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CALCIFIC METAMORPHOSIS – A REVIEW

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ABSTRACT

Calcific metamorphosis (CM) is seen in dental pulp after traumatic tooth injuries. There is a deposition of hard tissues within root canal space and yellowish discoloration of clinical crown. The purpose of this article is to consider rationale for the management of pulpal tissues in teeth that exhibit CM and a short review of the same.

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KEY WORDS

Calcific metamorphosis (CM),Trauma; Pulp canal obliteration (PCO),Nidus formation, Clinical Decision making

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INTRODUCTION

The management of trauma in the permanent dentition represents a significant challenge to the dental practitioner. Proper medical and dental histories, a thorough clinical examination, as well as a detailed history of dental trauma, will assist the dental provider in assessing orofacial injuries and are instrumental in formulating a proper diagnosis. Common squeal to dental trauma are pulp canal obliteration (PCO), also known as calcific metamorphosis (CM). It is recognized clinically as early as 3 months after injury, but in most instances it is not detected for about 12months [1-3]. Approximately 3.8% to 24% of traumatized teeth develop varying degrees of CM [4].

Etiology and incidence

CM is defined as a pulpal response to trauma that is characterized by rapid deposition of hard tissue within the root canal space[5].. CM occurs commonly in young adult because of trauma. It is usually in the anterior region of the mouth. It is more common in extruded, intruded and laterally luxated rather than subluxated and concussed teeth. Also C.M. depends upon the type of injury. Greater the injury, greater the intensity of either pulp canal obliteration or pulp necrosis. Moderate injury could result in partial PCO. Partial PCO usually diagnosed within first year after trauma while total PCO observed from 2-6 years after trauma.

Table: 1. The frequency of necrosis following C.M. in permanent teeth.

Study	Mean observation period	No. of Units started	No. of teeth with CM	No. of teeth with pulpal necrosis
Holcomb & Gregory (1967[6].	4	88 patients	41	6(7%)
Andreasen (1970) [7].	1-12 (3.4)	189 luxated teeth	42	3(7%)
Stalhane & Hedegard (1975) [8].	13-21	76 teeth with C.M.	76	12(16%)
Jacobsen & kerekes (1977) [9].	10-23(16)	122 traumatized teeth	122	16(13%)
Andreasen et al (1987) [10].	1-10 (3.6)	637teeth	96	1(1%)
Robertson et al (1996) [11].	7-22(16)	82 traumatized teeth	82	7(8.5%)

ve observations, studies indicate that 1% - 16% will develop pulpal necrosis following C.M.

THE IIOAB JOURNAL
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Clinical Features (figure-1)

Clinically a tooth with CM is darker in hue than adjacent teeth and exhibits dark yellow color because of decrease in translucency from a greater thickness of dentin. [12]. Tooth is asymptomatic unless and until there is periapical infection.

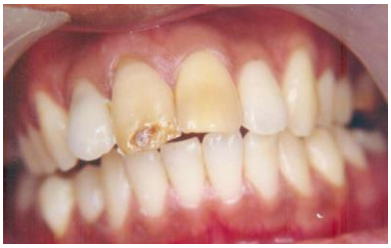
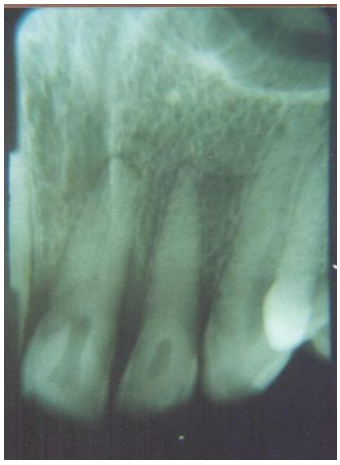


Fig: 1. Clinical features of CM

Radiographic Feature (figures- 2 & 3)

There will be either total or partial obliteration of pulp canal space with normal periodontal membrane space and intact lamina dura. Sometimes thickening of periodontal ligament space or periradicular radiolucency may be observed with or without subjective symptoms. Clinically, the apparent radiographic diameter of the canal does not always correspond to its true width. Kuyk and Walton[13]. measured the canal diameters of 36 teeth from radiographs and then compared them with the true widths of the canals as measured by histological sections. They found that all sections of the roots demonstrated a canal histologically, although some regions had no canal visible radiographically. Complete radiographic obliteration of the root canal space does not necessarily mean the absence of the pulp or canal space; in the majority of the cases, a pulp canal space with pulpal tissue is present[2,14].



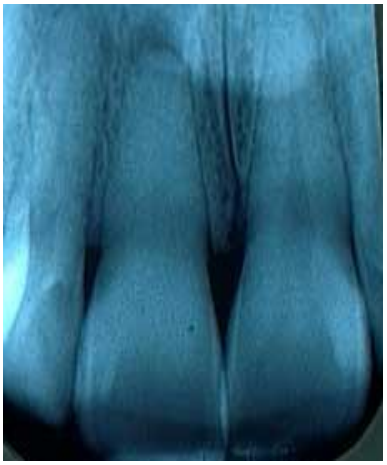


Fig: 2. and 3. Radiographic features of CM

Histopathology

Histopathologic studies designed to assess the pulpal status of teeth with CM have failed to show any inflammatory component indicative of pathologic process[2,12,15]. This may be a result of multiple causes, like poor tissue fixation, specimen sectioning, investigators interpretation etc. Histopathologically 3 types of calcific tissue occlude the pulp lumen. These include: dentin- like, bone- like, and fibrotic tissue. Blackwood's investigation has led to the conclusion that the hard tissue is primarily dentinal in character. Torneck (1990) [2] described calcific metamorphosis as a tertiary dentin response to trauma that is highly irregular in pattern and contains a maze of small irregular spaces and cul-de-sacs that extend from the pulp chamber to the apical foramen. Holan (1998) [17] described tube like structures that extended along the entire length of the pulp canal. These were separated from the root dentine by normal pulp tissue but connected to the dentin in some of the sites

THE IIOAB JOURNAL
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evaluated. The structures had a histologic appearance of osteodentin, with cellular inclusions in ring like formations.

Mechanism of hard tissue formation

The exact mechanism is not yet clear. Several hypotheses have been proposed to explain this phenomenon. Sundell et al (1985) produced (as per **Figure-4** takes into consideration of) several hypotheses that have been put forward.

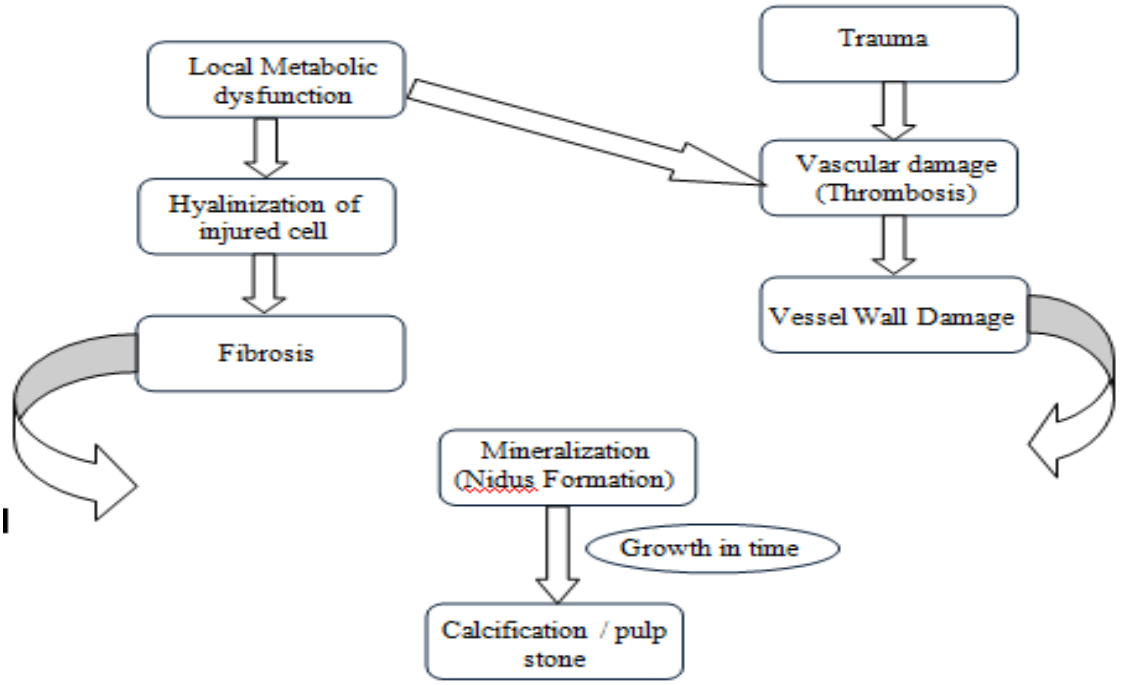

Fig. 4. Mechanism of hard tissue formation

After trauma there will be vascular damage. Sometimes local metabolic dysfunction will also lead to vascular damage, causing thrombus formation. This will act as a nidus and as the time progresses there will be calcification.

Ten Cate (1998) [18] also gave a mechanism for hard tissue deposition. He identified this process as a deposition of tertiary or reparative dentin in response to trauma. During development of tooth, the undifferentiated ectomesenchymal cells of dental papilla will differentiate into two daughter cells. The first daughter cell will differentiate into odontoblasts under the epithelial influence and lay down dentin while the 2nd daughter cell that is not exposed to epithelial influence persist as a subodontoblast cell which under certain influences differentiate into odontoblast like cells and deposit dentin like hard tissue.

Differential Diagnosis

1) Canal calcifications do not necessarily have pathologic origin; they can be result of normal aging of the pulp.
2) Diffuse calcification is seen in mild to severe periodontal diseases.
3) Also certain factors such as alkaline pH of Calcium hydroxide bases, unset composite monomers, hand or mechanical condensation pressure, thermal conductivity and microleakage may stimulate localized reparative dentin deposition leading to eventual obliteration of the pulp canals.
4) It is apparent in disease process like caries.
5) Some nutritional influences like excessive vitamin D cause calcification of pulp.

THE IIOAB JOURNAL
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6) In chronic pulpitis, the pulp tends to become obliterated by the elaboration of reparative dentin in root canal.

Diagnosis

For diagnosing calcific metamorphosis, thorough dental history and radiographic interpretation is must.Other test like sensibility to electrometric pulp testing shows no significant difference from contralateral tooth except lateral luxation cases which responds feebly to electric pulp tester.

Does the tooth need root canal therapy?

In 1965, Patterson and Mitchell [12] felt that a tooth that had signs of calcific metamorphosis due to trauma should be regarded as a potential focus for infection and that root canal therapy should be initiated. However, further research and clinical observation provided the foundation for current guidelines. The Naval Academy study [6] found that over a four year period only 3/41 (7.3%) of teeth with CM developed pulpal necrosis, and as a result the only definitive criterion for endodontic treatment was the appearance of a periapical radiolucency. Jacobsen and Kerekes [9] conducted a study of 122 traumatized teeth in which partial canal obliteration was identified in 36% of the cases and total canal obliteration in 64%. Only 13% eventually developed pulpal necrosis. Smith [19] performed a literature review and found that teeth with calcific metamorphosis have a low incidence of periapical pathosis development (0-16%) and recommended delaying treatment until symptoms or radiographic changes develop. The development of

CM following trauma does not justify prophylactic root canal therapy [6, 9,11]. According to Fischer (1974) [20] CM was a response to trauma with progressive hard tissue formation, with maintenance of vital tissue & pulp space observed up to the apical foramen. He argued, that such cases require endodontic treatment because of reduced cellular content leading to decreased ability for healing, therefore making the pulpal tissue more susceptible. Worman has described CM as either a reparative or retrogressive change. According to him, root canal treatment is not only futile but also contraindicated, for this obliteration in itself is a perfect root canal treatment. Lundberg & Cvek (1980) [15] evaluated 20 pulps from traumatized permanent incisors with reduced pulpal lumen under microscope. The tissue changes were characterized by a varied increase in collagen content and a marked decrease in number of cells. They concluded that tissue changes in the pulp of teeth with CM do not indicate the necessity for root canal therapy.

Management of canals with calcific metamorphosis

It is similar to management of pulpal spaces with any form of calcification. To locate the calcified orifice, first mentally visualizes and projects the normal spatial relationship of the pulp space onto a radiograph of calcified tooth. Then, the two dimensional radiographic image is correlated with the three dimensional morphology of the tooth [21]. There after the access preparation is initiated, with the rotary instrument directed toward the presumed location of the pulpal space. This approach requires knowledge of normal pulp chamber location, tooth canal anatomy and long axis of roots. Accurate preoperative radiographs are essential. Periodic assessment of bur penetration and orientation should be done radiographically.

Location and Penetration of root canal

DG-16 explorer (SybronEndo) is the most important instrument for orifice location. It will not penetrate and stick in solid denting, however, if orifice is present, firm pressure will force the instrument slightly into the orifice and it will resist dislodgement or catch.

Number 6 K- file is used to negotiate the canal but it is very fine and lacks stiffness. Alternate option is to use canal pathfinder such as canal Pathfinder (JS Dental) or instrument with greater shaft strength, such as pathfinder CS (Kerr). Use of magnification in the form of enhanced glasses or a microscope is also preferred by many practitioners. Examining the color changes in the floor with high magnification will aid in locating the canal orifice. Chelating agents such as REDTA (Roth drug), R C prep (Premier dental products), Glyde (Dentsply) are seldom of value in locating the orifice but can be useful during canal negotiation [22].

Tips in locating & negotiating calcified canals

- Copious irrigation with 2.5% - 5.25% sodium hypochlorite which enhances dissolution of organic debris, lubricates the
  Canal and keep dentin chips and pieces of calcified material in solution.
- Advance instrument slowly in calcified canals.

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- Clean the instrument on withdrawal and inspect it before reinserting it into the canal.
- Use chelating pastes or solutions to assist in canal penetration.
- Use ultrasonic instruments in the pulp chamber to loosen debris in the canal orifices.
- Flare the canal orifice in crown-down fashion.

Esthetic concerns

If the tooth with trauma becomes discolored and the patient has esthetic concerns, external bleaching should be considered first. However, since the decrease in translucency and acquisition of a yellowish color is due to irregular reparative dentin formation, external bleaching of the enamel may not achieve a clinically successful result. Intentional root canal treatment may be performed to facilitate internal bleaching. This may be carried out whether the pulp is vital or necrotic. Rotstein and Walton felt such teeth could be bleached with fair esthetic results A study by Friedman et al [23] found that after a recall period of 1-8 years, 79% of internally bleached teeth had clinically acceptable clinically acceptable or better esthetics.

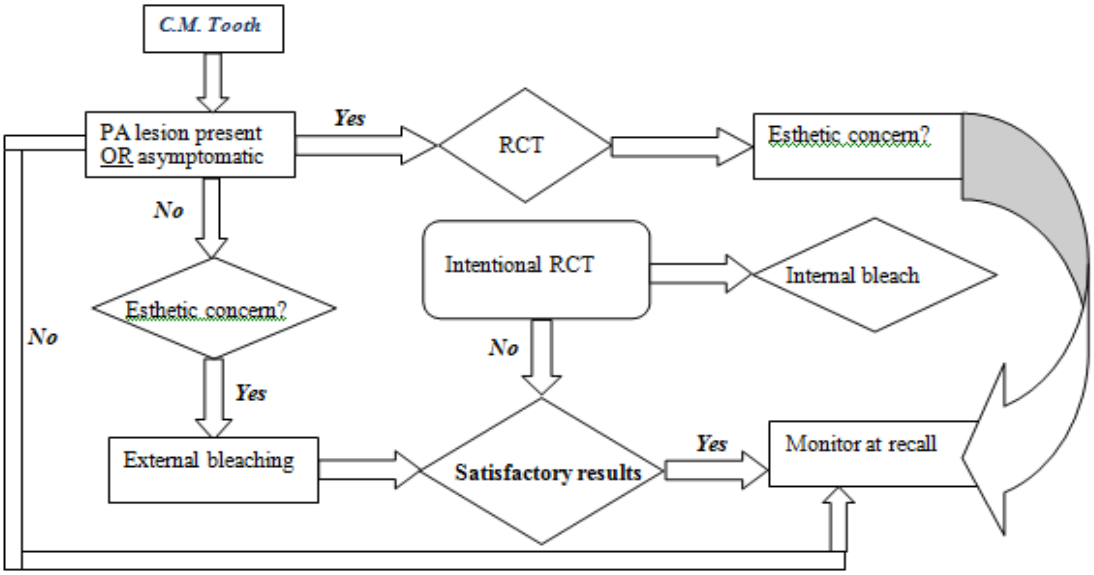

Fig: 5. CM clinical decision

SUMMARY

Although there are different opinions on the management of pulps exhibiting canal obliteration, studies indicate that the incidence of pulpal necrosis in these teeth is between 1% to 16% only. Pulpal necrosis, periradiular pathology or symptoms along with esthetic concerns are the definitive criteria for proceeding with endodontic treatment.

CONFLICT OF INTERESTS

There is no conflict of interest amongst the authors.

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