Implementation of oral care in primary diabetes care

Verhulst, J.L.M.

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Chapter 1

General introduction

Diabetes Mellitus and oral health

Diabetes mellitus (DM) is a complex, chronic disease, characterized by hyperglycemia that results from defects in insulin secretion, insulin action, or both (1). Two major types of DM are distinguished: type 1 (T1DM; 5-10% of the cases) and type 2 (T2DM; 90-95% of the cases) (2). Other types of diabetes include gestational diabetes mellitus (GDM), which occurs during pregnancy and mostly disappears after giving birth; maturity-onset diabetes of the young (MODY); drug or chemical induced DM; genetic insulin action defects; diabetes due to pancreas diseases; endocrinopathies; infections and finally uncommon forms of immune-mediated DM (2). DM is quickly becoming a disease of epidemic proportions, as an estimated 451 million individuals (8.4% of the global population aged 18–99 years) are currently affected worldwide, which is expected to rise to 693 million (9.9%) by the year of 2045 (3). The International Diabetes Federation (IDF) estimates that, in 2017 alone, DM was responsible for approximately 5 million deaths worldwide, and caused a global healthcare expenditure of USD 850 billion (3). Perhaps the most devastating consequence of DM is the development of chronic complications, of which retinopathy, nephropathy, neuropathy and cardiovascular diseases (CVD) are the most common. These complications are the result of damage to the micro- and macrovasculature, caused by metabolic disturbances such as hyperglycemia, insulin resistance, dyslipidemia, and other factors such as hypertension and immune dysfunction (4, 5).

Hypotheses about the existence of an association between DM and oral health are not particularly new, with periodontitis in particular. In fact, the term "diabetic gingivitis" was already mentioned as early as 1899 (6). However, it was not before the publication of Loë in 1993 that periodontitis became generally recognized as a complication of DM (7). Periodontitis is a chronic, multi-causal, inflammatory disease characterized by destruction of the supporting structures around the teeth (gingival connective tissue, periodontal ligament, alveolar bone, and root cementum) (8). The overall prevalence of periodontitis in adults is estimated to be 30-50%, with approximately 9-11% suffering from the severe form (9, 10). In the past few decades, many studies have been dedicated to unraveling the association between DM and periodontitis. This resulted in the general consensus that the prevalence, incidence, progression, and severity of periodontitis are higher in patients with DM (11). Moreover, in more recent years, it was demonstrated that the relationship between DM and periodontitis is bi-directional (12). In general, patients with DM who also suffer from periodontitis exhibit more difficulties to stabilize metabolic control and develop other diabetic complications more frequently (13). Interestingly, for patients with T2DM and periodontitis, intensive periodontal treatment demonstrated to

improve glycemic control (14, 15). Although there seems to be a clear epidemiologic association between DM and periodontitis, there is no consensus in the literature about underlying biologic mechanisms. As is the case for other chronic complications of DM, hyperglycemia seems to be particularly important (16). In fact, patients with well-controlled DM have a similar risk to develop periodontitis as non-diabetic individuals (17). However, besides hyperglycemia, other metabolic disturbances that characterize DM are largely ignored in the search for pathogenic mechanisms. Apart from periodontitis, associations with other oral diseases and complaints remain rather overlooked, such as dental caries, dry mouth, oral fungal infections, oral cancer and taste disorders.

Diabetes care and oral health

A complex, severe disease such as DM demands continuous medical care. As formulated in several medical guidelines, the main goals of diabetes care are the prevention and treatment of diabetic complications and optimizing quality of life (QoL) (18, 19). Although management of glycemic control is pivotal, the complexity of DM requires a broader, multifactorial approach to achieve these goals. In the Netherlands, medical treatment for T2DM is mainly organized in a structured program in primary care (19). This program has a strong interdisciplinary character, with a central role for the general practitioner (GP) office. Depending on individual patient needs, GPs and specialized nurse practitioners closely collaborate with other disciplines, such as dieticians and physical therapist to encourage lifestyle changes, ophthalmologists and podiatrists to improve eye- and footcare, pharmacists for optimal drug administration and internists to support complex cases. With such a multi-disciplinary team at a patient's disposal, close collaboration with the dental field seems only logical, especially considering the oral complications of DM.

In the Netherlands, the Dutch College of General Practitioners (NHG) – who aim to improve and support evidence-based general practice – has developed several primary care guidelines, one of which concerns T2DM. Following the accumulating evidence regarding associations between DM and oral health, a revised version of this guideline was published in 2013, now also including a recommendation on oral care. During the annual diabetes check-up, the GP is advised to: *"inspect the mouth (and pay attention to signs of periodontitis) and advise the patient to visit the dentist and/or oral hygienist twice a year"* (19). Similar recommendations have been made by other international organizations as well, such as the International Diabetes

Federation (IDF), the American Diabetes Association (ADA) and the Centers for Disease Control and Prevention (CDC) (11, 20-22). The bi-directional association between DM and periodontitis seems to justify these recommendations, but with an emphasis on periodontitis, other oral diseases and complaints may be overlooked. The abovementioned guidelines indicate that awareness for oral health in diabetes care is increasing. However, the impact on daily practice has been limited so far (23). Patients with DM still have very limited knowledge about oral health and its relation to their diabetes, and generally exhibit oral health behavior (24). If we look more closely at the recommendations formulated in the guidelines for GPs, two major aspects stand out. The first one is the advice to initiate and optimize collaboration between dental and medical professionals. In daily practice, this is not as straightforward as it would seem. In the Netherlands, the information flow between internists and dentists proved to be far from optimal. Fewer than 50% of the oral health questionnaires that were delivered by patients with DM to the dentist were returned to the diabetologist that treated the patient (25). The main reasons for the difficult communication were lack of routine, familiarity and willingness among both diabetologists and dentist. Another issue may be financial support. Nevertheless, recent research demonstrated that despite the identification of several barriers, dental and medical care professionals are actually receptive for an interdisciplinary healthcare approach for patients with DM (26). However, whether such an approach actually benefits the patient has not been investigated.

The second aspect that stands out in the medical guidelines for primary diabetes care is the recommendation that primary diabetes care providers, such as GPs and nurse practitioners, should screen their patients for the presence of periodontitis. The ultimate goal is (early) diagnosis and subsequent effective treatment of periodontitis, which could not only prevent further disease progression but could also contribute to the improvement of metabolic control (14). However, to date, thorough periodontal charting by a trained dental professional still is the only reliable way to assess periodontal health. Medical professionals generally lack the time, knowledge and resources to do so, and require alternative screening methods. Although advances have been made on the use of salivary biomarkers (27, 28) or self-reported oral health (29-31) to screen for periodontitis, a reliable, easy applicable screening tool has not been developed yet. Such a screening tool could have practical implications for other medical disciplines as well, as periodontitis is associated with for example atherosclerotic cardiovascular diseases (32), rheumatoid arthritis (33), Alzheimer's disease (34) and adverse pregnancy outcomes (35).

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Aims and outline of the thesis

The overall aim of this thesis was to initiate and assess implementation of oral care in primary diabetes care. As a start, primary diabetes care providers need to extend their knowledge about the association between DM and oral health, so that they know what to expect in the mouth of their patients. Therefore, **Chapter 2** of this thesis presents a comprehensive review, aiming to provide an up-to-date overview of the available literature on DM and all of its potential oral complications.

The lack of time, knowledge and resources in primary diabetes care prevents effective screening for periodontitis, and thereby hamper efforts to implement oral care in diabetes care as recommended in the guidelines. Primary care providers need alternative methods to pay attention to oral health, with the most prevalent problem – periodontitis – in particular. The study presented in **Chapter 3** aims to develop and assess a rapid, non-invasive tool for periodontitis screening, based on self-reported oral health, demographics and/or salivary biomarkers.

The extent of perceived oral health problems and oral healthcare behavior of patients with T2DM are described in **Chapter 4**, as it is important for primary diabetes care providers to know the characteristics of their population. This chapter presents a cross-sectional analysis of a study population with T2DM, assessing self-reported oral health, oral health-related QoL and general health-related QoL.

Finally, in a cluster-randomized controlled trial, a group of GPs and nurse practitioners implemented a structured oral care protocol into their regular diabetes care practice. The effects of this intervention on patient-centered outcomes are described in **Chapter 5**. This study mainly aims to investigate whether the implementation of oral care in primary diabetes care can improve oral health-related QoL in patients with T2DM.

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