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Review

Effects of Dental Implants on Diabetic Patients

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Abstract

Diabetes mellitus is a chronic condition which produces an inflammatory response in hosts leading to accelerated periodontal destruction and subsequent tooth loss. There is substantial evidence of a dose-response relationship between glycemic control and periodontal health in diabetes. Diabetes and edentulism are especially found to coexist in the elderly. Edentulism in diabetic individuals restricts dietary choices causing reduced consumption of nutrient-dense foods in favor of a soft, starch rich diet. Dental implants restore functional tooth loss, enhancing chewing ability and comfort, speaking ability and facial appearance, consequently improving patient satisfaction and oral health related quality of life. Peri-implant disease is an important consideration in dental implant maintenance therapy in diabetic individuals due to slow wound healing, and increased susceptibility to microbial plaque accumulation and periodontal inflammation. There is evidence of improved glycemic control after insertion of dental implants due to improved masticatory function allowing stimulation of satiety centers in the brain as well as improved nutrition from selection of healthier dietary choices in patients undergoing dietary counseling. Current literature supports the use of implant supported dentures in diabetic patients experiencing poor tissue health and treatment satisfaction despite conventional denture therapy.

Keywords: *dental implants, diabetes mellitus, edentulism, implant-supported denture*

Introduction

Diabetes mellitus is a metabolic disorder characterized by an increase in plasma glucose levels. There is substantial evidence to indicate that periodontal disease and diabetes are connected in a reciprocating cycle (1). Periodontitis has been reported as the sixth complication of diabetes mellitus (2). Periodontal disease has been found to be twice as common in diabetics in comparison with non-diabetic people (3). Moreover, periodontitis can affect glycemic control in patients with diabetes (1). Chronic hyperglycemia produces an inflammatory effect on various tissue structures (4). In-vitro studies have found it to be a stimulus for bone resorption (4). Interestingly, in diabetes, bone loss seems to depend more on the reduction in bone formation by various pathways as opposed to osteoclastogenic activity (5). The resultant gradual loss of tooth attachment to alveolar bone can render patients partially or completely edentulous. Most professional recommendations advise dialogue between dentists and diabetologists for diabetic patient's dental rehabilitation (6). Dental endosseous-implant treatment is one such important rehabilitative measure for restoring dentition.

Edentulism results in a dramatic debilitation of dental health and function (7). It especially compromises the masticatory function subsequently altering the dietary habits of diabetic individuals and adversely impacting their glycemic control (8). Various studies have noted strong evidence of a link between deteriorated chewing function and the intake of fruits, vegetables, meats, and breads in edentulous patients (10, 11). Edentate individuals compensate calorically with a diet higher in fats and cholesterol (9). Problems in chewing and swallowing have also been identified as risk factors of nutritional insufficiencies in older individuals and ethnic minorities (13).

Methodology

This study is based on a comprehensive literature search conducted on April 18, 2022, in the Medline and Cochrane databases, utilizing the medical topic headings (MeSH) and a combination of all available related terms, according to the database. To prevent missing any possible research, a manual search for publications was conducted through Google Scholar, using the reference lists of the previously listed papers as a starting point. We looked for valuable information in papers that discussed the information about the effects of dental implants on diabetic patients. There were no restrictions on date, language, participant age, or type of publication.

Discussion

The objective of modern implant dentistry is to restore physiological function, comfort, aesthetics, speech, and health to patients with one or more missing teeth. Comforts like functional tooth replacement, conservative treatment compared to teeth-supported fixed partial dentures and long term success for the edentulous as well as partially edentulous individuals have made dental implant-supported prosthetic treatment as an attractive substitute to traditional removable or fixed dental prosthesis despite being costly and involving higher degree of surgical intervention (15). Loss of teeth mostly occurs from decay, by failed endodontic treatment, by inflammatory loss of periodontal tissue, or through fracture. Disagreeable gaps between teeth can be eliminated by dental implants without causing additional damage to surrounding teeth [2]. Moreover, endosseous implants can prevent alveolar bone loss (16). The alveolar processes, in the mandible and maxilla, surround and support the dentition to ensure its function. Functional movements like chewing, biting, and speaking cause micromovements of the tooth radix within its socket (in the periodontium), indirectly leading to the rebuilding and remodelling of alveolar bone. When tooth loss occurs, the lack of bone stimulation results in decreased alveolar volume. As the loss of teeth progresses, more areas of bone cannot be maintained (17). An endosseous implant can prevent further loss of alveolar bone structure but should be integrated into the bone as soon as possible after extraction to initiate bone stimulation (18).

Despite a higher risk, dental implant is a beneficial treatment for edentulism in individuals with diabetes, especially in the case of well-controlled diabetes. It has been found that diabetes mellitus is significantly correlated with periodontal diseases (19), which is a frequent cause for tooth loss in adults. As a relatively comfortable and stable prosthodontic treatment modality, dental implants can rehabilitate masticatory function effectively and facilitate a broader choice of food for edentate patients, in comparison to conventional dentures (9, 11). Kapur et al. had 89 diabetic individuals participate in an evaluation of the efficacy of implant-supported overdentures and conventional dentures with 24-month follow-up period (20, 21). They reported a greater improvement in chewing ability and comfort, and overall satisfaction in diabetic individuals receiving implant-supported overdentures, as opposed to those

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given conventional dentures. It is also suggested that implant-supported overdentures might improve mucosal health, speech, and appearance in Type 2 diabetes (22, 23).

Effect on masticatory function and nutrition

Periodontal manifestations of diabetes mellitus can raise the risk of becoming partially or totally edentulous in patients. Diabetics are more prone to losing natural teeth and functional teeth units than nondiabetics because of the higher prevalence of periodontal disease. The occluding posterior tooth pair count is an essential score for nutritional intake and masticatory performance. A lesser number of functional tooth pairs is linked with chewing problems, speech difficulties, and poor oral health and facial appearance (23). One study showed that one in every five cases of edentulism in the United States relates to diabetes. This prevalence increases with individual's age, and the average number of missing teeth per patient was 7.2, in the overall dentate sample population over 50 years (25). Higher age, lower income and lesser education was associated with higher tooth loss (26). Many studies indicated that altered masticatory function and the reducted healthy food consumption were linked, which caused dietary insufficiencies of vitamins, minerals, fiber and proteins. Edentate individuals are forced to compensate calorically with a diet high in fats (27). Thus, functional tooth replacement must be taken into account in the overall dietary management of diabetic patients (28). The retention of overdentures using two or more dental implants can significantly increase satisfaction and oral health related quality of life in complete denture users (29).

Effect on peri-implant tissues

The incidence of biological complications in the form of peri-implant pathologies is reported to be 8.6% with a significantly increased risk of peri-implant disease for diabetic patients (30). Inadequate oral hygiene causes plaque buildup around dental implants, increasing the risk of peri-implant diseases in individuals with diabetes. Complete mouth scaling twice a year significantly reduced bleeding on probing and probing depth of immediately loaded dental implants in poorly controlled type 2 diabetes (31). In addition, the mean HbA1c levels of both well and poorly controlled diabetic patients participating in the periodontal therapy biannually were significantly reduced at 24-month follow-up in comparison to 6-month follow-up [118]. Therefore, it is suggested that diabetic patients should receive a regular peri-implant maintenance therapy (PIMT) to ensure implant longevity.

Oates et al. noted that implants given in poorly controlled diabetic individuals required double the time for the stability to return to initial insertion level than those placed in nondiabetic and well-controlled diabetic patients, suggesting a prolonged healing process in poorly controlled hyperglycemia (9, 32). Therefore, clinicians should be cognizant of the individual risk levels before proceeding with a treatment protocol.

Peri-implant health is thought to be the absence of signs of periodontal inflammation like bleeding on probing (34). Peri-implantitis is defined as a pathologic condition associated with plaque in the tissue surrounding the dental implants, marked by inflammation in the peri-implant mucosa causing progressive supporting bone loss subsequently (35). Peri-implantitis follows a non-linear, accelerated pattern of progression (36). Surgical inspection of peri-implantitis sites often finds a circumferential bone loss pattern (36). Literature on diabetes as potential risk factor for peri-implantitis is inconclusive.

Altered host response along with environment susceptible to excessive microbial plaque accumulation due to hyperglycemia is most likely to cause accelerated progression of peri-implant disease in individuals with diabetes as compared to their metabolically healthy counterparts (37). Impaired bone metabolism through various molecular mechanisms and poor osseointegration of dental implants coupled with the intricate signalling cascade affected by hyperglycemia have been suggested to be involved in the initiation and progression of the condition.

Particularly, in case of poor glycemic control, increased expression of interleukin 8 and tumor necrosis factor α has been found in peri-implantitis sites in comparison to well-controlled diabetics and healthy people (38). Along with the potential inflammatory mediators of peri-implantitis, in peri-implantitis cases, increase in matrix metalloproteinase-8 (MMP-8) has been found in active peri-implantitis with progressive loss of alveolar bone[14] and is suspected to be an early indicator of peri-implant inflammation (39). MMP-8 is a member of the family of metal-dependent neutral proteases and performs a dual role in immune protection as well as inflammatory pathogenesis (40). Likewise, in diabetics, significantly elevated salivary MMP-8 levels in comparison to healthy individuals and independent of periodontitis have been detected (41). A cross-sectional

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study of diabetic individuals with various glycemic profiles reported abnormal concentrations of bone metabolism biomarkers, vitamin D and osteocalcin in patients with poorly-controlled type 2 diabetes and judged hyperglycemia to be an independent risk factor for these biomarkers (42).

Effect on glycemic control

The number of teeth and magnitude of chewing ability in cases of edentulism have metabolic consequences directly affecting the basal metabolic index, and glycated hemoglobin levels (44). Since glycemic control relies largely on proper dietary management, it is the patients with substantial oral debilitation and elevated glycemic levels who may reap the most benefits from improvements in dental function via implant therapy. Conversely, one study proposed that the number of teeth decreases with increasing HbA1c values (22). Considering the increased prevalence of type 2 diabetes mellitus globally, populations are at higher risk for hyperglycemic complications now more than ever (43). Especially in the case of lower socioeconomic groups, for whom HbA1c levels are more frequently raised, the detrimental effects of compromised oral function may cause difficulty in optimizing glycemic control (43).

Effect on quality of life

Studies have found that conventional complete denture patients benefit greatly when even as few as two implants are inserted to retain their mandibular dentures, leading to significantly higher satisfaction and improved oral health related quality of life (44). In a randomized controlled trial, 60 edentate individuals (aged 65–75 years) received either new conventional dentures, or maxillary conventional dentures and mandibular two-implant overdentures (11). Six months after using their new prostheses, those in the implant group reported feeling less limited in their dietary options and requiring less fluid to aid swallowing. They also reported significantly less problems in chewing meat, hard vegetables and fruits than those who were provided conventional dentures (11). The ability of edentulous patients to freely opt for the foods they wish facilitates consumption of a fresher, healthier diet. Our literature search yielded only one study evaluating the impact of implant treatment on treatment satisfaction in diabetic individuals (21). In a randomized controlled trial, new maxillary and mandibular dentures were provided to edentulous diabetic individuals. Of 89 subjects, 37 received conventional complete dentures and 52 received a maxillary conventional denture and a mandibular two-implant overdenture. Although both groups showed improvements with their new prostheses, in cases with implant-supported overdentures, greater improvement was noted in eating enjoyment, speech, and general satisfaction. In addition, a greater proportion of patients in the implant-supported overdenture group expressed pre- to post-treatment improvements in chewing ability and comfort, and denture retention. However, this trial failed to observe a difference in food choices, suggesting the significance of dietary counseling in denture therapy (45).

Implant-supported denture versus conventional dentures

In the above-mentioned study conducted by Kapur et al. (21), significantly greater proportion of implant-supported overdenture cases than the conventional denture cases reported more improvement and less deteriorated chewing ability at six months after intervention but not at 24 months. This difference at six months was caused primarily from deterioration caused in 20% of patients with study dentures in the conventional denture group as opposed to none in the implant-supported overdenture group. It was noted that five of the 25 conventional denture patients needed greater than six months of adjustment after treatment with new dentures to attain the perceived chewing ability which they had with their original prostheses (20, 21).

Mean scores and percentage distributions indicated greater improvements in the overdenture group than in conventional denture group with study dentures for chewing ability and comfort, eating enjoyment, and dietary choices. However, the researchers failed to conclude whether the perceived gains in the two groups were due to treatment care/placebo effect and/or improved fit of denture, particularly in the absence of noteworthy masticatory performance differences among the two groups. It was suspected that the significantly greater stability and retention of mandibular overdentures reported in prior literature might have contributed to these differences in perceptions about chewing functions (21).

In this trial, the study dentures were of superior quality to the original dentures with regard to retention, stability, and occlusion. The improved fit substantially decreased the number of patients facing moderate and severe chewing discomfort and increased the proportion of cases with high overall satisfaction with both types of study prostheses. The mandibular implant overdenture was noted to be clinically more retentive and stable than

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the conventional denture and caused tissue trauma in lesser cases. A higher number of patients in the overdenture group felt improved chewing comfort and overall satisfaction than their conventional denture counterparts.

These reports have led experts to conclude that implant-retained prosthesis may be considered in selected cases where patients complain of chronic irritation and/or discomfort in performing functional movements even with well-fitting dentures (20, 21). Conversion of the existing clinically acceptable mandibular denture to an implant supported overdenture may be considered. In such cases, the inconvenience and supplemental cost of clip replacements and repairs may be justified to reduce tissue trauma and lessen chewing discomfort.

Conclusion

Enhancing the overall systemic health by re-establishing dental function is a major aim of oral rehabilitation of diabetic individuals with partial or complete loss of teeth. It is largely in the aging population that both edentulism and diabetes co-occur. There is clearly a huge potential for implant-based oral rehabilitation to enhance the well-being of patients with diabetes. The absence of any complications in the relevant literature indicates that dental implants can successfully support dentures in diabetic individuals with even low to moderate glycemic control. Many of the benefits of dental implants in diabetic patients, however, remains to be investigated.

Disclosure

Statement

The authors declare no conflict of interest.

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Ethical consideration

Non-applicable.

Data availability

Data that support the findings of this study are embedded within the manuscript.

Authors' contribution

All authors contributed equally to the drafting, writing, sourcing, article screening and final proofreading of the manuscript.

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