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MODERN CLINICAL AND LABORATORY METHODS FOR THE PREVENTION AND MANAGEMENT OF DENTAL CARIES IN PATIENTS WITH DIABETES MELLITUS

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ABSTRACT

Background: Patients with diabetes mellitus (DM) face an elevated and disease-specific risk of dental caries, driven by hyposalivation, salivary acidification, and altered oral microbiota, yet clinical prevention protocols rarely account for these mechanisms. Aim: To review modern clinical and laboratory-informed approaches for the prevention and management of dental caries in patients with DM. Methods: A narrative review of randomized controlled trials, systematic reviews, and clinical guidance addressing oral hygiene interventions, salivary substitutes, fluoride- and remineralization-based therapies, and glycemic-control-linked preventive strategies in diabetic patients. Results: Intensive oral hygiene programs combining professional debridement with interdental cleaning aids, and immunologically active saliva substitutes (containing lactoperoxidase, lysozyme, glucose oxidase, and lactoferrin) used alongside oral hygiene instruction and moisturizing gel, have both been shown to reverse or arrest dental caries in patients with type 2 diabetes. Minimally invasive remineralizing approaches and glycemic-control optimization further support caries arrest. Conclusion: Effective caries prevention in diabetic patients requires a combined protocol addressing oral hygiene, salivary dysfunction, and glycemic status, rather than the generic prevention advice applied to non-diabetic patients.

Keywords: dental caries, diabetes mellitus, prevention, saliva substitutes, oral hygiene, fluoride, glycemic control

INTRODUCTION

Diabetes mellitus (DM) is among the most prevalent chronic metabolic diseases worldwide, affecting nearly 1 in 11 adults, with type 2 diabetes accounting for 90–95% of all cases. Beyond its well-recognized systemic complications, DM is associated with a cluster of oral health disturbances — periodontal disease, salivary gland dysfunction, dental caries, delayed wound healing, and soft-tissue lesions — that together increase the burden of oral disease in this population.

Dental caries in diabetic patients differs mechanistically from caries in the general population. Chronic hyperglycemia reduces salivary flow and buffering capacity, lowers salivary pH, and shifts the oral microbiome toward more cariogenic species, creating conditions that standard, one-size-fits-all preventive advice does not adequately address. At the same time, the epidemiological relationship between DM and caries experience remains inconsistent across studies, with some reporting significantly higher DMF scores in diabetics and others finding no difference — a discrepancy that likely reflects differences in glycemic control and disease duration rather than the mere presence of DM.

Given this disease-specific pathophysiology, generic caries-prevention advice is unlikely to be sufficient. This review therefore examines which modern clinical and laboratory-informed prevention and management strategies are supported by evidence specifically in diabetic patients, rather than extrapolated from the non-diabetic population.

MATERIALS AND METHODS

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This is a narrative literature review. Sources were identified through searches of PubMed/MEDLINE, ScienceDirect, and Frontiers for systematic reviews, randomized controlled trials, and clinical guidance documents addressing caries prevention and management specifically in patients with type 1 and type 2 diabetes mellitus. Priority was given to studies reporting a concrete preventive or therapeutic intervention and its measured effect on caries status, rather than purely descriptive prevalence data. The following categories of intervention were extracted and analyzed:

- Professional and patient-directed oral hygiene programs — supragingival debridement, interdental cleaning aids, and structured oral hygiene instruction (OHI).
- Salivary substitutes and topical antimicrobial/protective agents — lactoperoxidase, lysozyme, glucose oxidase, lactoferrin, moisturizing gels, and mouthwash.
- Fluoride-based and minimally invasive remineralizing therapies — fluoride varnish, silver diamine fluoride, and sealants.
- Glycemic-control-linked strategies — the relationship between metabolic control (HbA1c) and caries prevention outcomes.

RESULTS

1. Intensive oral hygiene programs arrest caries progression

A structured intervention combining professional supragingival debridement by a dental hygienist with patient-performed interdental cleaning — using interproximal brushes and/or dental floss — supported by educational brochures, has been shown to reverse or arrest dental caries in patients with type 2 diabetes. This finding indicates that mechanical plaque control, when intensified and combined with structured education, remains an effective first-line preventive measure even in the altered oral environment created by DM.

2. Salivary substitutes address the disease-specific mechanism of hyposalivation

Because reduced salivary flow and buffering capacity are central to elevated caries risk in DM, therapies that restore salivary protective function are particularly relevant. A six-month intervention using immunologically active salivary substitutes — containing lactoperoxidase, lysozyme, glucose oxidase, and lactoferrin — combined with oral hygiene instruction, mouthwash, and a moisturizing gel, was also reported to reverse or arrest dental caries in T2DM patients. These substitutes work by replacing components of the natural antimicrobial and buffering systems of saliva that are diminished by hyperglycemia, directly targeting the mechanism that distinguishes diabetic caries risk from that of the general population.

A broader systematic review concluded that regular, extensive oral health education combined with interdental cleaning aids, mouthwash, moistening gel, and saliva substitutes including lactoperoxidase, lysozyme, glucose oxidase, and lactoferrin could control oral inflammation and contribute meaningfully to caries management in T2DM patients. Notably, the evidence base for this conclusion was limited to two quantitative studies identified from an initial pool of 909 sources, underscoring how few controlled trials specifically target caries prevention in diabetic populations despite the biological rationale for disease-specific protocols.

3. Minimally invasive and fluoride-based approaches remain relevant but under-studied in DM

Minimally invasive techniques — fluoride varnish application, silver diamine fluoride for arresting active lesions, and pit-and-fissure sealants — are established components of general caries prevention and are mechanistically well-suited to diabetic patients, since they act locally on the tooth surface regardless of systemic salivary changes. However, the reviewed literature contains comparatively few trials evaluating these interventions specifically in diabetic cohorts, meaning their preventive benefit in this population is inferred from general-population evidence rather than confirmed by diabetes-specific outcome data.

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4. Glycemic control is an implicit but essential prevention variable

Across the reviewed studies, caries outcomes in diabetic patients were consistently framed in relation to metabolic status: duration of diabetes and glycemic control (commonly assessed via HbA1c) were used to stratify participants and interpret caries findings, reflecting the understanding that poorly controlled hyperglycemia — not the diagnosis of diabetes itself — drives the salivary and microbial changes that elevate caries risk. This suggests that glycemic optimization should be regarded as a preventive intervention in its own right, complementary to direct oral-hygiene and salivary measures, rather than a separate medical concern unrelated to dental care.

DISCUSSION

The evidence reviewed here indicates that effective caries prevention in diabetic patients depends on addressing the specific mechanisms that DM introduces into the oral environment, rather than applying standard, generic preventive advice. Intensive mechanical hygiene programs and salivary-substitute therapies both produced measurable reversal or arrest of caries in T2DM patients, but they act through different mechanisms — the former through plaque control, the latter through restoration of salivary antimicrobial and buffering function — suggesting that a combined protocol addressing both pathways may be more effective than either alone.

The comparatively thin evidence base for fluoride-based and minimally invasive techniques specifically in diabetic patients is a notable gap: these interventions are widely used in general dental practice, but their efficacy has rarely been isolated and tested in diabetic cohorts, where altered saliva composition could plausibly affect fluoride uptake or lesion-arrest dynamics. Likewise, although glycemic control is routinely used to stratify participants in caries research, few studies test glycemic optimization itself as a prospective preventive intervention with dental outcomes as an endpoint.

A practical, evidence-informed prevention protocol for diabetic patients should therefore combine: (1) structured, intensified oral hygiene instruction with professional debridement and interdental cleaning aids; (2) salivary-substitute therapy for patients with documented hyposalivation; (3) fluoride-based and minimally invasive remineralizing measures as a standard adjunct; and (4) coordination with the patient's medical team to support glycemic control as part of the overall caries-prevention plan.

Limitations: This is a narrative rather than systematic review, and the underlying evidence — particularly for salivary substitutes and oral hygiene programs — is drawn from a very small number of controlled trials, which limits the strength and generalizability of the conclusions drawn.

CONCLUSION

Dental caries prevention and management in patients with diabetes mellitus should not rely on generic, one-size-fits-all preventive advice. The available evidence supports two concrete, evidence-based interventions — intensified professional and patient-directed oral hygiene, and salivary-substitute therapy targeting hyposalivation — as effective means of reversing or arresting caries in this population, while fluoride-based minimally invasive approaches remain a reasonable but less specifically validated adjunct. Because glycemic status underlies the oral mechanisms driving caries risk in DM, dental prevention protocols should be coordinated with medical management of the underlying disease rather than treated as an independent concern. Further controlled trials specifically in diabetic populations are needed to strengthen and expand this evidence base.

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