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EVALUATION OF DIRECT PULP CAPPING WITH BIODENTINE™ IN DIABETIC PATIENTS

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ABSTRACT

Diabetes is a systemic, endocrine pathology that affects a large number of people worldwide. Its oral manifestations are numerous and can contribute to tooth mortification and loss. Direct pulp capping represents a viable therapeutic alternative for preserving dental vitality, particularly with the advent of new calcium silicate-based materials such as Biodentine™.The aim of this work is to evaluate the therapeutic efficacy of direct pulp capping with Biodentine™ in diabetic patients.This study, carried out between March and September 2024 in a private dental practice in Faravohitra, Antananarivo, involved two cases. The results showed clinical and radiographic success: the patients were no longer in pain, the fillings were airtight, and no periapical or peridental lesions were observed, thus preserving the vitality of the treated teeth.Nevertheless, further research is needed to confirm these long-term results and better understand the influence of different factors on treatment success, as well as to assess the performance of the biomaterials used.

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Keywords :diabetes, hair styling, calcium tricalcium, Biodentine

Introduction

Diabetes, a chronic non-communicable disease, occurs when the pancreas doesn't produce enough insulin or the body doesn't use it efficiently [1]. Its growing prevalence is accompanied by increasingly severe complications, predicting that it will become the seventh leading cause of death worldwide by 2030 according to the WHO [1]. In Madagascar, the disease is already more than 6% prevalent [2].Diabetics are particularly prone to bacterial and opportunistic infections or opportunistic infections due to microangiopathy, which alters the leukotactic response. As the dental pulp has a terminal circulation, it is more prone to infection. Clinical and radiographic studies have shown that there is a greater prevalence of periapical lesions in diabetics than in non-diabetics [3].Conservative dentistry, which aims to preserve the vitality of pulp tissue, offers a therapeutic alternative in such cases. To this end, it has incorporated new approaches to treating caries, including the use of innovative materials such as Biodentine™, a tricalcium silicate, known to promote tissue healing during Direct Pulp Capping [4, 5]. Faced with pulpal exposure in diabetic patients, the question arises as to the advantages and specificities of using Biodentine™. The problem lies in altered inflammatory responses, the high risk of infection, delayed healing and glycemic variations [6], all of which can impact pulpal healing and the durability of restorations with this material. Thus, the overall aim of the study is to evaluate the clinical and radiographic responses of direct pulp capping with Biodentine™ in diabetic patients. The specific objectives are to identify the clinical and radiographic profile of patients, to describe the operative protocol during treatment treatment, as well as to evaluate treatment responses after clinical hindsight.

Methodology

This is a prospective clinical case study carried out at the private dental practice of AMADIA, a national center specializing in the care of diabetic patients, located in Faravohitra, Antananarivo.

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The study lasted 11 months, from November 2023 to October 2024, and involved diabetic patients treated at AMADIA.

The study included patients with dental caries diagnosed as pre-pulpitis, as well as caries with pulpal exposure due to bacterial aggression, requiring direct pulp capping.

Patients with caries types not requiring pulp capping, such as pulpitis, pulp necrosis or apical periodontitis, as well as those who refused to give consent, were excluded from the study.

In the present study, various materials and equipment were used to ensure both clinical examination of patients and specific dental interventions.

Evaluation criteria were set to assess the success of the treatment, on the one hand clinical success criteria such as the Absence of persistent or recurrent pain, the Absence of other signs of inflammation as well as the Integrity and watertightness of the coronal restoration and on the other hand radiographic success criteria namely the Absence of periapical lesion, ligament thickening, signs of resorption or any other pathological process, and dentinal bridge formationof resorption or any other pathological process, and dentine bridge formation [7,8].

Description of cases

First case

A 25-year-old woman with type 1 diabetes presented to the dental practice because of dental pain on contact with sugary foodsand cold water. The precise location of the pain was in the left anterosuperior region, affecting the left maxillary canine.

On general examination, it was noted that the patient had a history of arterial hypertension. Her blood glucose was measured at 1.12 g/L.

Inspection revealed deep caries on tooth 23, characterized by a brownish cavity and coronal decaySISTA 2.3. However, there was no dental dyschromia or signs of periapical periapical swelling (Fig. 1). On palpation, the apex of the tooth was painless, with no significant tooth mobility.

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The tooth was sensitive to cold and probing, but remained alive according to pulp vitality tests. Axial percussion was negative, while transverse percussion was positive.

Radiography showed a carious cavity close to the pulp chamber, but with no evidence of periapical lesion or root fracture (Fig. 2).

Based on these observations, the diagnosis of prepulpitis of tooth 23 was made.

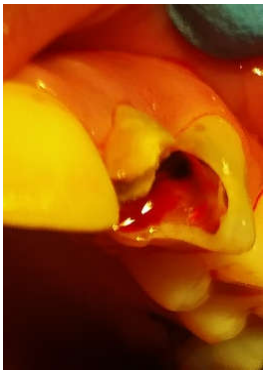

Figure 1:Image showing the maxillary canine preoperatively**[RABIALAHY2024]**

Figure 2 : Retro alveolarradiography of the maxillary canine **[RABIALAHY2024]**

Surgical protocol

The patient's care began with a blood glucose check, in line with the precautions in accordance with the precautions required for a diabetic patient.

Scaling followed by root planing was then performed to clean the oral cavity and limit the risk of infection.

After these preliminary steps, the carious tissues of the causal tooth were carefully removed. However, despite our caution, pulpal exposure occurred, causing the patient occurred, causing bleeding and pain to the patient. Following a detailed explanation of the tooth's condition, a treatment aimed at preserving pulp vitality by direct pulp capping using Biodentine™, was opted for.

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Adrenaline-free anaesthesia was administered, and carious tissue was removed using an excavator under copious irrigation, as well as with a ball bur mounted on a low-speed turbine. Hemostasis was ensured with hydrogen peroxide, followed by disinfection of the dentin and exposed area with a 2.5% sodium hypochlorite rinse. The cavity was then rinsed with saline.

The cavity was dried by compression using sterile cotton. Once bleeding was controlled, Biodentine™ was gently applied to the cavity

the cavity, close to the pulpal effraction, using a fuller (figure 3). The tooth was protected by a provisional watertight eugenol zinc oxide filling.

The patient was advised to maintain excellent oral hygiene and to avoid foods and drinks that could cause pain.

She was also told of the importance of attending follow-up visits to monitor the condition of the tooth and post-treatment healing.

Figure 3 : CavityfillingwithBiodentine™ on the maxillary canine **[RABIALAHY 2024]**

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Second case

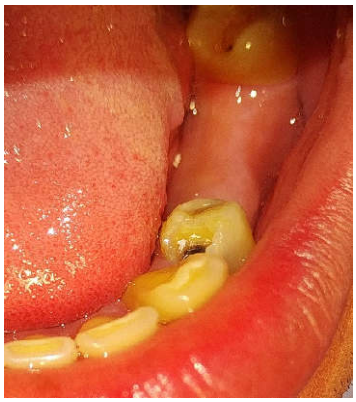
Observation summary

A 26-year-old type 1 diabetic patient presented to the dental practice pain in the left anterior-inferior region.

On general examination, the patient's blood glucose was measured at 1.19 g/L.

The symptoms reported indicated that the pain was triggered by thermal stimuli, such as cold water, and was localized, ceasing after a few seconds.

Clinical examination revealed several significant features. On inspection the presence of deep caries with brownish discoloration in the cavity,as well as coronal decay classified as SISTA 2.3. There was no dental dyschromia or periapical swelling (Figure 4). On palpation, the tooth apex was painless, with no tooth mobility. However, sensitivity to cold and probing was observed, and the tooth reacted positively to pulp vitality tests. Axial percussion tests were



negative, while transverse percussion transverse percussion tests were positive.

Figure 4:Preoperative image of the mandibularpremolar**[RABIALAHY 2024]**

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Finally, radiographic examination showed a carious cavity close to the pulp chamber, with no periapical lesions or root fractures (Figure 5).

Figure 5:Preoperativeretroalveolarradiograph of the mandibularpremolar[**RABIALAHY 2024]**

Operative protocol

The operative protocol began with a check of the patient's blood sugar levels to ensure proper management of the patient's health.

This was followed by scaling and root planing to clean up the oral cavity and limit the risk of infectionthe oral cavity and limit the risk of infection.

After explaining the condition of the patient's tooth and discussing the treatment options available, the decision was made to preserve pulp vitality by opting for a pulp capping treatmenta direct pulp capping treatment with Biodentine™ was made.

After scaling, a local anesthetic without adrenaline was administered. The carious tissue was carefully removed under copious irrigation using a turbine-mounted ball bur.

Hydrogen peroxide was used to ensure hemostasis. Next, the dentin and exposed area were disinfected by rinsing with sodium hypochlorite 2.5% sodium hypochlorite rinse, followed by a saline rinse.

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The cavity was dried by compressing with sterile absorbent cotton.

After checking that bleeding had stopped, the capping material was placed, namely Biodentine™ was proceeded with the Biodentine™ was gently treaded into the cavity, close to the pulpal of the pulp break, using a fuller. The tooth was then sealed with a provisional watertight filling using CVI, as illustrated in figure 6.

The patient was advised to maintain excellent oral hygiene and to avoid foods or drinks that could cause pain. The importance of attending follow-up visits to monitor tooth condition and healing after treatment was also recommended.

Figure6:CavityfillingwithBiodentine™ and CVI obturation **[RABIALAHY2024]**

DISCUSSION

Patient's clinical profile

Age

The patients examined and treated in this study were young adults. Younger patients have a higher repair potential of the pulp-dentin complex. This assertion is corroborated by the study by Auscill et al [9]. Moreover, therapeutic success often appears to be higher in younger patients, due to better vascularization and more active immune defenses. Despite these trends,

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studies such as that by Andrei [10] suggest that treatment success depends on age and the type of biomaterial used.

General condition

In both of the clinical cases examined, blood glucose levels measured were balanced, ensuring greater metabolic stability during treatment. This study corroborates Predine-Hug's finding that good blood glucose control should be maintained at an HbA1c level of less than 7% [11] to minimize the risk of complications during dental treatment, such as direct pulp capping [12].

Surgical protocol

The surgical protocol applied for direct pulp capping in diabetic patients is based on a series of measures designed to ensure patient safety and treatment success.

Once glycemic status was under control, scaling was performed to remove tartar build-up and improve oral hygiene. This is essential, as the links between periodontal disease and diabetes are well established, reducing the risk of complications [13].

As regards isolation of the surgical field, due to the unavailability of a dental dam as a preferred method of isolation, cotton rolls were used. The Institut Français pour la Recherche Odontologique in 2014 emphasized that cotton rolls can be used as a back-up ,moreover they are easy to use well tolerated by patients and present an advantageous cost, although their absorption capacity is limited [14].

For anesthesia, an adrenaline-free anesthetic was preferred to minimize the risk of complications, particularly in diabetic patients where the use of anesthetics with vasoconstrictors can be potentially dangerous[15].

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Curettage of carious tissue was performed with care to limit pulpal exposure. Iwamoto et al. observed that the size of the pulpal exposure is a determining factor in pulp healing [16].

During pulpal exposure, a sterile cotton pellet soaked in sodium hypochlorite was applied to the site for 2-3 minutes for haemostasis. This method is recommended by Demir et al in 2007 [17]. Sodium hypochlorite not only ensures effective haemostasis, but also disinfects the cavity [18].

After hemostasis, the cavity was thoroughly rinsed with saline to remove any residual debris. Excess moisture was then removed by compression using sterile cotton pads.

Capping and filling materials

The choice of capping and obturation materials is a crucial step in the management of diabetic patients.

The management of diabetic patients, given the significant impact pulpal health can have on their overall well-being. In our study, we selected Biodentine™ as the capping material, eugenate for the provisional obturation, and CVI for definitive obturation.

Capping material: Biodentine™

According to Modena et al. biocompatibility of materials is paramount in minimizing pulp tissue irritation and degeneration [19].

Biodentine™ stands out for its ability to promote healing of the vital pulp and repair dentin, at both coronal and root level.

Koubi G. et al. highlight its effectiveness in the treatment of carious lesions, asserting that Biodentine™ preserves pulpal vitality after direct pulp capping [20]. This is particularly relevant in the treatment of diabetic patients, for whom maintaining pulp vitality is crucial to avoid further complications.

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One of the major advantages of Biodentine™ is its release of calcium ions at higher concentrations than other styling materials.

These calcium ions play a key role in remineralization and promote the formation of mineralized dentin tissue, which is essential for pulp healing [21].

Studies also show that direct capping with Biodentine™ resulted in good pulp preservation after 28 days, corroborating with our clinical observations. These results underline the importance of this material in the management of carious lesions, particularly in diabetic patients, where pulpal health is often compromised [22].

Nevertheless, it should be remembered that successful pulp capping does not rely solely on the quality of the capping material. The tightness of the restoration is just as essential. Swift et al. observed that failure to seal the pulp cavity would allow bacteria to infiltrate the marginal spaces, leading to treatment failure [23]. Thus, to guarantee pulp vitality after capping, the placement of a tight restoration is paramount, as mentioned by

Filling material: CVI

The choice of CVI for definitive obturation is based on its adhesion properties, its ability to release fluoride ions and its excellent sealing properties. As a dentin substitute, it provides thermal insulation, a barrier against bacterial diffusion, and compensates for mechanical stress [24]. Because of its ability to seal the cavity effectively, CVI is a material of choice for coronal restorations after pulp capping, especially in the context of dental care for diabetic patients, where the risk of infection is increased.

Post-operative follow-up

Post-operative follow-up is essential for assessing treatment efficacy and pulpal health. According to Bergenholtz, clinical and radiographic checks are recommended at one week, three months and six months after treatment, in order to establish a reliable prognosis and determine the appropriate time for fitting of a permanent restoration [24]. This approach not

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only allows monitoring of pulp healing, but also early identification of possible complications, thus contributing to a better long-term outcome.

Studies show that regular follow-ups help prevent serious complications, such as pulpal and periapical infections. For example, Mott et al. point out that follow-up visits enable treatment to be adjusted according to patient's clinical response and radiographic evolution [25]. In addition, post-operative follow-up is an opportunity to assess pulpal vitality through thermal sensitivity and percussion tests, providing clinical indicators of the success of the treatment.

Clinical assessment

In the present study, the clinical assessment revealed distinct results between the two cases examined. In the first case, the patient presented an elevated blood glucose level at the three-month post-operative check-up, whereas the results were balanced at the one-week and six-month check-ups. Conversely, the second case showed a stable blood glucose level throughout the different control sessions. This glycemic imbalance could be a key factor influencing treatment success in the first case.

The literature supports the view that glycemic control is essential to prevent complications and promote optimal healing. It confirms that an HbA1c level below 7% is associated with a significant reduction in diabetes-related complications, including those affecting oral health [1]. On the other hand, poorly controlled diabetes can impair the healing process by decreasing collagen synthesis by fibroblasts and reducing blood flow due to microangiopathy[26].

In our study, capped pulps were considered “clinically healthy” at periodic checks, reacting positively to vitality tests, without pain or tenderness.

Vitality tests, without pain or increased sensitivity. On the other hand, signs of pain, discomfort or a negative response to sensitivity tests could be interpreted as treatment failures, as emphasized by Dammaschke et al. [27].

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Radiographic assessment

Radiographic assessment plays an essential role in evaluating the success of pulp treatments.

According to the European Society of Endodontology (2006), radiographic success criteria include dentine bridge formation, dentine repair formation, no radiological signs of apical periodontitis, no pulpal calcification or internal root resorption, and no decrease in pulpal volume [28].

Studies support these criteria for successful treatment by the absence of complications such as the need for subsequent endodontics or the formation of a periapical lesion or ligament thickening, signs of resorption or any other pathological process at 6 months and 1 year postoperatively and secondly, the development of a dentinal bridge is an important marker of the success of this therapy [29].

The dentin bridge must meet a number of criteria. It may be present in large or small quantities. Its homogeneity may vary [30].

In our study, radiographs showed the absence of periapical lesions at three and six months post-operatively. However, dentine bridge formation was not yet observed during the follow-up period, which limits our confirmation of treatment success from a radiographic point of view.

The absence of radiographic complications is a good indicator of pulpal health. However, the identification of a dentinal bridge, although still absent, remains a long-term objective. This underlines the importance of ongoing radiographic follow-up to assess the progress of healing and the success of treatment.

Conclusion

In conclusion, this study demonstrated that direct pulp capping with Biodentine™ in diabetic patients can offer promising clinical and radiographic responses Although adjustments may be necessary depending on patients' glycemic balance

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The results obtained indicate preservation of pulpal vitality, accompanied by an absence of significant post-operative complications, and potential formation of reparative dentin over time. In the future, it is essential to raise awareness and train healthcare professionals in the specificities of managing diabetic patients in dental practice, in order to improve the quality of care. In the long term, further studies into the biocompatibility and efficacy of new materials, as well as the evaluation of integrated treatment protocols, could contribute to significant advances in the care of this vulnerable population. By fostering a collaborative approach between dentists and general practitioners, better oral and general health for diabetic patients could be guaranteed.

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