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Research Paper

Non-Surgical Endodontic Management of Teeth with Aberrant Anatomy: A Case Series

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ABSTRACT : *The root canal therapy aims to remove the necrotic and vital pulp tissue remnants from the root canal to treat the periradicular inflammation. The knowledge of the tooth anatomy is essential to ensure a successful treatment. However, the deviation of the tooth anatomy complicates the diagnostic and treatment processes. Effective management of such complexities requires a tailored approach, utilizing detailed imaging and precise endodontic techniques to achieve successful outcomes and restore patient function and comfort. This case series presents the endodontic management of three different anatomic variations of permanent teeth that include taurodontism in the mandibular molar, two rooted mandibular canine and dilacerated maxillary central incisor and underscores the importance of personalized treatment planning and advanced diagnostic tools in managing complex dental anomalies.*

KEYWORDS: *Apical Periodontitis, Endodontics, Root Canal Irrigants, Root Canal Therapies, Taurodontism*

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I. INTRODUCTION

The major goal of root canal treatment is to remove pathogenic microbes and infected pulp tissue in the root canal, and prevent toxic by-product production, and protect the periapical tissue.[1] The success of root canal therapy mainly depends on the meticulous cleaning, shaping of the canal and effective disinfection. However, this is often challenged by complex anatomical variations. The root canal morphology exerts a decisive role in determining the outcome of the endodontic treatment.[2]

Endodontic failure can be attributed to inadequate cleaning of the root canal space.3 A comprehensive understanding of both typical and atypical root canal anatomies is vital for achieving successful endodontic treatment. The challenges of identifying and locating additional canals, negotiating abrupt changes in root curvature, and ensuring the complete removal of pulp tissues from the root canal system are common challenges encountered in clinical practice.

This case series details the management of three complex cases: a mandibular second molar exhibiting taurodontism, a two-rooted mandibular canine, and a severely dilacerated maxillary central incisor. Each case underscores the necessity of precise diagnosis and adequate treatment approaches to effectively address these anatomical complexities

Taurodontism is a developmental anomaly in which a morpho-anatomical change in the shape of the tooth occurs. It is caused by the failure in the invagination of Hertwig's epithelial root sheath which leads to an apical elongated pulp chamber of the root furcation. It is characterized by an elongated pulp chamber, apically displaced pulp chamber floor, and shortening of root canals.4 The prevalence of taurodontism in mandibular second molars is the highest among all molars, with reported prevalence rates ranging from 0.1%–18.8%.[5]

The mandibular canine is the second longest tooth in human dentition. Morphologically mandibular canine is mono-radicular. The mandibular canine has Vertucci's type I configuration in approximately 85% of

the cases.[6] Some atypical findings like, two root canals, one or two roots with three canals, and two roots and two canals have been reported in the literature.

Root dilaceration is an abnormality in tooth development and it is characterized by a deviation from the longitudinal axis, a sharp bend, or curvature in the tooth's root. Though the exact cause is not known, potential causes have been discussed in earlier studies, including trauma, genetics, spatial constraints, proximity to cysts, tumours, or unanatomical structures. Dilaceration can affect any tooth though its prevalence varies from 2.12% to 69.4%.[7]

II. CASE REPORT

2.1 Case -1

An 18-year-old male patient came to the Department of Conservative Dentistry and Endodontics with the chief complaint of pain in the lower right region of the jaw which was intermittent in nature, mild to moderate in intensity, and got aggravated at night.

Clinical examination revealed deep occlusal surface caries in respect to #47 and was mildly tender on percussion.

Radiographic evaluation revealed deep caries involving pulp, periapical lesion, and discontinuous lamina dura in the apical region. A large pulp chamber with greater apico-occlusal height than normal, lack of usual cervical constriction, and exceedingly short roots, was noted on radiograph, indicative of taurodontism.(Figure 1a)

A diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis in a taurodontic tooth was made. Multi-visit non-surgical endodontic therapy was planned.

In the first visit, L. A was administered, rubber dam was placed. Access opening was done under dental operating microscope. Three canals were located, the pulp was extirpated and working length was estimated using #15K files.(Figure 1b) Meticulous shaping of canals were done using constant taper files (NeoEndo, Orikam, India) till 25/4% and copious irrigation was done using 3% sodium hypochlorite (Parcan, Septodont, France). Calcium hydroxide paste was placed as an intracanal medicament for 7 days and the tooth was temporized.

After 7 days, the patient was asymptomatic. The tooth was isolated, temporary restoration was removed. Thorough irrigation was done using 17 % EDTA, saline, and 3% sodium hypochlorite. All irrigants were activated using ultrasonics. The canals were dried using paper points. Under the microscope, sectional obturation was done using GP points and bioceramic sealer (Rootfyx, Maarc Dental, India), followed by thermoplastic obturation in the extended pulp chamber of the taurodontic tooth. Ionoseal was used for coronal sealing of gutta-percha and the tooth was restored with composite (Tetric N Ceram, Ivoclar Vivadent, Liechtenstein). (Figure 1c) The patient was recalled after three months for follow-up and was completely asymptomatic. (Figure 1d)

2.2 Case-2

A 42-year-old female patient was referred to the Department of Conservative Dentistry and Endodontics with the chief complaint of multiple decayed teeth in the lower left region and multiple missing teeth.

Clinical examination revealed deep distoproximal caries with respect to #33 and was mildly tender on percussion. Following the clinical examination and pulp sensibility tests, a diagnosis of irreversible pulpitis with asymptomatic apical periodontitis was made for tooth #33.

Multiple visit endodontic therapy was planned. In the first visit, L. A was administered, rubber dam was placed. Access opening was done. The presence of 2 canals was suspected. Intraoral periapical radiograph revealed 2 separate canals with 2 separate roots. (Figure 2a and 2b) Working length was determined using the electronic apex locator Dentaport ZX (Morita Co, Japan) and radiograph using #10 K files (Mani, Japan).(Figure 2b) Shaping of canals were done using ProTaper Gold (Dentsply) to F1and copious irrigation was done using 3% sodium hypochlorite (Parcan, Septodont, France). Freshly mixed calcium hydroxide paste was placed as an intracanal medicament and the tooth was temporized.

The patient was recalled after one week. Rubber dam isolation was done, and temporary restoration was removed. Irrigation was done using 17 % EDTA and 1.5% sodium hypochlorite and flushed out using normal saline. All irrigants were activated using sonic activation. The canals were dried using paper points. Obturation was done using gutta-percha and resin-based sealer (ADSEAL Plus, Meta Biomed, Korea). (Figure 2c) Gutta-percha excess was removed till the orifice level and Ionoseal® (VOCO, GmbH, Germany) was used to seal the coronal part and the tooth was restored with composite (Tetric N Ceram, Ivoclar Vivadent, Liechtenstein). (Figure 2d)

Three-months follow-up revealed the patient was completely asymptomatic. (Figure 2e) The patient was referred to the Department of Prosthodontics for occlusal rehabilitation.

2.3 Case 3:

A 17-year-old female patient was referred from the Department of Orthodontics for the management of discoloured tooth with respect to tooth #21.

Present dental history included on-going orthodontic treatment. Clinical examination showed normal gingiva around tooth #21, no palpation tenderness at the root apex, normal tooth mobility, blackish intrinsic discolouration, and a negative percussion test. Periodontal probing was within normal limits. Cold testing with Endo-Frost cold spray (Coltene, Altstätten, Switzerland) on the maxillary left central incisor showed no response as compared to the control teeth (maxillary right central incisor) which revealed a brief, sharp pain, indicative of non-vital pulp.

The periapical radiograph of the tooth revealed a severely "S-shaped" curvature in the apical third of the root, though no periapical radiolucency was evident (Figure 3c). Limited field-of-view cone-beam computed tomography (CBCT) images confirmed multiple root curvatures. Also, the apical third of the root was found to be in close proximity to the roots of tooth #22.

The treatment plan included non-surgical root canal treatment to debride the necrotic pulp. The patient was informed and consented to the treatment plan and procedures throughout the pre-operative and entire treatment process.

Following the administration of local infiltration anaesthesia, a full capsule (1.7 mL) of 4% articaine with 1:1,00,000 adrenaline (Septanest, Septodont, France) was injected on the buccal side, and a half capsule (0.85 mL) was administered on the palatal side. The tooth was isolated with a rubber dam.

Subsequently, access opening procedures were carried out. Straight-line access was established, and pre-curved #8 and #10 K-files (Dentsply Tulsa Dental, Oklahoma City, USA) were used to negotiate the root canal (Figure 3a and 3b).. The working length was determined using an electronic apex locator, and a periapical radiograph was taken to confirm the working length (Figure 3c). A copious 1% sodium hypochlorite solution (NaOCl) was used to irrigate the canal.

Endostar E3 Azure (Poldent, Poland) NiTi rotary files were used to instrument the canal to #25/.04. Copious 1% NaOCl and 17% EDTA were used to irrigate the canals during instrumentation. Final irrigation procedures were performed using 1% NaOCl and 17% EDTA activated by an ultrasonic file. The canals were dried using absorbent paper points and a trial fitting of the master gutta-percha cones then confirmed by a periapical radiograph. Before placing them, the tips of the gutta-percha cones were dipped in a small amount of Bioceramic sealer (Safe Endo). The root canal filling was completed using the sectional obturation technique with lateral condensation of accessory GP cones. A periapical radiograph was taken later to evaluate the quality of the root canal filling (Figure 3d). The GP cones were sheared at the level of CEJ and access cavity was sealed with permanent composite restoration (Figure 3e).

The decision pertaining to the surgical management of root dilaceration regarding the orthodontic movement is to be assessed later if necessary.

III. FIGURES

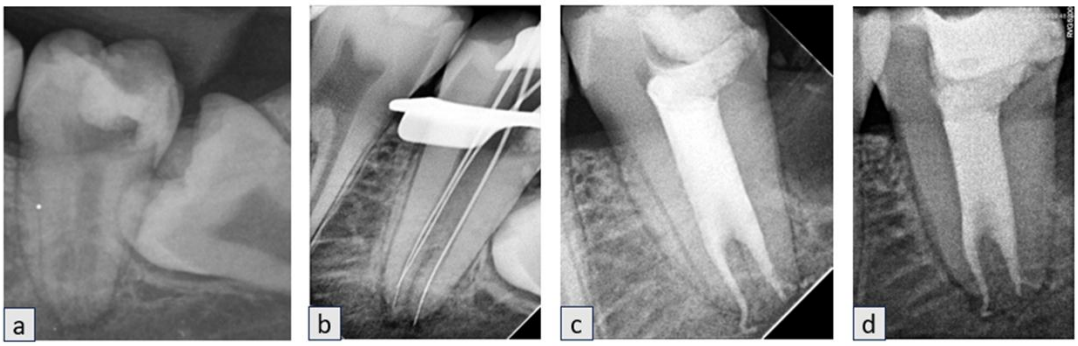

Figure 1. Endodontic management of taurodont tooth (a) Pre-operative (taurodontism) (b) Working length determination (c) Post-operative (d) 3 month Follow up.

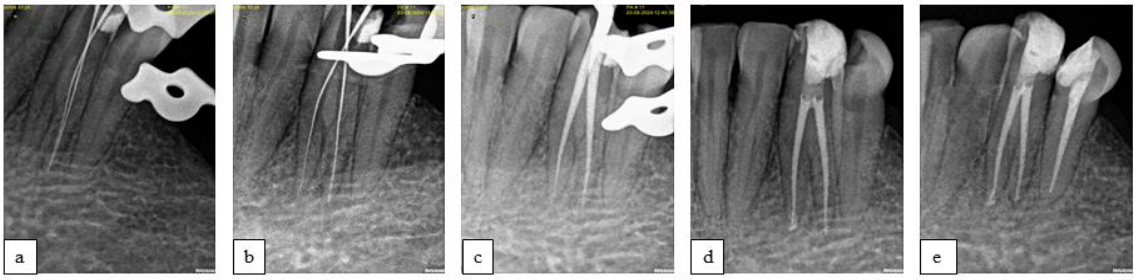

Figure 2. Endodontic management of mandibular canine with two roots and two canals. (a) Intraoperative radiograph revealing 2 roots and 2 canals (b) Working length determination (c) Master cone (d) Obturation and post endodontic restoration (e) Follow-up

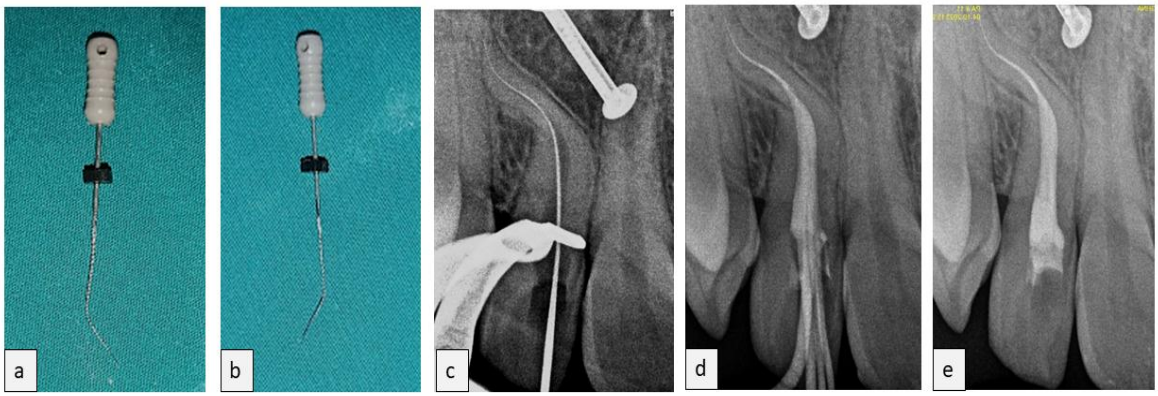

Figure 3 : (a) and(b) Shows the degree of curvature of the root canal 21; The radiographs of (c) Working length; (d) Lateral condensation with master cone and accessory GP cones e) Obturation

IV. DISCUSSION

Intraoral periapical radiographs play a major role in the diagnosis of the presence of variations in the root canal anatomies. If a morphological variation is expected, acquiring angled radiographs (20∘ –25∘ or Clark technique) will facilitate aid in the detection of extra canals.[8] If required, the use of limited field-of-view cone beam computed tomography can be used to confirm the internal variations that are not distinguishable with conventional methods.[9]

Taurodontism is defined as the enlargement of the pulp cavity of a molar tooth at the expense of root length.[10] Taurodontism appears most frequently as an isolated anomaly, but it has also been associated with several developmental syndromes and anomalies.[11]

In a study conducted by Bharti R et al (2015) in the North Indian population revealed the prevalence of taurodont tooth was 2.8% with a higher prevalence in males.[10] Taurodont tooth presents a challenge during negotiation, instrumentation, and obturation in root canal therapy. Magnification devices such as magnifying loupes or surgical microscopes can be helpful to locate canal orifices, evaluate the pulp chamber, and obturate the canals.[12] Prakash et al. suggested copious irrigation with 2.5% sodium hypochlorite to remove pulpal tissue from the irregular canal walls in such teeth.[10]

The occurrence of two roots and two canals is a rare entity ranging from 1 to 5%.[2] In general, 85% of the permanent mandibular canines exhibit a single root with a single canal (Vertucci Type I).[13] The presence of two root canals and two independent apical foramina were the most common anatomical variations of about 5.7% in permanent mandibular canine and this variation was found more common among females (87.5%).[13] The bifurcation of root and root canal occurred at floor or cervical 1/3 which is in accordance with previous study which states bifurcation at cervical and middle third has been shown to occur in 43% of situation at these sites.[14]

Andreasen et al, in 1971, defined dilaceration as the abrupt deviation of the long axis of the crown or root portion of the tooth, which is due to a traumatic nonaxial displacement of already formed hard tissue in relation to the developing soft tissue. According to a study by Malcic et al, dilacerations were less common in the mandible than in the maxilla. In 2006, Malcic et al reported a prevalence rate of 1.3 or 0.53% for maxillary

central incisors on the basis of periapical and panoramic radiographs respectively.[15] In dilacerated teeth, the accepted basic endodontic techniques must be strictly followed, that is, good preoperative and working radiographs, unobstructed access to the root canal orifice, as direct access as possible to the apical third of the canal (within the constraints of the dilaceration), pre-curving all files used and thorough irrigation. [16]
The complexities of the root canal systems, in addition to the structure and composition of the dentin, are key challenges for effective disinfection in endodontics. The conventional syringe-based method does not generate optimum shear stresses on the canal wall. Therefore, improved irrigant delivery (irrigation dynamics) within the root canal system is crucial to achieve the maximum efficacy out of the antimicrobial effect. The current endodontic disinfection trend aims towards improving the fluid dynamics during root canal irrigation.

V. CONCLUSION

The success of endodontic treatment relies upon the thorough understanding of the anatomy of root canal and the variations that can be encountered. Periapical radiographs and the cone beam CT plays an important role in the diagnosis and management of these anatomical variations. The strategic use of NiTi instruments, pre-curved hand files and magnification devices such as dental loupes or microscopes is very crucial. The combined use of these approaches ensures optimal treatment outcomes, particularly when dealing with complex anatomical variations.

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