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I J D R

CONTENTS

REVIEW

Guidelines for management of impacted canines

Criteria for management of calcific metamorphosis

ORIGINAL RESEARCH

An audit of drug prescribing practices of dentists

Effect of palatal vault configuration on complete denture dimensions

CASE REPORT

Canalicular adenoma of upper lip mimicking mucocele

Oral malignant melanoma

Mucormycosis causing excessive destruction of maxilla

Gingival cyst of adult

ADVANCES IN ORO DENTAL RESEARCH

Paedodontics

Oral Pathology and Medicine

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REVIEW
Endodontics

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ABSTRACT

Calcific metamorphosis is seen commonly in the dental pulp after traumatic tooth injuries and is characterized by deposition of hard tissue within the root canal space. Opinion differs among practitioners as to whether to treat these cases upon early detection of calcific metamorphosis or to observe them until symptoms or radiographic signs of pulpal necrosis are detected. In this article, the clinical, radiographic, and histopathologic appearance of calcific metamorphosis is described; a review of the literature is presented to address these issues in an attempt to establish sound rationale for treatment. Approximately 3.8% to 24% of traumatized teeth develop varying degrees of calcific metamorphosis. Studies indicate that of these, approximately 1% to 16% will develop pulpal necrosis. Most of the literature does not support endodontic intervention unless periradicular pathoses is detected or the involved tooth becomes symptomatic. It may be advisable to manage cases demonstrating calcific metamorphosis through observation and periodic examination. A report of a case where in non-surgical endodontic intervention was successfully carried out in a patient suffering from calcific metamorphosis with periapical pathoses is also presented.

Criteria for management of calcific metamorphosis: Review with a case report

INTRODUCTION

Teeth that have received a traumatic blow often undergo rapid calcification of the root canal system. This phenomenon is referred to as calcific metamorphosis or pulp canal obliteration. Calcific metamorphosis is defined as a pulpal response to trauma that is characterized by deposition of hard tissue within the root canal space (1). The endodontist, when he encounters this condition, is faced with a difficult decision. Should he intervene prophylactically before the calcification process renders the root canal unnegotiable? Or should he "leave well enough alone" and hope the tooth never develops clinical symptoms or radiographic signs of periapical pathoses? It is the purpose of this article to review the literature concerned with calcific metamorphosis and bring together all available data, which might aid the practitioner in making a treatment decision in these cases.

ETIOLOGY, INCIDENCE, AND CLINICAL FEATURES

Calcific metamorphosis occurs commonly in young adults because of trauma. It is evident usually in the anterior region of the mouth and can partially or totally obliterate the canal space radiographically (2,3). Clinically, a tooth with calcific metamorphosis is darker in hue than the adjacent teeth and exhibits a dark yellow color because of a decrease in translucency from a greater thickness of dentin under the enamel (2). The response to electric pulp tests may be normal in early stages and absent in the later stages of the condition. Responses to heat and cold also decrease with time and sensitivity to percussion is generally absent.

REVIEW OF LITERATURE

Sommer, Ostrander, and Crowley (4), in their text, mentioned about this phenomenon and stated that rapid calcification may go to the point of complete obliteration of the pulp cavity, in which case the tooth may be retained indefinitely in a healthy state as a pulpless tooth. Contrastingly, Patterson and Mitchell (2) stated that calcific metamorphosis due to trauma should be regarded as a potential focus of infection. They considered the phenomenon to be pathologic and recommended treatment as soon as it is diagnosed radiographically. Ingle et al (5) addressed the problem of pulp obliteration due to trauma. They recommended that the tooth in question be monitored radiographically and treated only in the event that an area of periapical rarefaction or clinical symptoms develop.

Holcomb and Gregory (3) examined 881 patients and found that 41 teeth in 34 patients exhibited calcific metamorphosis, representing an incidence of 3.8%. Over a 4-year period, only 3 of the 41 teeth (7.3%) developed periapical rarefactions. The authors concluded that a significant correlation exists between a history of trauma and calcific metamorphosis, but that accompanying periapical rarefaction during the first few years after trauma is rare and it is only in those instances that a definite criterion for endodontic intervention exists.

Andreasen (6) did a follow up study of 189 luxated permanent teeth with a mean observation period of 3.4 years. He found pulp obliteration in 42 teeth (22%). Interestingly, the incidence of pulp obliteration was higher among teeth with immature roots as opposed to those with fully developed roots. Extrusion and subluxation injuries produced a higher

Fig. 1: Calcific metamorphosis in relation to 11 and 21.

Fig. 2: Working length determination.

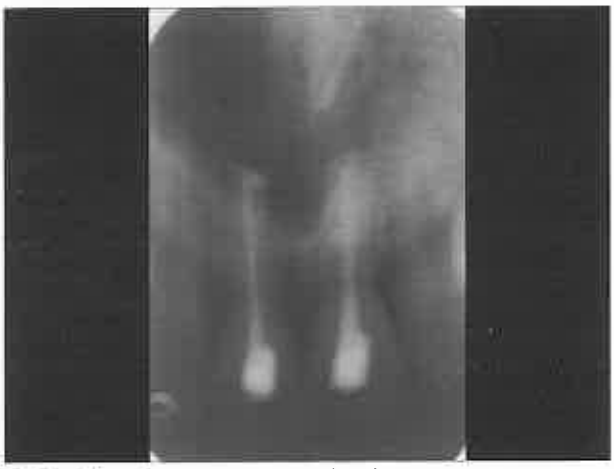

Fig. 3: Thermafil Verifiers being employed.

Fig. 4: Post obturation X-ray following Thermafil obturation.

frequency of obliteration than intrusion injuries and teeth without crown fractures obliterated more often than those with crown fractures.

Stalhane and Hedegard (7) did a long-term study on 76 teeth that displayed calcific metamorphosis following accidental injury. The teeth were examined 3 to 21 years after the accident. 12 of the 76 teeth (16%) developed periapical rarefactions during the observation period. The authors stated that in making treatment decisions, the success rate enjoyed by modern endodontic treatment must be weighed against the percentage of teeth that become necrotic secondary to calcific metamorphosis.

Jacobsen and Zachrisson (8) conducted a follow up study of repaired root fractures in permanent anterior teeth. A common radiographic finding in this study was pulpal obliteration, either partial or total, in 86% of the teeth. Importantly, periapical changes did not develop in any of the obliterated teeth.

Jacobsen and Kerekes (9) did a long-term study on 122 traumatized teeth with radiographic evidence of partial canal obliteration in 36% of the cases, with total obliteration in 64%. Of the total population studied, 13% eventually developed pulpal necrosis. Robertson's (10) study of 82 traumatized permanent incisors that were followed for a mean period of 16 years, periradicular bone lesions suggesting pulp necrosis developed in 7 teeth (8.5%). The 20 year pulp survival rate was 84% and no higher frequency of pulp necrosis was observed in teeth with calcific metamorphosis that were subjected to caries, new trauma, orthodontic treatment, or complete crown coverage when compared to intact teeth. The conclusion that the incidence of pulp necrosis in teeth displaying calcific metamorphosis seems to increase over time was not supported, and routine endodontic intervention on teeth with calcific metamorphosis was not justified.

MECHANISM

Calcific metamorphosis is characterized by an osteoid tissue that is produced by the odontoblasts at the periphery of the pulp space or can be produced by undifferentiated pulpal cells that undergo differentiation as a result of the traumatic injury. This results in simultaneous deposition of a dentin like tissue along the periphery of the pulp space (root canal walls) and within the pulp space proper (root canal). These tissues can eventually fuse with one another, producing the radiographic appearance of a root canal space that has become rapidly and completely calcified.

Ten Cate (11) identified this process as the deposition of tertiary or reparative dentin response to irritation or trauma. Reparative odontoblasts are somehow able to differentiate from dental pulp cells in the absence of any epithelial influence. Torneck (12) described calcific metamorphosis as a tertiary dentin response to trauma that is highly irregular in pattern and calcification and contains

Table 1: Frequency of necrosis following calcific metamorphosis in permanent teeth

Author	Mean Observation Period (Years)	Number of Units	Number of teeth with Calcific Metamorphosis	Number of teeth with Pulpal Necrosis
Holcomb & Gregory (3), 1967	4	88	41	3 (7%)
Andreasen (6), 1970	1 - 12 (3.4)	189	42	3 (7%)
Stalhane & Hedegard (7), 1975	13 - 21	76	76	12 (16%)
Jacobsen & Zachrisson (8), 1975	6	44	44	0 (0%)
Jacobsen & Kerekes (9), 1977	10 - 23 (16.0)	122	122	16 (13%)
Andreasen et al (15), 1987	1 - 10 (3.6)	637	96	1 (1%)
Robertson et al (10), 1996	7 - 22 (16.0)	82	82	7 (8.5%)

a maze of small irregular spaces and cul-de-sacs that extend from the pulp chamber to the apical foramen.

Fischer (13) indicated that calcific metamorphosis was a response to trauma with progressive hard tissue formation, with maintenance of vital tissue and a pulp space observed up to the apical foramen. However, he advocated root canal therapy in such cases because of reduced cellular content leading to decreased ability for healing, therefore making the pulpal tissue more susceptible to infection.

MANAGEMENT OF CALCIFIC METAMORPHOSIS

In an interesting survey by Smith and Crisp (14), a case of calcific metamorphosis was presented to 147 endodontists. Radiographs and a brief history of the case were provided. 54% of the practitioners selected no treatment, 40% opted to treat the teeth conventionally, and 6% selected calcium hydroxide treatment. The severity of trauma in this case was mild, with no sign of periapical rarefaction. The literature cited indicates that the prognosis for such teeth would have been good without treatment; yet almost one half of the clinicians surveyed in the study chose to intervene endodontically. This finding suggests that perhaps we are overtreating this condition that we need to consider carefully all factors, which might influence the prognosis of these teeth, and possibly take a more conservative approach to their management.

Approximately 3.8% to 24% of traumatized teeth develop varying degrees of calcific metamorphosis. The incidence of pulpal necrosis in these teeth varies between 1% and 16% (15). Most of the literature does not support endodontic intervention unless periradicular pathoses are detected or the involved tooth becomes symptomatic. As the overall failure rate of nonsurgical root canal treatment is between 10% and 19%, it may be advisable to manage cases demonstrating calcific metamorphosis through observation and periodic examination. If the pulp tissue becomes necrotic and periradicular radiolucency develops, nonsurgical root canal therapy has been shown to be successful 80% of the time.

CASE REPORT

From the above discussion, it is clearly evident that the first line of management of calcific metamorphosis is periodic examination and observation, and unless pulpal necrosis and clinical symptoms develop, endodontic intervention is not warranted. The following is a report of a case where in non-surgical endodontic intervention was successfully carried out in a patient suffering from calcific metamorphosis with periapical pathoses.

A 21-year-old male reported to our outpatient department with a complaint of swelling and discharge in relation to his upper anteriors. The patient gave an history of trauma 9 years back in the upper anterior region .The patient was asymptomatic during this period and started developing pain and swelling in relation to 11 and 21 over a duration of one week. The clinical examination revealed a diffuse swelling with sinus discharge in relation to 11 with pain on percussion in relation to 11 and 21. A negative response was elucidated with both heat and electric pulp testing for both the involved teeth, with normal responses in the adjacent teeth. The radiographic examination revealed completely obliterated pulp chamber and pulp canal in 11 and 21, with periapical radiolucency (Fig 1). On the basis of the history, clinical, and radiographic examination, it was evident that this was a case of calcific metamorphosis.

A non-surgical endodontic intervention was initially planned for the management of both 11 and 21. A standard access preparation was done in both the teeth at the exact center of the palatal surface of the crown buccolingually and incisogingivally. Bur penetration of 3 to 4 mm, at an angle of roughly 45 degrees to the long axis of the tooth, will generally intersect with the pulp chamber in an average sized tooth. However, in this case as the pulp chambers of both the teeth were completely calcified, after reaching a depth of 4 mm, the bur was rotated to be as parallel to the long axis of the tooth as possible to prevent perforation. Penetration was proceeded down the lingual aspect of the access preparation, with frequent exploration of the orifice with the DG 16 endodontic explorer.

We were able to locate the orifice of the both the canals

using the DG 16 explorer. In firm probing during excavation of the pulp chamber floor, the explorer will not penetrate and 'stick' to solid dentin; however, if an orifice is present (as in both the teeth here), firm pressure will force the instrument slightly into the orifice, and it will resist dislodgment, or stick. The calcified orifice can also be distinguished from the surrounding dentin on the basis of the perceivable difference in color.

At this point, a No 8 followed by No 10 K file was placed into the orifice to negotiate the canal unsuccessfully. Then, on the basis of the recommendations made by Amir, Gutmann & Witherspoon (16) we employed a chelating EDTA gel in conjunction with Profile Orifice Shapers (Dentsply). After flaring the canal orifice in a crown down fashion the canals were negotiated further using .04 Profile rotary instrumentation along with copious irrigation of 2.5% NaOCl, which enhances dissolution of organic debris, lubricates the canal, and keeps dentin chips and pieces of calcified material in solution (17). The rotary instrument was repeatedly inspected for any signs of unwinding or breakage. We were able to negotiate till the apical third of both the canals in this manner. At this point No 10 K file was employed to negotiate the rest of the canal successfully. After estimating the working length (Fig 2), the biomechanical preparation was completed. After ensuring a smooth fit of the Size 60 Thermafil verifier (Fig 3), both the teeth were obturated using the size 60 Thermafil obturators (Fig 4). A hybrid composite was used to fill the entrance filling. The patient was monthly reviewed for the need of further surgical intervention. In the one-year follow up so far, the patient is clinically asymptomatic with no pain on percussion and absence of swelling & discharge.

CONCLUSION

This article highlights the fact that dentists perhaps over treat calcific metamorphosis in general. This benign condition is best left alone with periodical radiographic and clinical evaluation; until a necrotic episode warrants an endodontic intervention. In cases where such calcified chambers and canals have to be negotiated, the use of chelating gels (EDTA) and NaOCl in conjunction with a DG 16 endodontic explorer and rotary instrumentation techniques like Profiles are highly useful.

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