, and esthetic rehabilitation is highlighted in the present case. The discussed case underscores the importance of an integrated and patient-centric treatment plan approach in a complex case.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given her consent for her images and other clinical information to be reported in the journal. The patient understands that her name and initials will not be published and due efforts will be made to conceal her identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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