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DENTAL ORTHOPEDIC REHABILITATION IN PATIENTS WITH PROBLEMS RELATED TO TYPE 2 DIABETES. LITERATURE REVIEW

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ABSTRACT — The paper discusses modern approaches to restoration of dentition defects in patients with type 2 diabetes mellitus (DM). Endocrinopathy severely affects the status of the teeth periodontium, the oral mucosa and the jaw bone tissue and poses a challenge to the denture design. This accounts for the techniques employed to prepare supporting teeth for prosthetics and the choice of construction materials which should ensure optimal functional capacity, biocompatibility and aesthetics. Besides, our article reveals systematized specifics of prosthetic treatment using dental implants in patients suffering from diabetes.

KEYWORDS — literature review, secondary adentia, diabetes mellitus, dental prosthetics.

BACKGROUND

Tooth loss results in a worse quality of life caused by deterioration in chewing efficiency and aesthetic dissatisfaction. Prosthetics of dentition defects in individuals with type 2 diabetes enables not only to restore the dentition function and aesthetics, yet it also produces a positive effect on the course of the major disease through improving the glycemia level [1]. This means that prosthetics of missing teeth appears as an important step in comprehensive rehabilitation for patients with type 2 diabetes. During that, it is to be noted that dentists are extremely cautious when it comes to discussing truly successful prosthetics for diabetic patients, and in view of that, we decided to focus on modern issues of orthopedic dental treatment offered to patients with type 2 diabetes.

Numerous studies have revealed a high prevalence of tooth loss in diabetic patients [2, 3, 4, 5]. A number of authors have found that along with an increase in the age of patients and their diabetes experience, there is a significant increase in the number of removed teeth within the structure of the CFR-indicator (C-caries, F-filling, R-removed tooth) [6]. Besides, as a study by Yonekura S. suggests that the number of removed teeth correlates with the level of glycated hemoglobin (HbA1c): individuals with poorly controlled DM (HbA1c ≥ 9%) featured a greater number of removed teeth, if compared to patients with well or moderately controlled DM (HbA1c ≤ 9%) [7].

Therefore, due to a higher occurrence and a large number of teeth removed, patients with type 2 diabetes are in an urgent need to restore the dentition and improve their chewing efficiency. R.A. Kerimov, for instance, in his work focusing on dental rehabilitation for patients with type 2 diabetes, claims that the need for prosthetics was identified in 95.24% of the patients[8]. Rumyantseva E.V. et al. claim that a study involving 76 patients with type 2 diabetes, showed that 78.3% of them falling within the age group of 35–44) needed prosthetics; within the group of those aged 45–64, that need was identified in 95.4% of patients, whereas 100% of patients aged 65–74 needed prosthetics [9].

The high need for orthopedic treatment in patients with type 2 diabetes comes along with great difficulties impeding the process of dental prosthetics due to a number of pathological issues in the oral cavity: periodontal inflammation of the supporting teeth; reduced resistance of the oral cavity capillary vessels (OCCR); progressive atrophy of the alveolar process; paresthesia and perverted taste; the OCCR spilled inflammation, especially in case of candidiasis, and undoubtedly the mucous membrane dryness in the prosthetic bed. Given that, when replacing dental defects in patients with type 2 diabetes, there is a number of requirements dealing with the technique of preparing supporting teeth, dental prosthesis design and materials.

MODERN APPROACH TO DENTAL DEFECTS PROSTHETICS IN PATIENTS WITH DIABETES

Restoring and maintaining proper oral hygiene is a mandatory step preceding any orthopedic intervention [10, 11].

The preparation of teeth should be done carefully in order to avoid soft tissue injury due to poor wound healing. This also explains why the preparation of supporting teeth should be performed strictly following the requirements of asepsis and antiseptics, whereas after the preparation of hard tissues, the sharp edges of the teeth should be smoothened, with their surfaces treated with a respective polish. When compensating for partial loss of teeth with removable plate prostheses, impressions should be obtained using alginates. To create supporting structures of such prostheses, we recommend obtaining casts and employing the sandwich method [12].

When carrying out tooth replacement in patients with type 2 diabetes, it is a good idea to expand the indications for using fixed prostheses, which have basically no pressure on the mucous membrane while having minimal contact with it. However, it is important to take into account the existing periodontopathies that complicate the process of installing fixed prosthetics due to constant inflammation of the gingival papillae, and even a slight touch of the crown can cause vascular injury, exudation, and subsequent inflammation. Given the above, the preparation of supporting teeth should be performed with a bevel above the gum level and without a ledge, since the latter can concentrate stress on the periodontal area of the already weakened teeth [12].

The bridge-like prosthesis body cannot join the alveolar process mucous membrane in order to avoid its mechanical injury. The bridge structures should be well polished (quality degree — 9–10) with no sharp and protruding elements [13].

Dental mobility against periodontitis in patients with type 2 diabetes often complicates prosthetics of dental defects. In such cases, it appears rational to manufacture dental splint structures of dentures that would compensate for the missing dentition at the same time immobilizing the mobile teeth [13, 14]. V.N. Sukholitsky proposed using plastic-lined non-removable solid splinting dentures. A special point featured by the proposed prosthesis design is the frame with a metal garland at the neck area of the dental crowns, as well as the intermediate part with vestibular and oral surfaces. This design allows reaching optimal distribution of loads on the metal part of the frame, while this also prevents chips of the facing material, as well as improves the hygiene in the area of structures and the oral cavity, which is due to the absence of facing material (plastic) at the neck area [15].

Diabetic patients have an alveolar process bone metabolism that is impaired, which, in turn, affects the reparative and regenerative processes [16–21]. Any prosthesis can aggravate the situation, causing rapid progression of bone atrophy. In case of type 2 diabetes, the oral mucosa develops serious changes in microvessels as well as hemodynamic disorders, significant dystrophy and oral mucosa' epithelial cells atrophy. As for removable prostheses, the basis exerts pressure on the oral mucosa and, respectively, on the capillaries, which makes the hemodynamics disturbance even worse. This, in turn, will lead to disturbed trophism in the mucous membrane, and will entail complications in the subprosthetic bed. This means that in case of dealing with removable dentures indicated for people with type 2 diabetes, a better choice would be clasp and plate prostheses with supporting and retaining elements (clasps, attachments, telescopic crowns, beam and magnetic fixation systems), which allow unloading the oral mucosa. Another option in this case is a plate prosthesis with a two-layer base made of plastic with an elastic lining [22, 23].

A number of studies focusing on work with people with diabetes have demonstrated the advantage that metal-base partially removable prostheses over partially removable plate prostheses. The design of metal-base partially removable prostheses allows including splinting elements, which makes it the most acceptable solution for patients with DM. Also, a partially removable prosthesis with a metal base has a smaller triggering effect on the development of clinical symptoms of oral dysbiosis, as well as has a lower traumatic effect, while patients experience less of an issue adapting to it, if compared to a partially removable plate prosthesis [24].

Nearly 50% of all patients with diabetes have oral candidiasis, which is related to intolerance to many structural materials. The complexity of prosthetics is due to the fact that any removable prosthesis creates under itself perfect conditions for fungal microflora growth and reproduction, which triggers the development of oral dysbiosis or acute fungal stomatitis. Given that, when it comes to manufacturing removable prostheses, it is important to choose materials that do not facilitate microbial colonization on their surface. A number of studies focused on comparing microbial colonization on the surface of a conventional acrylic prosthesis, which was matched against polyamide and nylon flexible thermoplastic polymer prostheses, when used for prosthetics in patients with type 2 diabetes.

A flexible thermoplastic polymeric prosthesis made of nylon is a more predictable treatment method due to its lower microbial colonization and relatively healthier biological tissue response, apart

from a better aesthetic appearance [25, 26]. Silver ions help improve the activity of saliva enzymes, so this allows recommending the manufacture of dental prostheses from silver and palladium-based alloys [27]. To reduce microbial contamination of dentures, a number of authors suggest treating them with a 4% solution of chlorhexidine gluconate [28], as well as disinfecting them in an Ozon-Stom device [29] or in a microwave oven [30]. Applications of acid-soluble chitosan to the mucosa at the prosthetic bed prove effective for restoring the microbiocenosis of the oral mucosa in patients with diabetes who wear removable prostheses [24]. Good glycemic control ensures a level of biofilm development on the surface of the prosthesis, which is similar to that in healthy people [31].

A modern alternative in orthopedic dental rehabilitation of diabetics is prosthetics on implants. Earlier, there was a common idea that the indication for dental implantation in people with type 2 diabetes implied strict control of glycemia, whereas poor glycemic control was a contraindicating factor to prosthetics on implants. However, recent studies allow expanding the indications for implantation in people with type 2 diabetes. C.C. Eskow and T.W. Oates point at a high survival rate of dental implants after one year (98.6%) and 2 years (96.6%) in patients with poorly controlled diabetes (8.0% ≤ HbA1c ≤ 12.0%) [32]. In an earlier study, Oates T.W. et al. estimated the survival rate of implants for 1 year, after it was exposed to a load in patients with poorly controlled type 2 diabetes, at 95.0%, which is comparable to similar indicators for implantation of somatically healthy patients and individuals with well-controlled DM.

However, the negative impact of poor glycemic control on early bone healing and primary implant stability was noted [33]. These data confirm the possibility of wider use of implantation therapy in patients with type 2 diabetes and poor glycemic control. However, in case of good glycemic control, the survival rate of implants 5 years after the installation, and the bone loss around the implant in diabetics, were comparable to the same indicators in individuals without chronic pathology, which serves another proof to the importance of glycemic control in the dental rehabilitation of patients with type 2 diabetes [34].

For people with DM, a protocol of delayed implant introduction (installation 4–6 months following the tooth extraction) is recommended, which is due to a lower level of bone tissue loss around the implant, if compared to immediate and early (6–8 weeks after the tooth extraction) installation techniques. There was no difference in the clinical and radiological status of implants installed in diabetics with immediate and normal loading [35].

Recently, there has been success demonstrated in immediate implantation and prosthetic rehabilitation employing the All-in-Four method, when working with patients with type 2 diabetes. In R.I. Juncar's study, implants demonstrated good osseointegration and stability 6 months after the installation in individuals with diabetes; however, the authors emphasize the importance of maintaining proper oral hygiene and glycemic control for better postoperative recovery [36].

Prosthetics on implants helps reduce the indications for removable prosthetics, avoid overloading the supporting teeth with excessive occlusal stress through non-removable prosthetics, and improve the patients' adaptation to the dentures. In view of that, prosthetics on implants appear an acceptable treatment for patients with diabetes, with a good risk/benefit ratio [37].

When installing prostheses in patients with type 2 diabetes, the issue of the biocompatibility of materials used to make permanent prostheses is extremely relevant, since this is what comes into close and long-term contact with the gum. P. Saravanakumar's study focused on evaluating the effect that various crown materials (metal, ceramics, and zirconium dioxide) work on the content of beta-interleukin-1 (IL-1β) in the gingival fluid of the supporting teeth in somatically healthy patients. IL-1β is a powerful inflammatory cytokine and is a marker indicating acute inflammation in tissues, including periodontal teeth. A three-month long observation of the effect that crowns, made of metal, metal-free ceramics and zirconium dioxide, have on the marginal gum, revealed that crowns made of zirconium dioxide feature the least inflammation in the gums [38]. The obtained data suggest that dentition defects prosthetics in diabetic patients with crowns made of zirconium dioxide is a more preferable option. However, literature does not offer enough coverage of this issue, and requires additional investigation, since prosthetics in patients with type 2 diabetes is usually done along with inflammation of periodontal teeth on.

CONCLUSION

1. When restoring the dentition in people suffering from type 2 diabetes, it is recommended to expand the indications for prosthetics with fixed structures, including those based on dental implants, as well as manufacturing prostheses from bioinert materials such as zirconium dioxide.

2. In case of indications for removable structures in persons with type 2 diabetes, the preferred option includes splinting and plate prostheses with supporting and retaining elements or a two-layer basis in order to unload the oral mucosa.

3. When selecting the design of removable dentures, a better choice would be prostheses made of materials that feature lower microbial colonization on their surface, for example, those made of thermoplastic polymeric nylon or silver- and palladium-based alloys.

4. The key to successful prosthetics of dental defects in diabetics is good glycemic control and maintaining a good level of oral hygiene.

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