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Breakthrough Approaches In Managing Calcified Canals With Guided Endodontics: A Case Report

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Abstract-
The term "pulp calcification" describes the build-up of hard tissue following dental trauma in the root canal space. Even though obliterated pulp chambers are frequently found in dental practices, access to them and the ensuing canal negotiation remain difficult for practitioners because of the higher risk of iatrogenic errors such as ledging, gouging & perforation. In this case report, a male patient aged 43 years reported with complaint of discoloured maxillary central incisor having history of trauma 10 years ago. On clinical examination, the tooth was tender on percussion and no signs of periodontal pocket present. Intraoral periapical radiograph revealed partially calcified root canal with periodontal ligament widening. Root canal treatment was initiated and attempts were made to locate the canal using digital operating microscope, which however wasn't successful. To help locate the root canal orifice, a 3D-printed endodontic guide was designed using digital planning software and cone beam computed tomography (CBCT) data. With the aid of guided endodontics, the canal was effectively navigated, and a three-month follow-up showed that the patient was asymptomatic and that radiographic revealed periapical healing. When handling significantly calcified canals, a digital process that utilizes CBCT imaging, planning software, and a 3D-printed endodontic guide may be taken into consideration for conservative, precise, and predictable outcomes.

Keywords*: Cone-beam computed tomography, guided endodontics, pulp canal calcification, root canal treatment, three-dimensional printing*

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I. Introduction

The American Association of Endodontists (AAE) categorizes the difficulty of managing obliterated root canals as high.[1] Even with the aid of a dental operating microscope (DOM) , it might be challenging to locate and prepare root canals in such teeth.[2,3] Procedural errors that may occur are, missing canal orifice, overextension of the wall of the access cavity perforations, canal deviation and instrument separation.[4,5]. The field of endodontics is making substantial use of digital technologies to improve treatment planning and expedite technical operations.[6] Images obtained with the help of Cone beam computed tomography (CBCT) and the patient's digital impression are integrated to enable the fabrication of 3D guides that help ensure accurate access to the tooth.[7] Localizing the canals is made possible by this strategy, which also minimizes procedural errors.[8] This study describes the use of guided endodontics to treat a maxillary anterior tooth that had a calcified canal.

II. Case Report

A 43 year old male patient reported to department of conservative dentistry & endodontics with chief complaint of discoloration of upper front tooth region persisting for past few months. Patient had history of trauma due to fall around 10 years back. Medical history was not significant. Clinical examination was

performed, yellowish brown discolouration was noted in the maxillary right central incisor. On percussion , mild tenderness was noted. Pulp sensibility tests Electric pulp test, cold test gave no response. There were no signs of periodontal pockets, movement, edema, or sinus opening. Calcified pulp chamber and a hazy sign of radiolucency in the canal within the middle part of the tooth #11 were visible on intraoral periapical radiography (IOPAR) images.

With the help of a CBCT scanner (Planmeca Romexis 5.3.5.80, G-XR-136953, Helsinki, Finland) under 10 mA and 90 kV, limited field of view pictures were obtained in coronal, axial, and sagittal views. The IOPAR results were supported by these CBCT images, and the image data (dicom files) were utilized in the 3D guide's fabrication.

Steps used in digital planning were :-

1) Using the 3D slicer software (3D slicer, ver 5.0.3R30893/7ea0f43), the CBCT files were converted from DICOM format to Surface Tessellation Language (STL) file.
2) The Autodesk Meshmixer software (Autodesk Meshmixer version 3.5.474, San Francisco, CA, USA) was used to import the STL files from 3D Slicer. This software aids in constructing the guide rod that is used to locate the pulp canal.
3) To accurately direct it toward the pulp chamber, the guide rod was positioned (superimposed) on the tooth's 3D model.
4) The stent was then exported to Lychee Slicer (Lychee Slicer, ver 5 (5.2.201), Bordeaux, France), where it was oriented towards the print bed and printed on a Phrozen Sonic Mighty 4K SLA 3D printer (Phrozen, Hsinchu City, Taiwan) using photocurable resin. This produced the final model of the 3D guide, which is now prepared for guided access.

Clinical Steps:-

1) Local anaesthesia was administered using infiltration technique (Lignox 2% A, Indoco remedies Ltd, Mumbai).
2) To ensure that the stent guide fit properly, it was inserted intraorally into the anterior teeth and checked.
3) Access opening was performed using high speed long neck round diamond bur(BR -154 Mani), enamel was carefully removed until underlying dentine was exposed.
4) The pulp chamber was located by advancing a long, tapered Endoguide bur (SS White) through the sleeve.
5) The drilling was performed with the help of a micromotor and with copious saline irrigation to penetrate through calcified portion of the root canal. The drill was routinely cleared of debris throughout preparation, and 3% sodium hypochlorite was used to irrigate the root canal completely.
6) Canal was negotiated with a 6 size k file (MANI)
7) Working length was determined to be 20mm using apex locator and verified by a intraoral periapical radiograph.
8) The apical preparation was done upto size 50 K file and step back preparation was done upto size 65 K file.
9) A final irrigation protocol utilizing 17% ethylenediaminetetraacetic acid and 3% sodium hypochlorite was carried out in addition to the usage of sodium hypochlorite (3%) for irrigation.
10) Both sonic (EndoActivator, Dentsply, USA) or manual dynamic activation methods were used to activate the irrigant using a calibrated master cone .
11) Paper points were used to dry the canal following which a calcium hydroxide dressing was placed (RC Cal) and the access cavity was sealed with Cavit (3M ESPE, USA).
12) After 2 weeks the canal was obturated using lateral compaction technique with bioceramic sealer (Cerafill RCS, Prevest Denpro)
13) The access was restored with resin composite (Ivoclar vivadent, Schaan, Liechtenstein).

Clinical Photos :-

Figure 1:-Pre-operative image

Figure 2:- Pre-operative IOPA

Figure 3:-IOPA post Access opening attempt

Figure 4:- Guided Endodontics under Digital Operating Microscope

Figure 5:- Working Length IOPA

Figure 6:- Immediate Post-op Image

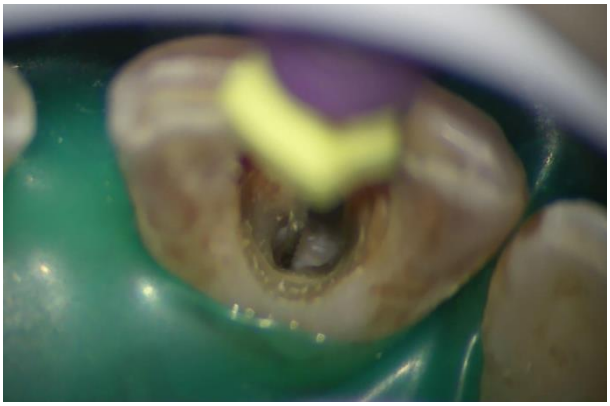

Figure 7-Image showing correct pathway of root canal with 10K File

Figure 8:- 3D Printed Guide

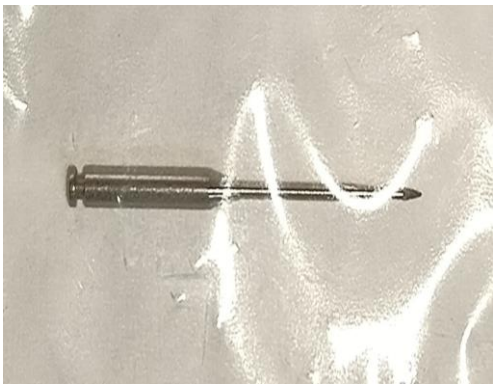

Figure 9:- Endoguide Bur

Figure 10 :- 3 Months follow up

III. Discussion

The formation of hard tissue inside the root canal space is known as pulp calcification, which is the pulp's response to dental trauma.[4] There is always a difficulty when deciding whether or not to treat such teeth with endodontics. According to Andreasen et al., 15% of traumatized permanent incisors had obstructed root canals, which was taken to mean that the pulp had healed and endodontic intervention was not considered essential. Nonetheless, some research indicates that teeth with obstructed canals may need endodontic therapy due to a 1%–27% risk of pulpal necrosis.[3,9,10]

When it is decided to proceed with a root canal, a conventional radiograph (IOPAR) can be used as a guide to try to construct a traditional access cavity. However, the precision and accuracy of getting access in a calcified tooth are always limited because of the 2D nature and distortion. As a result, using advanced radiological imaging techniques like CBCT has grown in importance as an investigative tool in endodontics.[12]

CBCT is emphasized as a suggested technique for identifying and finding calcified canals in a joint statement from the American Academy of Oral and Maxillofacial Radiology (AAOMR) and the AAE.[1]

A reliable method for managing severely blocked canals is guided endodontic access.[4,13]

There are two types of guided endodontics: static and dynamic. Software for virtual images, surface scanning, and CBCT imaging are used to build 3D-printed models (fixed surgical guides) of the static type. In contrast, dynamic navigation (DN) uses a guide to help with the drilling process by keeping track of the intended access depth, direction, and angle. A real-time stereoscopic motion-tracking camera is used in an optical triangulation system to accomplish this.[14]

The management of calcified canal cases should take into account nonsurgical root canal therapy and apical surgery as treatment alternatives. But there are three things to keep in mind: (i) time; (ii) the possibility of iatrogenic mistakes like gouging or perforation; and (iii) radiation exposure.[21]

Taking the procedure's overall duration into account is crucial. With traditional methods, the canal negotiation can take a while; but, with a guided approach, the canal patency could be reached in a matter of minutes.[22]

Successfully navigating an obliterated root canal without guidance may cause significant hard tissue loss, particularly in the cervical area where root fractures are frequent.[23]

Furthermore, in the absence of guided endodontic access, even the most skilled practitioners should proceed with caution and might suggest getting many radiographs to confirm that the tool is positioned precisely for a successful canal negotiation.[24]

Reducing the number of radiographs taken compensates for the radiation dose the patient receives during the CBCT scan, which is another advantage of the guided procedure.[25]

However, even with a guided approach, intraoperative radiographs from two or more angles are highly suggested.[25]

Apical surgery may be the choice of treatment for pulp canal obliteration, especially in cases where canal patency is challenging, for example, severly curved canals, even with guided approach.[21,22]

The predominant limitations of guided endodontics include the clinician's learning curve, radiation exposure, equipment, and laboratory expenses.[14,21,24,25]

IV. Conclusion

The unification of contemporary equipments & technologies, knowledge of pulpal anatomy and radiography procedures, and patience are essential for the successful management of calcified canals.

When it comes to managing calcified canals, guided endodontic treatment modality has demonstrated the ability to achieve high accuracy, little tooth preparation, which saves lot of time.

Future studies should focus on contrasting alternative planning programs, evaluating the viability of designs & various materials for both 3D guides and burs used to prepare access cavities.

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