Case Report
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Non-surgical endodontic management of calcific metamorphosis with periapical lesion using bioactive glass: a case report

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Abstract
INTRODUCTION. Calcified root canals lead to various complications in endodontic treatment, as they complicate the locating of canal orifices, negotiating access, preparing the canals, and factoring in the time required for these procedures. Even with extensive precautions, the most serious problems can occur at any phase of the root canal treatment process. The pulpal chamber or root canal space is most frequently partially or completely obliterated in a tooth that has experienced a traumatic injury. A total or partial loss of pulp space is the most typical radiological representation of such a tooth. Pulp necrosis and radiographic signs of chronic periapical periodontitis are present in 7–27% of teeth with partial canal calcification. Small percentage of teeth (2–3%) may exhibit a complete occlusion of the pulp chamber and root canal system.
AIM. To describe the clinical management of a calcified mandibular lateral incisor with a periapical lesion using a bioactive glass-based sealer.
MATERIALS AND METHODS. A traumatized mandibular lateral incisor with radiographic evidence of canal calcification and a periapical lesion was identified. The root canal was located, negotiated, and prepared using standard endodontic techniques with special consideration for calcified anatomy. A recently developed bioactive glass-based sealer was selected for obturation.
RESULTS. The calcified canal was successfully located and treated. Radiographic follow-up demonstrated proper canal obturation with resolution of the periapical lesion.
CONCLUSIONS. Bioactive glass-based sealers show promising outcomes in the treatment of calcified root canals. Their bioactivity and sealing ability may enhance prognosis in complex endodontic cases involving traumatic canal calcification.

Keywords: calcific metamorphosis, endodontic treatment, calcified canals, bioactive glass

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Эндодонтическое лечение кальцифицирующей метаморфозы с периапикальным поражением с применением биоактивного стекла (клиническое наблюдение)

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Резюме
ВВЕДЕНИЕ. Кальцифицированные корневые каналы приводят к ряду осложнений при эндодонтическом лечении, так как затрудняют определение устьев каналов, прохождение доступа, проведение инструментальной обработки, а также увеличивают временные затраты на выполнение процедур. Даже при соблюдении всех предосторожностей серьезные осложнения могут возникнуть на любом этапе лечения корневых каналов. У зубов, подвергшихся травматическому воздействию, полость пульпы и/или пространство корневого канала чаще всего частично или полностью облитерированы. Радиологическим проявлением данного состояния обычно является полная либо частичная утрата пульпарного пространства. Некроз пульпы и рентгенологические признаки хронического периапикального периодонтита выявляются в 7–27% случаев частичной кальцификации каналов. У небольшой части зубов (2–3%) может наблюдаться полная облитерация пульпарной камеры и системы корневых каналов.

ЦЕЛЬ. Описать клиническое ведение случая кальцифицированного нижнего латерального резца с периапикальным поражением с использованием силера на основе биоактивного стекла.

МАТЕРИАЛЫ И МЕТОДЫ. Был выявлен нижний латеральный резец после травмы с рентгенологическими признаками кальцификации канала и периапикального поражения. Корневой канал был найден, пройден и подготовлен с применением стандартных эндодонтических методик с учетом кальцифицированной анатомии. Для обтурации был выбран недавно разработанный силер на основе биоактивного стекла.
РЕЗУЛЬТАТЫ. Кальцифицированный канал успешно локализован и пролечен. Рентгенологическое наблюдение показало адекватную обтурацию канала и разрешение периапикального очага.
ВЫВОДЫ. Силеры на основе биоактивного стекла демонстрируют перспективные результаты при лечении кальцифицированных корневых каналов. Их биоактивные свойства и высокая герметичность могут улучшить прогноз в сложных эндодонтических случаях, связанных с травматической кальцификацией каналов.

Ключевые слова: кальцифицирующая метаморфоза, эндодонтическое лечение, кальцифицированные каналы, биоактивное стекло

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INTRODUCTION

Dental trauma often results in complications like calcifications and periapical lesions, leading to tooth discoloration that frequently necessitates root canal therapy [1]. Root canal treatment is generally carried out to diminish or entirely eradicate all micro-organisms and their byproducts from the root canal system. Standard debridement, appropriate disinfection, and full 3D obturation are required to eradicate all microbes and their waste products from the root canal system. However, attaining the intended results becomes very difficult if the canal is small, blocked, or packed with any biological calcific substance or foreign particles. This makes it challenging in location of canal orifice and making entry into the root canal system. Calcific metamorphosis, Pulp Canal Obliteration, Dystrophic Calcification, Diffuse Calcification, and Calcific Degeneration are the names given to this condition.

Dental pulp tissues frequently exhibit characteristics of dystrophic mineralization or calcific metamorphosis. According to American Association of Endodontists [2] Calcific Metamorphosis is defined as "*A pulpal response to trauma characterized by rapid deposition of hard tissue within the canal space*".

Patterson and Mitchell suggested that if such teeth are clinically identified, either endodontic treatment or extraction should be performed. It was suggested that the pulp tissue affected by such conditions could act as a source of infection and should therefore be removed or treated [3]. When performing endodontic therapy in calcified canals, operators or physicians face a number of difficulties. Recent developments in endodontic equipment, like as high-resolution magnification, flexible rotary files, and high-quality imaging, make it easier to precisely and quickly negotiate and handle calcified canals while reducing procedural errors.

In order to help doctors better understand this difficult clinical disease, this case report examines the causes, diagnosis, and available treatments for calcified canals.

CASE REPORT

A24yearold woman visited the department with discolored lower front teeth and a history of trauma that occurred 10 years earlier. She had been experiencing pain in the same tooth for the past two weeks. No abnormalities were observed during the extraoral examination; however, the intraoral examination revealed discoloration of the mandibular lateral incisor. The tooth was tender on percussion. Clinical and radiographic evaluation revealed canal obliteration in coronal 1/3rd of root and a periapical lesion associated with 42. Thermal test exhibited no response, signifying the need for root canal treatment (Fig. 1).

The case was diagnosed as calcification with a chronic apical abscess secondary to trauma concerning tooth 42, based on historical, clinical, and radiological findings.

A root canal procedure was planned using conventional techniques to address calcified canals and a periapical lesion.

Fig. 1. Pre-operative Radiograph

Рис. 1. Предоперационный рентгеновский снимок

TREATMENT PROCEDURE

With the patient's written consent obtained, the entire treatment procedure was thoroughly explained to them. The potential advantages and disadvantages were also explained to the patient. The preoperative evaluation was carried out through meticulous examination of the preoperative radiograph**.** Administration of L.A (with 2% Lignocaine hydrochloride, 1:1,00,000 Adr) was done and tooth was isolated using rubber dam (Coltene). Under magnification, preparation of straight-line access cavity was done for the concerned tooth with the high speed no 4round bur (Mani). Troughing done using ultrasonic tips (Dentsply start-X Tips EMS# 1&3) and Endodontic Explorer DG 16 was used to cautiously inspect the canal orifice and find a catch point in the middle of the tooth where a small blackish discoloration point was observed.

The line of patency of canal negotiated with the help of no 8-k file (Dentsply-Maillefer) (Fig. 2). 17% EDTA (RC Help,Prime Dental) was used to demineralise the restricted hard tissues along the canal. No 10 kfile was used to obtain the glide route (Dentsply). Using an apex locator (Root ZX, J. Morita), the working length was determined and verified radiographically.

Multiple files were used to rule out any missed canal (Fig. 3). Once the working length was established, canals were prepared using a standardized method up to the 25/04 (Herogold) file.Canals were irrigated with 3% NaOCl ((Prime dental) for 5–10 minutes during each instrument change, after which normal saline was used. Irrigant was activated ultrasonically (Fig. 4). Glass ionomer cement was used to seal the orifices of root canal after $Ca(OH)_2$ was combined with equal parts of glycerin and distilled water and left for seven days.

A week later, patient was recalled and intracanal medicament of calcium hydroxide was placed after irrigation and drying of the canals. Similar protocol was repeated for 2 weeks.

The canal was cleaned and dried during the next visit, and a master cone that matched ISO #25 4% size was chosen. Bioactive glass-based root canal sealer (NISHIKA CANAL SEALER BG) was used for obturation (Fig. 5). Permanent restoration was done using composite restorative material. After treatment, the patient exhibited no subjective or objective signs and symptoms. Patient was advised to follow up at 1, 6, and 24 months (Fig. 6).

DISCUSSION

Trauma to maxillary anterior teeth, resulting in tooth discoloration is a common occurrence that often leads to pulpal necrosis and potential calcification [4]. A comprehensive clinical and radiographic evaluation is necessary for an accurate diagnosis.

Assessing the vitality status of the tooth using thermal tests is crucially important in these cases [5]. The actual pathophysiology of calcification of pulp tissue is not known yet. Several researchers claim that formation of blood clot due to bleeding or hemorrhage from a traumatic injury might play key role for calcification, if pulp remains vital or recovers after the trauma [6]. Furthermore, important variables in the calcification of pulp tissue include the nature, severity, frequency, and amount of trauma. The cellular constituents of pulp substances play a critical role in the calcification of pulp tissue, which may impact blood flow to the pulp. In general, around 4–24% of the teeth radiologically show different degrees of calcification which leads to gradual loss of pulp space and clinically characterized as yellowish discoloration [7]. According to the American Association of Endodontists Case Assessment criteria, these teeth requiring endodontic are considered as high difficulty category.[8]. The Dental Operating Microscope offers superb magnification, leading to the accurate identification of orifices in cases of calcification.

In a tooth with calcific metamorphosis the pulp chamber becomes darker than that of the rest root dentine as compared to normal tooth where pulp chamber is located near the Cemento enamel junction at the center [9].

For deep troughing, which is occasionally required to locate canals, specialized tools are recommended, such as the Mueller bur and ultrasonic tips.

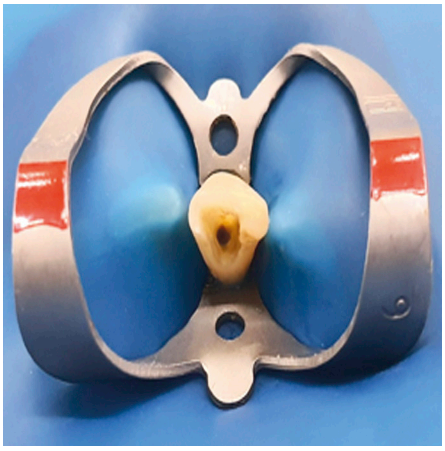


Fig. 2. Location of canal using ultrasonics and magnification

Рис. 2. Определение канала с использованием ультразвука и увеличения

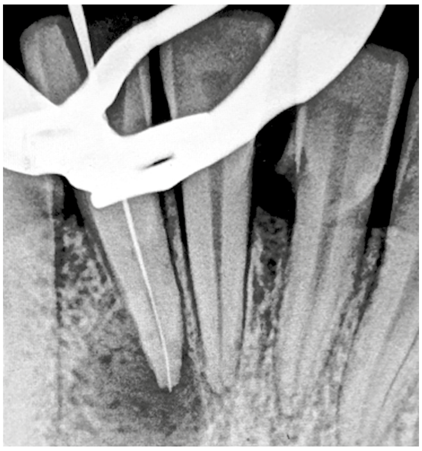


Fig. 3. Canal negotiation and working length determination

Рис. 3. Прохождение канала и определение рабочей длины

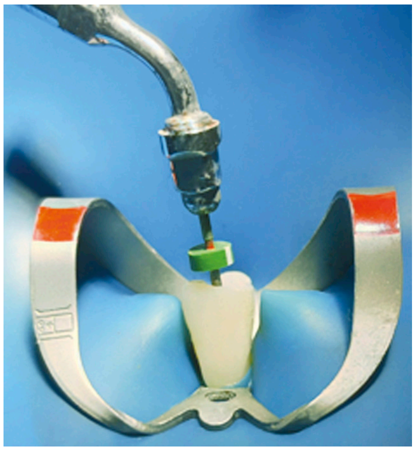


Fig. 4. Ultrasonic activation of irrigant

Рис. 4. Ультразвуковая активация ирриганта

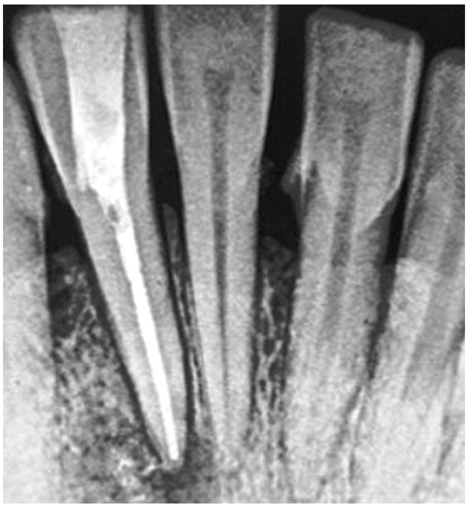
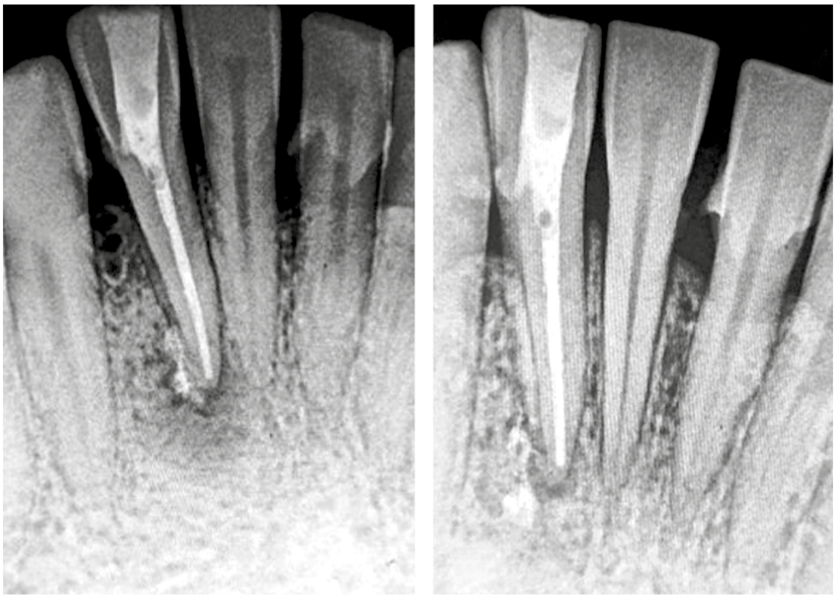


Fig. 5. Post operative, obturation using bioactive glass-based sealer followed by composite restoration

Рис. 5. Послеоперационный снимок: обтурация с использованием силера на основе биоактивного стекла с последующей композитной реставрацией



A B

Fig. 6. Follow up at 6 months (*A*) and 2-year (*B*)

Рис. 6. Контрольный осмотр через 6 месяцев (*A*) и 2 года (*B*)

CM can be radiographically divided into two groups: Total Obliteration, in which the pulp chamber and canal are hardly or not visible, and Partial Obliteration, in which the pulp chamber is not visible but the canal is narrowed and still visible.

Various types of “pathfinding” instruments have recently been introduced in root canal treatment to achieve this goal. These pathfinders or glide path instruments have unique feature that all the instruments possess a quadrangular cross-section, which has significantly enhanced the rigidity of the files compared to that of finishing files [10]. Furthermore, different chelating chemicals at varying concentrations – for example, 17% EDTA – can be used as lubricants or to facilitate instrumentation after root canal negotiation.

The use of “bioactive” materials in restorative and reconstructive dentistry is a topic of great interest nowadays. Within the field of regenerative dentistry, the term “bioactive” typically denotes a material’s capacity to generate hydroxyapatite crystals on its surface. From a biological standpoint, bioactive substances are regarded as agents that have the potential to positively interact with living cells and tissues [11]. Recently, a more reactive form of calcium-silicate-based bioactive glass, referred to as “bioactive root canal sealers”, and calcium-silicate-based sealers have been developed [12]. While bioactive glass (BG) has traditionally been employed for regenerating dental hard tissues, it has shown recent potential in treating diverse complex tissues [11]. Specifically, calcium and silicate ions, pivotal in biological processes, exhibit the capability to expedite both osteoinduction and angiogenesis, crucial for supporting periapical healing [13].

Schindler & Gullickson concluded that when acceptable cleaning and shaping cannot be achieved through conventional endodontic treatment, periapical surgery involving root-end resection and retrograde filling must be done [14]. It is widely recognized that endodontic microsurgery offers a direct approach to the root apex and serves as an alternative treatment for calcified canals when conventional root canal treatment fails.

CONCLUSION

The case study demonstrated that effective periapical healing of a big lesion can be achieved non-surgically with careful debridement, disinfection, and three-dimensional obturation of the root canal system. It has been shown that bioactive glass may regenerate hard tissue, which helps periapical lesions recover. For big preapical lesions, a non-surgical method that uses magnification, ultrasonics, and novel bioactive materials can avoid the need for invasive procedures like surgery.

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AUTHOR'S CONTRIBUTION

All the authors made equal contributions to the publication preparation in terms of the idea and design of the article; data collection; critical revision of the article in terms of significant intellectual content and final approval of the version of the article for publication.

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