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Association between apical periodontitis and root canal treatment in patients with type II diabetes. A systematic review

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SUMMARY

Background. Type II diabetes mellitus (T2DM) is a chronic endocrine disease affecting over 6% of the world population. Sustained hyperglycaemia plays a role in inhibited healing and chronic inflammation which can lead to complications after root canal treatment, such as delayed healing of apical periodontitis.

Material and methods. The systematic review adhered to PRISMA guidelines and databases of PubMed, ScienceDirect, and The Cochrane library were used to perform the search. The search was carried out between November 15 and November 30 in the year 2021.

Aim. To evaluate the relationship between apical periodontitis and root canal treatment in patients with type II diabetes.

Results. Primary database search yielded 313 results. After checking the content and relevance of the articles, 4 articles were used with a total of 15810 patients. Out of 4 studies, 3 concluded that apical periodontitis after root canal treatment was statistically significantly more frequent in patients with T2DM than in control groups. However, the results from another study showed that there is no significant correlation between T2DM and post-treatment apical periodontitis ($p>0.05$).

Conclusions. A statistically significant relationship was found between T2DM patients and the occurrence of apical periodontitis in most studies.

Keywords: diabetes, apical periodontitis, root canal treatment, endodontics.

INTRODUCTION

Type II diabetes mellitus (T2DM) is a chronic endocrine disease affecting over 6% of world population (1). The aetiology of the disease is multifactorial including genetic and environmental causes. The risk factors, however, are obesity and lack of physical activity (2). Due to inability to produce insulin or inability of the tissues to appropriately respond to insulin, the cells are unable to absorb and metabolise glucose. This leads to increased circulating glucose levels in the blood (3). Sustained hyperglycaemia plays a role in inhibited healing and chronic inflammation which can lead to complications after root canal treatment, such as delayed healing of apical periodontitis (AP) (4). In addition, other studies have found that in patients with T2DM the higher prevalence of AP compared to healthy individuals is linked to increase of osteoclastic activity due to the interaction of their receptors and advanced glycation end products (5). These days, as the prevalence of T2DM is increasing rapidly, it is essential for dentists to have knowledge about possible complications associated with dental interventions and this disease. For diabetic patients with long-term poor glycaemic control, dentists should evaluate oral conditions, glycaemic control status, medicine, used for treatment of T2DM and treat infections accordingly (6)

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MATERIALS AND METHODS

Methods

The systematic review adhered to PRISMA (Preferred Reporting Items for Systematic Review) guidelines. A focused question was formed accord-

ing to the PICOS model: is there an association between type II diabetes mellitus and apical periodontitis in adult patients after root canal treatment?

Search strategy

The search was carried out using databases of PubMed, Scopus, and The Cochrane Library between November 15 and November 30 in the year 2021. The following search terms were used: "Diabetes", "Apical Periodontitis", "Root canal treatment", and "Endodontics". The search was supplemented using additional articles in references and lists of similar studies.

Eligibility criteria

The inclusion criteria for the studies were: studies in English language not older than 10 years, studying adult patient radiographs with T2DM after root canal treatment. We included only clinical investigations on humans. Case reports, systematic reviews, meta-analyses, animal studies were excluded from the search as well as other studies which evaluated apical periodontitis in patients without root canal treatment or patients with other types of diabetes.

Study selection and data collection process

Firstly, the possible studies from the initial search were selected for further screening based on the title and the abstract by two authors (K.B. and M.V.). If there were any disagreements, the supervisors (D.O. and J.Ž.) would have resolved it. The selected studies were then analysed and the studies that did not match the inclusion criteria were discarded.

RESULTS

Study selection

Primary database search yielded 313 results out of which 10 were duplicates and were excluded. Titles and abstracts of 303 articles were screened and after the process, 24 studies were used for further full text analysis. After checking the content and relevance of the articles, 4 articles were used with a total of 15810 patients. The studies were published between the years 2011 to 2021.

Characteristics of included studies

3 of the studies were cross sectional studies and one study was a retrospective observational study. A total of 15810 patients were included in the studies. Sisli et al performed a cross-sectional study with DM patients who had their root canals treated as well as the tooth restored with a permanent coronal restoration at least one year ago. The quality of the obturation as well as periodontal status was assessed using Cone Beam Computed Tomography (CBCT) (7). A retrospective observational study by Martinho et al used periapical radiographs to assess the healing as well as oral examination to find out any signs of periodontitis (8). Another author performed a cross-sectional case-controlled study to find out the relation between T2DM and apical periodontitis. Additionally, the study investigated commonly used medications for T2DM (metformin and statins) and their effect on healing (4). Marotta et al studied adult Brazilian population in a cross-sectional study (9). The authors of this study compared full-mouth periapical and panoramic radiographs of T2DM patients and control group. Only patients with adequate root canal obturations were included in the study.

Qualitative synthesis of results

Out of 4 studies, 3 concluded that apical periodontitis after root canal treatment was statistically more frequent in patients with T2DM than in control groups (4, 7, 8). However, the results from another study showed that there is no significant correlation between T2DM and post-treatment apical periodontitis ($p>0.05$) (9). A study performed by Yip et al. also investigated the effect of glycaemia control on the outcome of endodontic treatment – the results showed a significant association between AP and poor glycaemia control (4). Another author found similar results as Yip et al, as in the poorly controlled T2DM group, apical periodontitis lesions were statistically significantly more frequent than in well controlled T2DM group (7). None of 4 articles found a significant difference between the diabetics and control group in terms of age, sex, and type of teeth evaluated. Yip et al extended the research to medications, usually used for treating T2DM. It was found that statins and metformin were associated with increased periapical healing and reduced bone resorption, leading to lower frequency of postoperative AP (4). Selen Nihal Sisli et al (7) investigate prevalence of AP in root-filled teeth using CBCT and found that the frequency of AP was 37.3% for the DM group and 28.4% for the control group, and this difference was statistically significant ($p < .05$). The frequency of CBCT PAI score ≥ 3 was statistically significantly larger in the DM group than in the control group with 21.3% and 6.79% respectively. The frequency of CBCT periapical index (PAI) score ≥ 3 in the DM group was 21.3%, while it was 6.79%

in the control group, and this difference was also statistically significant ($p<0.05$).

DISCUSSION

There are just a few articles so far that investigate type 2 diabetes mellitus impact on periodontal tissues after endodontic treatment. This systematic review concludes that T2DM has a statistically significant relationship with the occurrence of AP (4, 7, 8). This result links to DM affecting and delaying the healing process of root canal treatment (4, 8, 9).

The overall prevalence of AP was significantly higher in diabetics compared with control group (4, 7, 8). However, diabetes could be not the only factor affecting poor treatment results: AP could also be linked to delayed treatment of root canal infections, mistakes in root canal treatment, for example insufficient obturation (10). In addition, it should be considered that the main cause for impacted healing is not DM itself, but the elevated glucose levels in the patient's blood. It affects the functions of inflammatory cells and markers which leads to higher susceptibility for further infections (11). 2 of the studies, included in this systematic review, observed that poor control of glucose levels in diabetic patients has a negative impact on postoperative healing and increases the chances of apical periodontitis (4, 7). This can also be confirmed by another study which summed up that lower glucose levels have a greater reduction in AP over 30-week period (12).

All studies used different methods of evaluating periapical status: one study used CBCT (7), the others either used periapical or panoramic radiographs (4, 8, 9). The literature suggests that CBCT offers the best diagnostic quality compared to other types of imaging, however it should be noted that this type of imaging emits the largest amount of radiation. Therefore, CBCT should only be used for patients who display nonspecific clinical signs and even then with the lowest possible radiation dosage (13).

Our systematic review had some limitations. Firstly, the small number of included studies to the review acts as the main limitation. One of the limitations was that the mean follow-up time, as well as diagnostic tools, differed in included studies. One more limitation – the technique of root canal formation, filling and irrigation materials was excluded from the articles. Nevertheless, our systematic review showed that T2DM could have negative effect on the outcome of root canal treatment, also various reasons could have caused unsuccessful outcome, such as missed canals, insufficient obturation or cleaning, and low-quality coronal restoration.

CONCLUSIONS

Within the limitations of these studies, a statistically significant relationship was found between T2DM patients and the occurrence of apical periodontitis in most studies. In addition, a link between glycaemia control and post-treatment apical periodontitis was found which could have a great impact on managing endodontic patients with T2DM. All things considered, it is advised to take into consideration that apical periodontitis might occur more frequently in T2DM patients and the healing process could be delayed after root canal treatment.

STATEMENT OF CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest to report.

REFERENCES

1. Khan MAB, Hashim MJ, King JK, Govender RD, Mustafa H, Al Kaabi J, et al. Epidemiology of type 2 diabetes - global burden of disease and forecasted trends. *J Epidemiol Glob Health* 2020;10(1):107-11.
2. Wu Y, Ding Y, Tanaka Y, Zhang W. Risk factors contributing to type 2 diabetes and recent advances in the treatment and prevention. *Int J Med Sci* 2014;11(11):1185-200.
3. Galicia-Garcia U, Benito-Vicente A, Jebari S, Larrea-Sebal A, Siddiqi H, Uribe KB, et al. Pathophysiology of type 2 diabetes mellitus. *Int J Mol Sci* 2020;21(17):6275.
4. Yip N, Liu C, Wu D, Fouad AF. The association of apical periodontitis and type 2 diabetes mellitus: A large hospital network cross-sectional case-controlled study. *J Am Dent Assoc* 2021;152(6):434-43.
5. Crabtree M, Pileggi R, Bhattacharyya I, Caudle R, Perez F, Riley J, et al. RAGE mRNA expression and its correlation with nuclear factor kappa beta mRNA expression in inflamed human periradicular tissues. *J Endod* 2008;34(6):689-92.
6. Hsu YJ, Chen YH, Lin KD, Lee MY, Lee YL, Yu CK, et al. Clinical outcomes and oral health-related quality of life after periodontal treatment with community health worker strategy in patients with type 2 diabetes: a randomized controlled study. *Int J Environ Res Public Health* 2021;18(16):8371.
7. Sisli SN. Evaluation of the Relationship between type II diabetes Mellitus and the prevalence of apical periodontitis in root-filled teeth using cone beam computed tomography: an observational cross-sectional study. *Med Princ Pract* 2019;28(6):533-8.
8. Martinho JP, Coelho A, Oliveiros B, Pires S, Abrantes AM, Paulo S, et al. Impairment of the angiogenic process may contribute to lower success rate of root canal treatments in diabetes mellitus. *Int Endod J* 2021;54(10):1687-98.

9. Marotta PS, Fontes TV, Armada L, Lima KC, Rôças IN, Siqueira JF Jr. Type 2 diabetes mellitus and the prevalence of apical periodontitis and endodontic treatment in an adult Brazilian population. *J Endod* 2012;38(3):297-300.
10. Nair PN. On the causes of persistent apical periodontitis: a review. *Int Endod J* 2006;39(4):249-81.
11. Fouad AF, Huang GT-J. Chapter 9: inflammation and Immunological response. In: Rotstein I, ed. Ingle's Endodontics, 7th ed. Canada: PMPH-USA; 2015.
12. Cheraskin E, Ringsdorf WM Jr. The biology of the endodontic patient. 3. Variability in periapical healing and blood glucose. *J Oral Med* 1968;23(3):87-90.
13. Mostafapoor, M., Hemmatian, S. Evaluation of the accuracy values of cone-beam CT regarding apical periodontitis: a systematic review and meta-analysis. *Oral Radiol* 2022;38(3):309-14.

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