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Pulp Canal Obliteration- A Daunting Clinical Challenge

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Abstract: *Traumatic injuries of primary or permanent dentition can lead to certain clinical complications and its management presents a considerable challenge for apractitioner. Pulp canal obliteration (PCO) also called as calcific metamorphosis (CM) following dental trauma has been stated to be approximately 37 - 40% and commonly noticed after luxation injuries. The diagnostic status and treatment planning decision regarding PCO always remains controversial. The decision on when to start treatment of such cases, whether on early detection of PCO or to wait until detection of signs and symptoms of pulp necrosis, always remains a clinical dilemma. Following calcific metamorphosis, scouting for the canals and negotiating it to full working length may lead to iatrogenic errors such as perforations or instrument separation. This article emphasizes on protocols to be followed on diagnosing and treating PCO and challenges that are to be encountered while managing these cases.Thorough knowledge of tooth morphology, skill, patience, use of appropriate instruments and materials are essential to successfully manage such cases.*

Key Words: *Pulp canal obliteration, Calcific Metamorphosis, Spiral computed tomography (CT).*

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I. Introduction

Traumatic dental injuries (TDIs) are the most common injuries for which people seek treatment and considered as a global problem accounting upto10- 35% of population according to various epidemiological studies. It is often considered as a dental emergency, as it requires a multidisciplinary approach and presents an absolute challenge to clinicians world-wide.[1]These injuriesleads to several complications which may appear shortly or after few months to years such as pulp necrosis, inflammatory/ ankylotic root resorption, and pulp canal obliteration.[2,3]Hence an accurate diagnosis, treatment planning and follow up are critical to curtail such complications.

Pulp canal obliteration, or calcific metamorphosis, is a sequelae of dental trauma due to severe injury to the neuro- vascular supply of the pulp which after healing directs to an expeditious dentin deposition within the pulp chamber and root canal space. This phenomenon more closely related to the loss and reestablishment of pulpal neural supply.[4,5]The American Association of Endodontists defines calcific metamorphosis as "*A pulpal response to trauma characterized by rapid deposition of hard tissue withinthe canal space."*Dystrophic Calcification, Diffuse Calcification and Calcific Degeneration are the other terms used to describe this condition.[4]

Prevalence of PCO after TDIs varies widely in clinical literature, ranging from3.7% to 40%. Development of PCO depends on two main factors: the type of injury and the patient's age at the moment of trauma. It is frequently encountered after luxation injuries such as subluxation, lateral luxation, extrusionof permanent teeth and also associated with tooth avulsion. The prevalence of PCO after root fractures in permanentteeth is noteworthy with reportedfrequency from 29.4% to 95.2%. PCO primarily involves teeth injured before completion of root formation.[6]Immature teeth has larger apicaldiameter which provides a broaderinterface through which new nerves and vessels can grow intotraumatized pulp from vital periodontal tissues, thus improving the probability of pulp revascularization and dentin deposition.[4]

PCO can be either partial or total obliteration of the pulp canal space with or without associated periapicalpathosis. Though complete obliteration of pulp space noticed in radiographs, it does not mean the absence of pulp canal space. Majority of these cases still show presentence of pulp space with pulp tissue.[7]

The following case report deals with the management of calcific metamorphosis in an immature teeth where in non-surgical intervention was successfully carried out.

II. Case Report

A 19 year old female patient reported to theDepartment with a chief complaint of discoloration in relation to her upper front tooth region. The patient gives a history of trauma 10 years back. The patient was asymptomatic during this period. The clinical examination revealed discolored tooth in relation to 11. Pulp vitality test showed negative response for affected tooth. The radiographic examination revealed immature teeth with incomplete root formation and entirelyradiopaque canal with respect to11 [Fig.1]. Spiral CT was advised to further confirm the diagnosis, which reveals completely obliterated pulp chamber and canal [Fig 2a,2b]. On the basis of history, radiographic and spiral CT findings,it was evident that this was a case of calcific metamorphosis. A non-surgical endodontic intervention was initially planned for management using dental loupes as magnification aids.

Fig 1: Intra oral peri apical radiograph irt 11

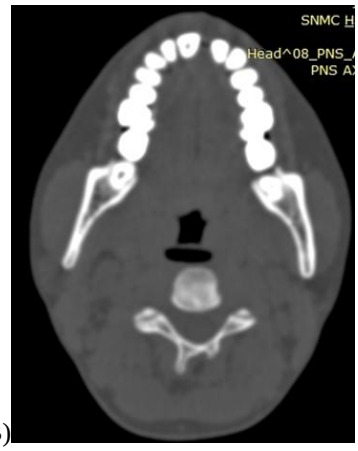
(A)  (B) 

Fig 2: 3D Imaging irt 11 using spiral CT (A;Sagittal and B;axial view)

Access cavitypreparation was done from palatal surface of crown with endo-access bur penetrating 3-4mm at an angle of roughly 45° to long axis of tooth.Then the bur was rotated parallel to long axis of toothto prevent perforation. Penetration was proceeded down the lingual aspect of access preparation with a frequent exploration of orifice with DG-16 endodontic explorer but failed to locate the orifice. The radicular access was tried using thin, long and pointed ultrasonic tips (start-X #3, Satellac). Short vertical up and down strokes were performed.

Thensmall k files No.6, 8, 10 were placed into the orifice to negotiate the canal but these files got unwind. Later stiffer stainless steel files like C- files (Dentsply Sirona) were used which helped in locating the canal orifice. EDTA gel was used along with SX orifice shaper (Dentsply Sirona) to enlarge the coronal portion of the canal. Working length was determined by 10 k file introducing till the apical portion.[Fig-3].

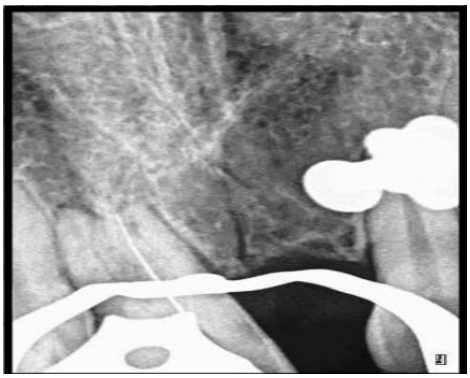


Fig 3: Working length determination irt 11

Biomechanical preparation was done by step back technique using k files and H files in circumferential motion and entire calcified portion was removed from the canal. Irrigation was done with 5 ml of 5.25% NaOCl and 17% EDTA alternatively with intermittent saline rinses. After drying the canal thoroughly with paper points, apical barrier was created with MTA plug [Fig-4]. Remaining portion of root canal was backfilled with thermoplasticizedguttapercha using calamus obturating unit along with AH plus resin sealer[Fig-5]. The pulp chamber was sealed with a nano hybrid composite (Filtek z250, 3M ESPE). Regular follow up was done for every month during which patient was asymptomatic with no pain or tenderness on percussion. After 3 months follow up, metal ceramic crown was given in relation to 11.

Fig 4: Apical plug with MTA

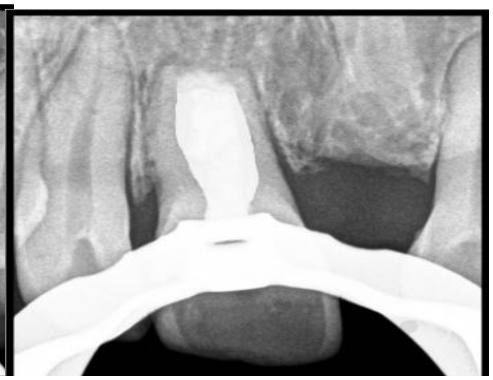


Fig 5: post obturation radiograph

III. Discussion

The management of case with calcific metamorphosis poses a dauntingtask to clinician. Though the exact mechanism of pulp canal calcification is unfamiliar, it has been theorized that hemorrhage and blood clot formation in the pulp after traumatic injury acts as nidus for calcification if pulp remains vital. Calcification replaces cellular components of the pulp and may disturb the blood supply of pulp. These traumatized teeth develop varying degrees of canal obliteration characterized by yellowish discoloration of the clinical crown and thinning of the pulp canal space radiographically.[8] Treatment should be delayed until there are no symptoms or radiographic signs of periapical disease. If endodontic treatment is required, these teeth fall into the high difficulty category of the American Association of Endodontists Case Assessment criteria.[9]

Andreasen et al from previous clinical observations, histopathological findings and experimental information hypothesized that PCO was related to revascularization after severe injury to the pulpal neurovascular bundle. Differences in the chronological patterns of neural and vascular repair could lead to loss in control of sympathetic nerve stimulation over odontoblastic secretory activity, resulting in rapid deposition of dentin and obliteration of the pulpal lumen. Once pulpal revascularization and reinnervation are complete, inhibitory control of odontoblastic secretion can reinitiate, thus ceasing the process and resulting in partial PCO. This regulatory mechanism over dentin synthesis may never be reinstated, leading to complete obliteration. Since obliteration progresses in a corono-apical direction, partial PCO usually affects the pulp chamber and the coronal part of the canal, whereas the radicular part remains visible, although markedly narrowed. There are also clinical reports of partial PCO affecting only the apical third of the root canal. Total PCO is diagnosed when both aspects of the pulp cavity are hardly discernible, or not at all visible.[4]

Thoma and Robinson have stated that teeth with complete obliteration of the pulp chamber and root canal are usually not sources of pathologic disturbances, and no treatment is required even though there might

be no response to pulp testing. Worman has described calcific metamorphosis as either a reparative or a retrogressive change. The development of pulp necrosis is a late complication following PCO.[5]Holcomb et al in their investigation on the incidence of periapical pathologic changes associated with calcific metamorphosis emphasized it as pathologic deviation from the normal pulp, with rare periapical changes on radiographs in first few years after trauma. The only definite criterion for endodontic or surgical intervention seems to be appearance of periapical rarefaction in radiographs.[6]

Radiographsplays a major role in the management of anticipated endodontic difficulties. The use of digital imaging aids like computed tomography (CT) was studied by Tachibana and Matsumoto who suggested that this method allowed the observation of the morphology of the roots and root canals and the appearance of the tooth in every direction. In this study, spiral CT (SCT) was used for three- dimensional visualization of tooth because it can get a large volume of data in seconds and offers more rapid examination time, with an effective dose in the range of about 1–30 mSv, which is much less than the conventional CT.[10]Moreover, the image could be analyzed, altered, and reconstructed by the computer to produce a rapid prototyping model using stereolithiography or 3D printing of the tooth; which may serve as a physical guide to the endodontist to identify the presence of additional root canals.

To achieve an accurate access to these calcified canals, enhanced magnification and illumination are required, which could be in the form of LED loupes or dental operating microscope. Though long necked round drills such as LN bur (DentsplyMaillefer, Oklahoma, USA) and Mueller bur (Brasseler, Savannah, GA, USA) are helpful in locating the canals but ultrasonic tips are highly effective for this purpose and has an added advantage over the burs whereby reducing the risks of mishaps such as perforation.[11] A DG-16 endodontic explorer (Hu-Friedy, Chicago, IL) is a very helpful tool in location and exploration of calcified canal.[8]

In the present case report, small files (No 6, 8 & 10 K-files) are used for initial pathfinding. However, these files lack the rigidity and tend to unwind, buckle or fracture when used with vertical watch-winding forces. The best approach is to use a gentle watch- winding motion with minimal vertical pressure and regular replacement of the instruments before fatigue occurs. Varieties of 'pathfinding' instruments are also available for this objective such as C files, Hi- 5 files, D and S - finders.[11]C- fileshave greater taper, more rigid, binds earlier in a constricted canal resisting deformation because of its robust quadrangular design.[13]

The pulp chamber and canal should be lubricated with sodium hypochlorite because it provides all-in-one lubrication, antibacterial, and tissue-dissolving properties. Use of EDTA gel is also beneficial to lubricate the canal and removal of smear layer respectively.

In the present case report, bio mechanical preparation was done in step back manner for better ease to remove all calcified material from the canal as it is an immature tooth with open apex with thin root canal walls.

MTA was used as a barrier (apical plug) material in this case, it has been proposed as a material suitable for one visit apexification (Torabinejad&Chiavian 1993, Shabahang&Torabinejad 2000, Maroto et al. 2003), as it combines biocompatibility and a bacteriostatic action with favourable sealing ability when used to repair root/pulp chamber perforations or as root-end filling material (Torabinejad et al. 1995b, Xavier et al. 2005).[14]

Most of the literature suggests the prognosis of tooth with calcific metamorphosis is considered good after nonsurgical root canal treatment and it has been shown to be successful 80% of the time.[7]

IV. Conclusion

Calcific metamorphosis is a benign condition which can be kept under observation and treatment is required only if any pulp necrosis or periradicularpathosis persists. Many histological studies have proved presence of canal even in completely calcified canals. Though it is a challenging scenario, use of appropriate radiographs, magnification and armamentarium will improve ease of work and enhances the success rate.

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