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Interdependency of medical professionals and periodontists in managing hyperglycemia and assessment of their understanding on two-way relationship between diabetes and periodontitis – A questionnaire survey

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Abstract
Periodontitis is a chronic inflammatory condition characterized by the destruction of periodontal tissues and is considered the sixth complication of diabetes mellitus (DM). Untreated periodontitis can worsen glycaemic control or increase the risk of developing DM. Medical professionals play a crucial role in promoting early counselling for periodontal maintenance among diabetic patients, as they often have more frequent interactions with patients compared to dentists. The interrelationship between systemic and oral diseases necessitates a comprehensive approach to treatment. Despite this, awareness among medical professionals about the association between DM and periodontitis remains limited. This survey aims to investigate the knowledge of medical doctors regarding periodontitis as a complication of DM and their opinions on the timely referral of these patients to a dentist.
A structured questionnaire was prepared using Google Forms and distributed among medical practitioners. It included multiple-choice questions under six categories i.e. Awareness of uncontrolled DM and its complications; Pathogenesis of uncontrolled hyperglycaemia; Awareness of the two-way relationship between DM and periodontitis; Complications of periodontitis; Effects of periodontal therapy on hyperglycaemia; Need for referral of diabetic patients to a dentist.
A total of 104 certified medical professionals participated in the survey, including 67 general practitioners and 37 specialists. 31% of participants recognized DM as a disorder with its symptoms in the oral cavity and regarding referral practices, only 33.7% of the participants regularly referred diabetic patients for regular periodontal evaluation.
It was seen that a significant gap existed in the knowledge of medical practitioners regarding the interrelationship between DM and periodontitis. This highlights the need for enhanced educational programs aimed at promoting inter-professional collaboration, in order to improve overall health outcomes and quality of life.

Keywords: Periodontal therapy, medical professionals, systemic health, glycemic control, periodontitis, diabetes Mellitus

Introduction

Periodontal disease (PD) is a chronic inflammatory condition characterized by the destruction of periodontal tissues, resulting in connective tissue attachment loss, alveolar bone loss, and the formation of pathological pockets around the diseased tooth [1]. Incidence of periodontitis increases with age: 82% in the elderly, 73% in young adults, and 59% in adolescents [2]. It is generally accepted that "the oral cavity is a mirror to systemic health." PD has been associated with nutritional deficiencies, obesity, diabetes mellitus (DM), cardiovascular disease, adverse pregnancy outcomes, osteoporosis, rheumatoid arthritis, chronic obstructive pulmonary diseases, and chronic kidney diseases [3].
According to the International Diabetes Federation, India ranked globally 2nd with a prevalence rate of 69.2 million cases of DM in 2015, expected to reach 123.5 million by 2040 [4]. Several authors have reported a bidirectional relationship between DM and PD [5, 6, 7]. The underlying mechanism involves a nonenzymatic reaction of glucose with amino acids, leading to the accumulation of irreversible advanced glycated end products (AGEs). Receptors for AGE (RAGE) are present on smooth muscles of endothelial cells, fibroblasts, monocytes, macrophages, neutrophils, etc [8]. This AGE-RAGE interaction on endothelial cells increases cell membrane permeability and adhesion. On fibroblasts, it decreases collagen production and increases susceptibility to attachment loss, leading to apical migration of microorganisms. On macrophages, it causes secretion of pro-inflammatory cytokines like tumor necrosis factor-alpha (TNF-α), interleukin-1B (IL-1β), and interleukin-6 (IL-6) [9, 10, 11]. Uncontrolled hyperglycemia also provides a suitable environment for the growth of subgingival microflora. This makes PD more prevalent and severe in diabetics compared to systemically healthy individuals. Hence, periodontitis is recognized as the "sixth complication" of DM [1]. This association carries a 6-fold higher risk for worsening of the glycemic index over time [12]. Untreated periodontitis also increases the risk of developing TIIDM [13, 14].
With advancements in diagnostic aids and comprehensive treatment planning, if medical professionals are well-acquainted with oral diseases bearing a systemic origin, they have an upper hand in promoting and encouraging early counselling for periodontal maintenance of diabetic individuals, as patients tend to seek medical care more often than dental check-ups. Therefore, creating awareness about the interrelationship between systemic and oral diseases among medical professionals is the need of the hour. As periodontal treatment in uncontrolled DM is compulsorily preceded by a physician's consultation, similarly, a periodontal opinion along with regular blood sugar analysis in DM is essential for comprehensive treatment.

It was found that only 10.8% of referred patients with TIIDM visited a dentist for regular dental checkups [15, 16, 17, 18]. Lack of awareness among patients also contributes to delayed periodontal consultation, often at a severely diseased state. This can be attributed to the failure of proper patient counselling by healthcare providers. The International Diabetes Federation and World Dental Federation have emphasized that "prevention of periodontitis in patients with DM relies on close collaboration between dentists and physicians" [4]. A study reported that an interprofessional learning tool was developed for qualified pharmacists, nurses, healthcare assistants, and junior doctors to improve treatment needs for patients with DM, but the study overlooked the importance of involving dental professionals in the management of patients with DM [19]. Another study showed that medical professionals, including general medical practitioners, specialists, nurses, and allied healthcare workers, were unaware of the association between oral health problems and DM [20]. Unfortunately, this gap remains significant even today, where advancements in early diagnosis of oral diseases can help bridge the gap between the delay in reporting of diabetic patients to the dental OPD and reducing tooth morbidity to improve the overall health of the patient.

The aim of this survey was to investigate the knowledge of medical doctors regarding PD as a complication of DM and their opinion towards the timely referral of these patients to a dentist.

Material and methods

A structured questionnaire was prepared using Google Forms, and the link was circulated among certified medical practitioners. The questionnaire was open for 10 days. Answering all the questions was made compulsory, and no corrections could be made once the form was submitted. Ethical approval was obtained from the institutional ethical board. The multiple-choice questions were framed under the following six categories:

1. Awareness of uncontrolled DM and its associated complications
2. Pathogenesis of uncontrolled hyperglycemia
3. Awareness of the two-way relationship between DM and periodontitis
4. Complications of periodontitis and its effects on general health
5. Awareness of the effects of periodontal therapy on hyperglycemia
6. Awareness of the need for referral of a diabetic patient to a dentist.

Results

A total of 104 certified medical professionals participated in the survey, including 67 general practitioners and 37 specialists. (Table 1)

Table 1: Demographic details of the participants

S.NO	Variable	No. of Participants	% of Participants
1	General practitioners	67	64.4 %
2	Specialist	37	35.6 %

Questions regarding awareness of participants on symptoms of uncontrolled DM showed that 31% of the participants considered "DM as a disorder with its associated symptoms in the oral cavity," and almost 10% of them were unaware that DM could potentially have complications in the oral cavity. Only 51% of the participants marked gingival/periodontal abscess as the most common oral complication of DM, and 14.4% of the participants were unaware that poor oral maintenance, along with excessive antibiotics administration in diabetics, caused a favorable environment for fungal overgrowth, leading to frequent mouth and tongue burning in uncontrolled diabetics. (Table 2)

Table 2: Awareness on uncontrolled DM and its associated complications

S.NO	Questions	Answers	% of Participants
1	Which endocrinal condition/disorder has its associated symptoms in the oral cavity?	Puberty	2.9 %
		Pregnancy	6.7 %
		Diabetes mellitus	31.7 %
		None of the above	1 %
		All of the above	57.7 %
2	Which of the following are complication(s) of uncontrolled Diabetes mellitus?	Retinopathy	85.6 %
		Nephropathy	72.1 %
		Diseases of the oral cavity	62.5 %
		Neuropathy	72.1 %
		Peripheral Vascular diseases	48.1 %
		Impaired healing	60.6 %
3	Which is the most common complication of Diabetes Mellitus in the oral cavity?	Candidiasis	15.4 %
		Aphthous ulcers	20.2 %
		Periodontal/ Gingival Abscess	51 %
		Stomatitis	13.5 %
4	What is the reason for frequent mouth burning and tongue burning in uncontrolled diabetic?	Ill maintenance of oral cavity	41.3 %
		Favourable environment for fungal overgrowth	66.3 %
		Excessive antibiotics administration for various infections	40.4 %
		None of the above	14.4 %

Questions regarding awareness of the two-way relationship between periodontitis and DM showed that only 6.7% of the participants were unaware of the systemic involvement of reactive oxygen species, nuclear factor kappa B ligand, osteoprotegerin (OPG), and AGEs in the pathogenesis of DM and periodontitis. (Figure 1)

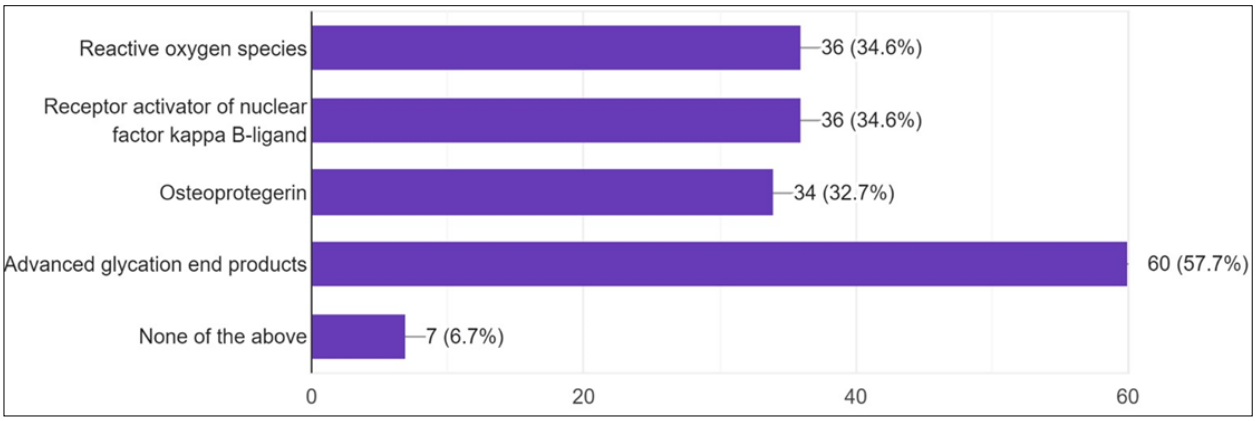

Fig 1: Pathogenesis of uncontrolled hyperglycaemia

Only 37.5% of the medical professionals were aware of the involvement of AGEs affecting the endothelial cells, fibroblasts, and macrophages in the degradation of tooth-supporting structures. 21.2% of the professionals were unaware of the local involvement of increased sugar levels in saliva and gingival fluid, responsible for gum disease in DM. A significant number of medical professionals, 70.2%, reported that they were introduced to this concept for the first time through our questionnaire study. (Table 3)

Table 3: Awareness on two-way relationship between periodontitis and DM

S.No	Questions	Answers	% of Participants
1	What causes severe gum disease (periodontitis) in uncontrolled diabetes mellitus?	Advanced glycation end products that affect endothelial cells, fibroblasts and macrophages	37.5 %
		Increased sugar level in saliva	19.2 %
		Increased sugar level in gingival (gums) fluid	22.1 %
		Excessive plaque accumulation and ill maintenance that increases inflammatory mediators	21.2 %
2	Which of the following are reason(s) for diabetes-perio relationship?	Altered microbial flora in the oral cavity	63.5 %
		Obesity	29.8 %
		Decreased bacterial resistance	53.8 %
		Alterations in components of saliva and gingival fluid	58.7 %
		Other systemic diseases	18.3 %
3	Have you come across any studies that indicate the 2-way relationship of diabetes and periodontitis? If yes, please elaborate.	Unaware responses	83.6 %
		Aware responses	16.3 %
4	Was this questionnaire the first time you were introduced to the 2-way relation of diabetes mellitus and periodontitis.	Yes	70.2 %
		No, I was aware of it	29.8 %

Additionally, 14.4% of the participants were unaware of any complications associated with untreated periodontal disease. (Figure 2)

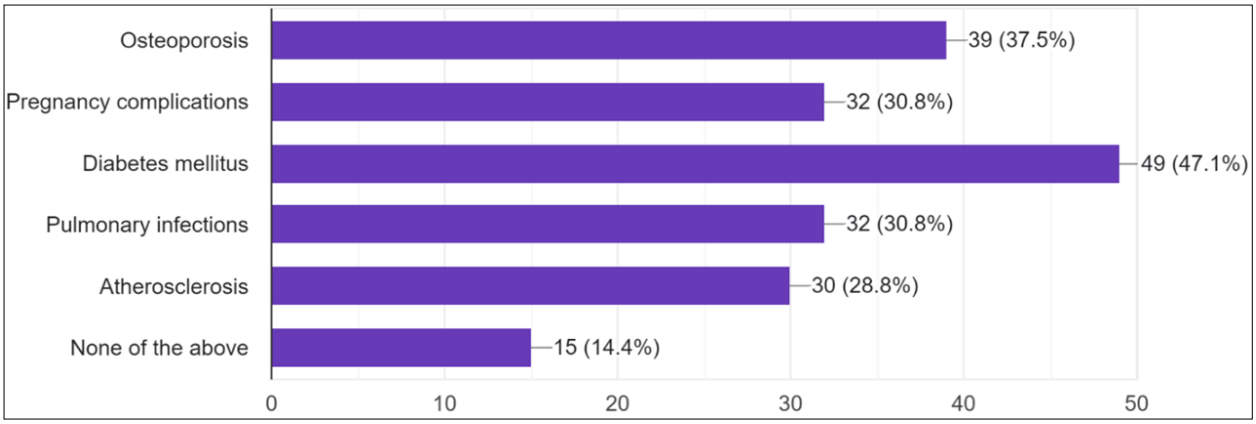

Fig 2: Complications of untreated periodontitis

Questions regarding the effects of periodontal therapy on hyperglycemia showed that only 36.5% of the participants were aware that it improves insulin resistance and signalling. However, 26.9% of the medical professionals were unaware that oral prophylaxis has an advantageous effect on insulin signalling, and 7% reported that periodontal therapy could potentially deteriorate insulin metabolism. 25% of them were unaware that periodontal

therapy could improve glycemic control by decreasing HbA1c levels. When asked about the insulin dosage requirement following periodontal therapy, 30.8% of the professionals reported "no effects" as their response. Only 49 participants out of 104 were aware that periodontal therapy could decrease HbA1c levels in uncontrolled diabetics, and 41 participants were aware that periodontal therapy helps to reduce the insulin dosage in TIDM. (Table 4)

Table 4: Awareness of effects of periodontal therapy on hyperglycaemia

S.No	Questions	Answers	% of Participants
1	What affects does oral prophylaxis have on insulin signalling and resistance?	No effects	26.9 %
		Improves insulin resistance	36.5 %
		Deteriorates insulin metabolism	7.7 %
		Not aware	28.8 %
2	What are the effects of periodontal therapy on glycaemic index?	Increased HbA1c	25 %
		Decreased HbA1c	47.1 %
		No effect	27.9 %
3	What is the role of periodontal therapy on insulin dose requirement in Type 1 DM?	Reduction in insulin dosage	39.4 %
		Further increase in insulin dosage is required	29.8 %
		No effect	30.8 %

Questions regarding the need for referral of a diabetic patient to a periodontist showed that only 33.7% of the participants referred a diabetic patient for a periodontal opinion, 22.1% did not refer patients to a periodontist, and 44.2% referred only if the patient presented with a related complaint. Furthermore, 26% of the professionals believed that periodontal consultation for a diabetic patient is only necessary when required. (Table 5)

Table 5: Awareness on need for referral to a periodontist

S. No	Questions	Answers	% of Participants
1	Do you regularly refer/advice dental periodontal check-up for diabetic individuals?	Yes	33.7 %
		No	22.1 %
		Only if patient gives a related complaint	44.2 %
2	Here onwards, will you consider including regular periodontal consultations for diabetics?	Yes definitely	58.7 %
		Maybe	15.4 %
		Only when required	26 %
		Not sure	0 %

Discussion

The World Health Organization has identified oral health as an integral part of general health, stating it as "essential for the general well-being of an individual." The 101st FDI Annual World Dental Congress of “Oral health and general health – A call for collaborative approach” emphasized that all healthcare providers must be aware of the relationship between oral diseases and general health as it plays an important role in early diagnosis and periodic referral to a dentist [21].

Multiple studies have established the bidirectional relationship between DM and periodontitis. Despite this, the present study showed that there is still a lack of knowledge among medical practitioners, with only 33.7% of the participants referring diabetic patients for an oral health check-up and 44.2% referring only if the patient presents with a related complaint. Siddiqui A & associates reported in a systematic review that one-third of medical professionals were unaware of the relationship between oral health and DM, with only 30% referring their patients to a dentist for an oral health assessment [22]. Similar findings were reported in a study where medical students had little to no knowledge of oral and systemic interactions [23]. These findings highlight the need for continued educational programs aimed at "cross-over conditions between oral health and general health," with the goal of a collaborative treatment approach for patients with systemic conditions such as DM, cardiovascular disease, and pregnancy.

A study that included only specialists reported that referral of diabetic patients was more frequent among specialists compared to general practitioners [24]. Another study showed that endocrinologists considered oral health an integral part of treatment for systemic diseases, especially DM [21]. Even with the availability of literature in medical sciences, our study showed that 70.2% of practitioners were introduced to the concept of a two-way relationship between DM and PD for the first time through this questionnaire survey, likely due to the lack of specific emphasis on oral health in the medical curriculum.

Supporting this assumption, a questionnaire survey among post-graduate physicians and interns showed that the majority of participants were unaware of studies linking DM and periodontitis [25]. Areej K *et al*. conducted a survey among 510 general practitioners (232 physicians and 278 dentists) and found that more than 50% believed that diabetics were more susceptible to tooth loss due to PD than non-diabetics. This majority response can be attributed to the greater number of dental professionals that participated in the survey [19]. Allauddin S *et al*. conducted a pilot study among 46 medical professionals, which demonstrated that 89% of medical practitioners were aware that the glycemic index of an individual with TIIDM and periodontitis could be improved by providing periodontal therapy. However, this knowledge was not reflected in their clinical practice, as a low frequency of referral and communication with the dentist was also observed [26]. This highlights the importance of scenario-based education programs that bridge the gap between theoretical knowledge and practical application for comprehensive treatment planning, to restore the general well-being and improve the quality of life for diabetic

individuals. Although the notion "Oral health and general health are inseparable" is frequently mentioned in scientific literature, it has not sufficiently penetrated the medical community.

Conclusion

It is important to understand that patients with DM are at an increased risk of developing oral health problems, and collaboration is required between physicians and dentists. As patients are often unaware of this possible relationship, healthcare providers play a crucial role in increasing knowledge about the potential complications and motivating patients for regular dental visits and maintaining good oral hygiene. DM and periodontitis are both global epidemic ailments with severe health consequences, and inter-professional collaboration is required, primarily initiated by physicians as they are the primary healthcare providers.

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