

# The implications of diabetes mellitus in Endodontics

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DOI: <https://doi.org/10.14436/2358-2545.8.2.047-052.oar>

## ABSTRACT

Diabetes mellitus (DM) is the third most prevalent condition in patients with systemically compromised health. In view of the above, the objective of this study was to verify the implications of DM in patients who require endodontic treatment. To this end, an exploratory research was carried out through a literature review of articles published between 2003 and 2016. It can be verified that approximately 3 to 4% of adults who undergo dental treatment are diabetic. These are predisposed to chronic inflammation, progressive tissue degradation and decreased tissue repair, besides having high oral acidity, higher viscosity and reduced salivary flow, which makes them more prone to

develop apical periodontitis and tooth loss compared to the non-diabetic. There is also an interrelationship between DM and oral infections, in which the presence of one condition tends to increase the risk and severity of the other and vice versa. Thus, removal of infectious agents and inflamed tissues by endodontic treatment is an important measure for those patients. There are strategies for planning endodontic treatment, such as: patients' knowledge about being diabetic, the severity of the disease and its degree of control, patient risk classification, as well as stress and anxiety reduction, choice of anesthetic, antimicrobial therapy, and concern with drug interactions.

**Keywords:** Diabetes Mellitus. Diagnosis. Endodontics.

**How to cite:** Tomazoli ATP, Endo MS, Pavan NNO. The implications of diabetes mellitus in Endodontics. *Dental Press Endod.* 2018 May-Aug;8(2):47-52. DOI: <https://doi.org/10.14436/2358-2545.8.2.047-052.oar>

» The authors report no commercial, proprietary or financial interest in the products or companies described in this article.

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Submitted: April 03, 2017. Revised and accepted: August 15, 2017.

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## Introduction

Over the past 50 years, type 2 diabetes mellitus (DM) has emerged as a major public health problem, being the sixth leading cause of death in the United States. In Brazil, the disease affects about 15 million people. It is estimated that by 2030 there will be a 69% increase in the number of adults with DM in developing countries and a 20% increase in developed countries.<sup>7,12</sup>

Diabetic patients tend to present reduced pulp activities or pulp necrosis problems due to changes in the antioxidant system of pulp tissue.<sup>15</sup>

Hyperglycemia that characterizes DM can affect various functions of the individual's immune system, predisposing him/her to chronic inflammation, progressive tissue degradation, and decreased tissue repair. Among alterations in the oral cavity, the following stand out: xerostomia, dysgeusia, periodontal changes, increased susceptibility to infection and alterations both in pulp and periapical tissues.<sup>9,14</sup>

In the pathogenesis of diabetes, inflammation is an important factor, as it increases tissue resistance to insulin, thus worsening its control. Even a local inflammatory process, such as apical periodontitis (AP), can have significant impact on diabetes control. The reasons are not fully understood, but local inflammatory stimuli are known to induce the production of inflammatory mediators that are supposed to reduce insulin sensitivity and increase glucose.<sup>22</sup>

Diabetic patients who are aware of their dysfunction and maintain it controlled, can receive endodontic treatment as a normal patient, and the dental surgeon (DS) should be aware of the particularities of each case, whereas an uncontrolled diabetic patient requires additional care.<sup>5</sup> However, the condition that deserves greater attention on the part of the professional is undiagnosed diabetic patient.

Therefore, the objective of this study is to verify the implications of diabetes mellitus in patients who need endodontic treatment.

## Methods

This is an exploratory research carried out by means of a literature review based on previously organized material available online.

As a procedure for data collection, we retrieved scientific articles published from 2003 to 2016 and

indexed in Scientific Electronic Library Online (SciELO), US National Library of Medicine (PubMed) and Capes Portal of Journals.

Searches were based on the following descriptors: Diabetes mellitus, Diagnosis, Endodontics, Dental Pulp Cavity, Periapical Periodontitis, Oral Health.

A total of 68 articles were selected from international sources, of which 27 were chosen. The following inclusion criteria were used: abstracts compatible with the objective of the study, original and relevant articles, clinical or laboratory research, and literature reviews on endodontic treatment in diabetic patients.

## Results and Discussion

DM is a progressively debilitating disease which promotes unsatisfactory immune response, with decreased chemotaxis and decreased leukocyte motility. It, thus, results in insufficient phagocytosis of infectious particles, causing a greater susceptibility to infections.<sup>19</sup> Chronic hyperglycemia, which is a perennial characteristic of DM, affects virtually all organs and tissues of the host. The five main complications observed in the metabolic syndrome caused by this dysfunction include retinopathy, neuropathy, altered wound healing, macrovascular disease, and currently periodontal disease has been added.<sup>9</sup>

The effects of hyperglycemia show damage in saliva production, excessive wear of enamel and hypomineralization, as well as invasion of dentinal tubules with *Streptococcus mitis* and microabscesses originated in the coronal pulp with progression to pulp necrosis and AP. Additionally, effects comprise inflammation in the apical periodontal ligament, root resorption and alveolar bone reabsorption.<sup>27</sup>

Diabetic patients, therefore, tend to have high oral acidity, higher viscosity and reduced salivary flow; thus, they have a higher incidence and severity of caries and aggressive forms of periodontal disease, making them more prone to develop AP and tooth loss when compared to non-diabetic patients.<sup>14</sup> The number of teeth lost is significantly higher in individuals with DM than in the group without the disease.<sup>12</sup>

Although some differences are evident when chronic periodontal and periapical inflammatory processes are compared, both have important similarities and are associated with the same systemic disorders, such as smoking and DM. They are polymicrobial,

sharing common microbiota with a predominance of Gram-negative anaerobic bacteria, and have high levels of cytokines that can be released systematically from acute or chronic manifestations.<sup>23</sup>

There are more studies dealing with periodontal problems in diabetic patients than those discussing periapical inflammations in these patients. The reason is based on diagnostic issue, since periodontal disease is most often clinically evident, whereas AP can be silent and imperceptible.<sup>20</sup>

Despite the above, diagnosis of periapical lesions with pulp origins in diabetic patients is frequent, ranging from 65 to 97%, according to different studies.<sup>15,23</sup>

The incidence of DM patients diagnosed with severe pulp infections is 24%, whereas moderate infections appear in only 2.3% of cases, suggesting this systemic condition predisposes to endodontic infections.<sup>23</sup>

When analyzing the presence of AP in endodontically treated and untreated teeth, there was a higher prevalence of diabetics in untreated teeth, suggesting these patients may be more likely to develop the primary disease. However, treated teeth had no increased prevalence of periodontitis when compared to controls. Therefore, it is not stated that DM can influence root canal treatment response.<sup>14</sup>

On the other hand, there were no differences regarding the number of lesions in the periapical region, edema or lesion size in diabetic patients when compared to non-diabetic patients. Nevertheless, diabetic patients had twice as many pain outbreak rates caused by periapical lesions and a significantly lower postoperative success rate of endodontic treatment.<sup>7</sup>

Periapical lesions healing after endodontic treatment was evaluated by means of radiographic follow-up. It was found that, after 30 weeks, periapical radiolucencies in non-diabetic patients were reduced by 74% when compared to 48% for diabetic ones.<sup>23</sup>

Difficulty healing pulp inflammation also occurred in diabetic rats, which presented greater pulpal inflammation and inhibition of dentin bridge formation when compared to non-diabetic ones.<sup>8</sup>

Aforementioned studies give examples of a systemic disease (DM) predisposing to oral infection; however, it is known that the interrelation between them takes place in two directions. In other words, the presence of one condition tends to increase the risk and severity of the other and vice versa.<sup>2</sup>

Acute periodontitis combined with diabetes causes a 30% increase in glucose intolerance compared to diabetic patients without periodontitis, which may put the patient in an uncontrolled diabetes status.<sup>3,22</sup>

Recognizing the threats posed by oral infections to individuals with chronic diseases, such as DM, is relatively recent, although their influence on general health has been known for more than 3,000 years.<sup>24</sup> Mechanisms for the various relationships remain unknown; however, a number of hypotheses have been raised.<sup>24,2,26,29</sup>

It is believed that infection in the oral cavity serves as a metabolic stressor, generating an increase in circulating cytokines and inflammatory mediators, inducing the inflammatory cascade, as well as stimulating cross-reactivity or molecular mimicry between bacterial antigens and autoantigens. There may also be common susceptibility due to a genetically determined phenotype, which leads to a greater risk of both infection and diabetes.<sup>3,24,20</sup>

Therefore, attention to non-vital teeth or any other dental inflammation in diabetic patients is indispensable, as these conditions may increase insulin resistance. A 70-year-old patient with an endoperiodontal lesion noticed a sudden increase in his insulin demand. After three weeks, the required dosage was 100% higher. Only one day after root canal preparation, the need decreased to 50% of what was required before treatment. Forty days after endodontic treatment, insulin dosage was back to normal.<sup>22</sup>

Thus, it becomes axiomatic to remove all infections, including those of the dental pulp.<sup>23</sup>

To provide competent care to patients, DS needs to understand this bidirectional relationship between DM and infections, their treatment and the impact it may have on the patient's response to endodontic treatment<sup>3,16</sup>.

The clinician's performance should also be based on the aid to diabetes diagnosis in view of the growing number of undiagnosed people. Early diagnosis helps to prevent long-term complications which are responsible for high morbidity and mortality. Detailed anamnesis, clinical examination and gingival blood samples analyzed in self-monitoring devices are a promising approach in this process, followed by medical evaluation to establish definitive diagnosis.<sup>13</sup>

A significant number of undiagnosed diabetic patients routinely seek dental treatment, and special considerations are necessary during anamnesis, including questioning family history, requiring complete medical history, paying attention to possible signs and symptoms of diabetes, conducting careful intrabuccal assessment, including comprehensive periodontal evaluation, in addition to assessing the presence of other systemic conditions, thus establishing communication with medical treatment.<sup>12</sup>

For a possible diagnosis of DM, it is necessary to check some specific symptoms, such as dry mouth and burning sensation, difficulties in chewing and speaking, dry lips, altered taste and lack of adaptation of removable prosthesis, as well as disorders of the oral mucosa, such as lichen planus and stomatitis associated with candidiasis.<sup>12</sup>

Considering saliva as a blood ultrafiltrate, salivary glucose level analysis is a noninvasive method for diagnosis and follow-up of diabetes of which DS can be involved.<sup>11,13</sup>

According to different authors, care for diabetic patients should be scheduled early in the morning because endogenous levels of cortisol are generally higher, and this decreases the risks of a hypoglycemic episode. Consultations should preferably be short and, in case of lengthy consultations, they should be interrupted for a quick snack.<sup>25,5</sup>

Blood glucose level should be monitored constantly for a longer procedure because hypoglycemia is a common complication, and symptoms may range from mild (anxiety, sweating and tachycardia) to severe (changes in mental status, convulsions and coma). These cases will characterize medical emergencies and should be promptly treated with 15g oral carbohydrates or 1mg glucagon by subcutaneous or intramuscular injection.<sup>5</sup>

Hypoglycemia episodes represent 3% of dental office urgencies, whereas hyperglycemia manifested by ketone breath, abdominal pain, vomiting, hyperventilation, convulsion and coma represent about 0.4%, mainly in type 1 diabetes. These conditions can progress rapidly from urgency to emergency, thereby requiring hospital medical attention. Therefore, the DS should be aware of all patients' reactions.<sup>17</sup>

Before the procedures, it should be ensured that the patient has eaten normally and taken medication. Emotional and physical stress increases the

amount of cortisol and adrenaline secretion, which induces hyperglycemia. Therefore, if patient is very apprehensive, pretreatment sedation should be considered.<sup>5</sup> For this purpose, benzodiazepine should be chosen: midazolam, alprazolam, diazepam or lorazepam, in the same dosages used for normal patients. Inhaled sedation with nitrous oxide and oxygen is another good option due to safety, speed and predictability of sedation.<sup>5,6,1</sup>

Use of local anesthetics with epinephrine is safe for diabetic patients who use hypoglycemic drugs reduce toxic effects and reduce bleeding because they promote more lasting anesthesia. A stated amount in relation to maintaining blood glucose level would be six tubes in each procedure. However, other factors should be considered, such as age, gender, psychological factors, time interval, type of hypoglycemic medication and the nature of dental surgery.<sup>11</sup> Blocking anesthesia should be the one of choice, and special care should be given to unmedicated or uncontrolled diabetic patients, since, in these cases, epinephrine may cause an increase in blood glucose levels.<sup>21,10,25</sup>

Diabetic subjects with uncontrolled disease should only be treated in situations of dental urgency, and anesthetic Citanest 3%™ or Cytocaine 3%™ is recommended in combination with felypressin, following the recommended dosage limits.<sup>6,1</sup>

In controlled type 2 diabetic patients undergoing oral surgery, blood glucose levels and anxiety were verified. Half of the subjects received 5.4 mL 2% lidocaine, whereas the other half received the same amount of this anesthetic drug, but with epinephrine 1: 100,000. There were no significant differences in hemodynamic and anxiety parameters.<sup>21</sup>

Similar results were found in patients with controlled type 2 DM who received an anesthetic solution with adrenaline 1: 80,000. However, in unmedicated diabetic patients, an increase in blood glucose level was observed after procedures.<sup>10</sup>

It is hypothesized that pulp necrosis in diabetic patients has an even more virulent microbial profile, with a significant increase in *Prevotella intermedia*, *Porphyromonas gingivalis*, *F. nucleatum* and *Streptococcus*. Thus, they should be treated with effective antimicrobial regimens of the root canal. Chlorhexidine and sodium hypochlorite prove to be effective irrigating solutions.<sup>18</sup>

Odontogenic infections deserve particular vigilance in diabetic patients. Amoxicillin is the antibiotic of choice. Antibiotic prophylaxis is not indicated, since these patients do not present a higher postoperative risk than non-diabetic patients, simply adopting a protocol of asepsis and local antiseptics. However, in acute dental infections in uncontrolled patients, antibiotic use should begin before the invasive procedure and continue after drainage and primary control.<sup>25,5</sup>

In these cases, a single dose of amoxicillin 1g one hour before intervention is recommended. For patients allergic to penicillin, 500mg clarithromycin or 600mg clindamycin should be prescribed.<sup>1</sup>

Other important care concerns interactions that may occur between analgesics/anti-inflammatories and oral hypoglycemic agents in diabetic patients. The hypoglycemic action of sulfonylureas may be enhanced by the use of acetylsalicylic acid (ASA) and non-steroidal anti-inflammatory drugs. Paracetamol or dipyrrone is recommended in the usual dosage for mild pain, and in more invasive procedures dexamethasone or betamethasone is recommended in a single 4-mg dose.<sup>6,1</sup>

Edentulous patients deserve additional care, since lack of six or more teeth can offer up to four times more risk of developing type 2 diabetes. This is due to the fact that edentulism is associated with a reduction in functional efficiency and concomitant dietary selectivity. Patients tend to avoid protein, fiber, fresh fruit and vegetables in favor of foods rich in carbohydrates and saturated fats.<sup>12</sup>

Demonstration of the correct way to perform oral hygiene and visual feedback of diabetic patient performance should be performed by the DS with caution. Recommendations for the use of dental floss, interdental brushes and electric toothbrushes should be emphasized. Returns to follow-up should occur at time intervals shorter than six months.<sup>28</sup>

Diabetic subjects need to be informed of their risk for periodontal diseases and the importance of oral health to their overall health; 83% of the adult population is unaware of this connection. Only 22.2% of diabetic adults brush their teeth twice a day, 65.4%

brush their teeth once a day, and most of them (73.6%) never floss to clean their teeth. Therefore, encouragement of appropriate oral hygiene methods should be performed by the DS in order to improve oral health and prevent gingival diseases in this high-risk population.<sup>4</sup>

Effective control of oral diseases can be achieved systemically through better glycemic control and locally with better oral hygiene. Diabetic patients should be warned about the importance of diet to control blood sugar, daily removal of plaque with meticulous mouth cleaning, improved perception of dry mouth, elimination of tobacco consumption, and submission to cleaning and professional care on a regular basis.<sup>28</sup>

## Conclusion

After the present literature review about the implications of DM in Endodontics, it is possible to consider that:

DM is a major health problem in the 21<sup>st</sup> century, affecting a large number of people, whether diagnosed or not.

Endodontic treatment in diabetic patients should be based on patient's knowledge about being or not diabetic, on the degree of the glycemic control, as well as on the schedule of visits (being the early morning the most recommended); reduction of stress and anxiety, through the use of benzodiazepines in specific cases; in the choice of anesthetic, which may contain adrenaline as a vasoconstrictor for those controlled patients; in antimicrobial therapy and in preoccupation with drug interactions.

Exacerbated inflammatory response, favoring primary periapical lesions, difficulty in healing of these lesions, increased resorption of the root and alveolar bone, postoperative pain episodes and risks of intraoperative emergencies are also considerable implications in the endodontic treatment of diabetic patients.

The DS must understand the characteristics of the metabolic dysfunction, its treatment and impact on patient's oral health. As a result, the DS must provide help in the diagnosis of DM, so that he/she can act in a conscious, safe and effective way.

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