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Analysis of Complications in Prosthetics: Problems and Modern Approaches to Resolving Issues in the Use of Removable and Fixed Prostheses

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A B S T R A C T

This is a review of removable and fixed dental prostheses complications, and the present-day methods of their prevention and treatment. The main types of complications, such as inflammatory periodontal tissue diseases, secondary caries, prosthetic stomatitis, and mechanical damage, are considered. The findings of clinical investigations unveiling the most important risk factors for complication development are reviewed. Prophylactic approaches to problems of removable and fixed dental prosthetics use are presented, including patient education programs, the use of new materials and technologies, and systematic dental monitoring.

Keywords: removable prostheses, fixed prostheses, complications, secondary caries, stomatitis, oral hygiene, periodontitis, prevention.

Introduction

Dental prosthetics is a specialty field of modern dentistry that deals with the restoration of lost esthetics and function of dentition. The patient population seeking prosthetic care has been growing in number over the years, possibly associated with improved life expectancy of the population [1]. The expected growth in the number of older people worldwide (by the United Nations, by 2050, people older than 60 years will grow from 1.2 to 2.1 billion – Figure 1) means growth in the frequency of use of removable and fixed dental prostheses (DP) [2].

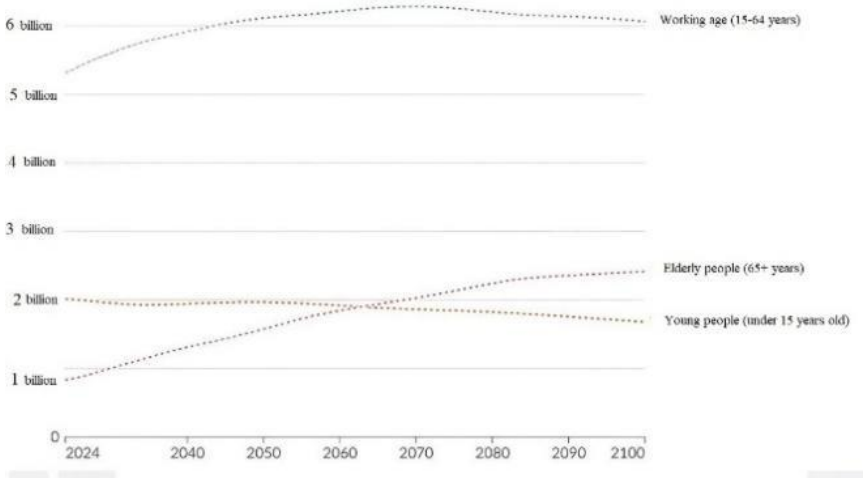

Fig. 1 - population by age groups [2]

Despite significant advances in dental prosthetics, complications associated with the application of DP still exist. They may range from slight pain to complex inflammatory diseases and chewing function disruption. The significance of this study is connected with the need to systematize information on the problems occurring in prosthetic treatment and modern approaches to their solution. The aim of the present work is to standardize scientific literature data on complications' etiology caused by application of removable and fixed prostheses and discuss modern techniques for their prevention and solution.

Main part. Complications associated with the use of removable prostheses

Removable DP, though popular and easy to install relatively, can cause several complications in patients. One of the most frequent complications of removable prostheses is mucous membrane inflammation, which may appear as stomatitis, glossitis, or gingivitis [3]. The inflammatory process is associated with the continuous contact of the prosthesis with the oral cavity's soft tissues, causing trauma, pain, and inflammation. One of the works conducted by Asim Elsir Elmahdi et al. was to assess the level of oral hygiene in patients who had removable and fixed partial prostheses in the Asir region of Saudi Arabia. The study enrolled 286 patients between the ages of 25 and 55 years. The study was a prospective, cross-sectional clinical examination. Of the 286 patients, 72% used fixed prostheses, 25% used removable partial prostheses, and 3% used both. Fixed prostheses patients possessed much higher plaque index, gingival inflammation index, and calculus index on abutment teeth than on natural teeth ($p \leq 0,001$). The plaque index was 1,24 in fixed prostheses and 1,33 in removable, and in both types of prostheses patients, it was 1,68. The gingival inflammation index was higher (1,62 in comparison with 1,18 in natural teeth), with higher frequency of gingival inflammation, especially in patients who wear removable prosthesis (74%). More than half of the patients (52,8%) reported bad odors of the prostheses, related to insufficient hygiene and infrequent visits to the dentist. Patients with prostheses in posterior sectors of the oral cavity had higher plaque and gingival inflammation indexes than those in anterior sectors (1,63 vs. 1,15 and 1,66 vs. 1,11, respectively; $p \leq 0,001$), an effect that can be explained by the fact that these regions are difficult to clean. Patients who had not been instructed on how to take care of the prosthesis (28,7%) had the highest frequency of inflammation and plaque, emphasizing the importance of regular control, prevention, and hygiene training. Based on the study results at the conclusion of the research, the authors believed that better control of oral hygiene in patients with prostheses is required. Special attention should be taken to abutment teeth, which are more susceptible to inflammation and plaque. The authors recommend regular follow-ups, prophylaxis, and patient education in order to properly use special cleaning tools, such as interdental brushes and floss.

Prosthetic stomatitis (PS) associated with DP use may appear as redness, pain, and swelling of the mucosa, which further affects the patient's ability to wear the prostheses for longer periods [5]. A systematic review study by Mirjana Perić et al. discussed the epidemiology, etiology, clinical presentation, predisposing factors, and global distribution of Candida species associated with PS based on published literature during the past 20 years [6]. A total of 28 studies were included, 21 of which focused on PS and 7 on Candida albicans colonization in patients with removable prostheses. The frequency of PS ranged from 20% to 67%, reaching 70% in some studies. The highest percentage of PS was observed in older adults over the age of 50 years. The prevalence of PS among men and women varied with the study, with some studies showing higher rates in men, while others indicated higher rates in women. The review identified the majority of significant risk factors for PS, including continuous prosthesis wearing, inadequate prosthesis and oral hygiene, diabetes, hypertension, smoking, carbohydrate consumption, dry mouth, and use of acrylic-based prostheses that promote the adhesion of Candida albicans and biofilm development. C. albicans was the most common species, though in recent years an increase in colonization by Candida glabrata and other species has occurred. The most common clinical forms of PS were mucosal inflammation under the prosthesis, redness, and swelling. Types I and II (localized inflammation and generalized redness) on Newton's classification were most commonly encountered, while type III (hyperplastic inflammation) was relatively less common. In 3789 PS patients, Candida spp. was isolated in 2,237 (59%). C. albicans prevailed in 87,7% of cases of colonization. Patients using prostheses for more than five years had a significantly high PS rate (84,2%) in comparison with those who used them for less than one year (25%). The results of the review justify the need for continuous monitoring and prevention of PS in patients with removable prostheses. Special attention should be paid to maintaining good hygiene, avoiding wearing them overnight, and early detection and treatment of colonization by Candida spp.

Inadequately adapted removable prostheses may feel unnatural, unstable in the oral cavity, and result in food-chewing difficulty, soft tissue overloading pressure, and unexpected complications (i.e., choking) [7]. Overload of individual teeth due to poor prosthesis design or lack of stabilization may result in destruction. A study by Amulya Dakka et al. detailed complications in terms of misuse and poor hygiene of removable DP among older adults [9]. 22 articles were analyzed. Individuals using removable DP revealed high incidences of pathogenic bacteria, such as Escherichia coli and Klebsiella pneumoniae. The authors established that the use of DP while sleeping increased the risk of pneumonia to 2,45 times (odds ratio (OR) 2,45; 95% confidence interval (CI): 1,23-4,51) among elderly patients. The study also showed that the rare cleaning of DP in individuals over the age of 75 was associated with an increased frequency of pneumonia by 58% (OR=1,58; 95% CI: 1,15-2,17). Five clinical cases yielded complications such as aspiration pneumonia as a result of swallowing prostheses and endobronchial actinomycosis. Routine hygiene and proper use of removable DP were emphasized in the study as the best ways to prevent infectious, inflammatory, and mechanical complications. The identified high-risk groups were elderly patients and low socioeconomic status patients.

Removable prostheses, being economic and functional, generate a variety of complications that necessitate careful attention while being fitted and cared for. Design and use of preventive and therapeutic management, such as regular cleaning, prosthesis adjustment, and stability monitoring, are effective measures to reduce the frequency and severity of complications.

Complications associated with the use of fixed prostheses

Fixed dental prostheses possess significant functional and aesthetic advantages, but in the process of their placement and functioning, they may produce a range of complications. The most common complication is inflammation of periodontal tissues around fixed prostheses, associated with the formation of dental plaque on the prosthetic structures, which makes proper hygiene unachievable [9]. Lucian Paul Dragomir et al. studied the influence of fixed prostheses on the periodontal status of patients [10]. This review paper reviewed recent scientific literature from 1982 to 2022. Fixed prostheses were associated with increased periodontal pocket depth, bleeding on probing, gingival hyperplasia, and loss of attachment. The risk of inflammatory

periodontal diseases in patients with fixed prostheses increased by 24-28% compared to the control group without prostheses. Probing depth of the periodontal pocket increased by 1,2–1,8 mm six months after prosthetic treatment, which was statistically significant ($p<0,01$). The authors determined that fixed dental prostheses significantly impact the periodontal condition, and for the improvement of clinical results, mutual cooperation of prosthodontists and periodontists, continuous professional monitoring, and an individually tailored hygiene approach are required.

Subprosthetic caries of the supporting teeth develop due to poor subprosthetic hygiene. Ali Alenezi et al. studied the frequency and risk factors of secondary caries in patients with fixed prostheses in relation to their oral hygiene status [11]. The research included 423 patients with 1,116 fixed prostheses. Secondary caries were detected in 8,4% of the cases (94 prostheses). Frequency of complications included fracture/chip in 85 (7,6%), need for endodontic treatment in 42 (3,7%), and detachment in 4 (0,3%). Oral hygiene status determined risk of secondary caries: 4% (9 out of 219) in good oral hygiene, 5,5% (35 out of 634) in medium oral hygiene, and 18,4% (50 out of 272) in poor oral hygiene ($p \leq 0,001$). The prevalence of secondary caries also varied according to gender: 5,5% (42 out of 760) in women, and 14,2% (52 out of 356) in men ($p \leq 0,001$).

The study confirmed that proper oral hygiene is the single most significant contributing factor in preventing secondary caries in fixed prosthesis patients. Secondary caries remains among the most common biological complications for patients with poor oral hygiene and hence these patients require regular follow-up and education in hygiene. Use of fixed prostheses can also lead to pulpitis or pulp necrosis, particularly in the case of traumatic tooth preparation for crowns. Shivani Kohli et al. uncovered a high rate of pulp vitality preservation with fixed prostheses, which was 92-98% in 5 to 20 years of follow-up [12]. Despite the above, a limitation of this study is being review-based since it stems from observational studies. More patients would need to have randomized controlled clinical trials to confirm these findings. Complications due to the utilization of fixed prostheses include inflammatory periodontal disease right through to prosthetic framework damage by mechanical insult. To minimize risks, correct tooth preparation, use of quality materials, regular professional observation, and educating the patient on oral hygiene are necessary.

Modern approaches to the prevention and treatment of complications

The existing prevention and treatment methods of complications from the use of removable and fixed prostheses are based on an integrative strategy that includes patient educational programs, the use of modern materials and technologies, and regular dental supervision [13].

One of the prevention elements of complication is oral care: removable prosthesis patients should clean them every day with a soft-bristled toothbrush and non-abrasive pastes, and also remove them during the night to prevent contamination and inflammatory processes, including stomatitis. For fixed prostheses, special floss, irrigators, and interdental brushes are recommended in order to prevent secondary caries and periodontal diseases. High-precision prothesis manufacturing technologies decrease microleakage and increase the durability of restoration, hence decreasing secondary caries incidence. Routine dental visits facilitate detection of microcracks, changes in adaptation of the prosthesis, and early signs of inflammation, thus allowing the opportunity to correct complications on time.

Treatment of mucosal inflammation caused by removable prostheses includes the use of antiseptic preparations, anti-inflammatory creams, and laser devices to promote faster healing, as well as prosthesis adjustment in case of trauma. Periodontal inflammatory diseases are treated with mechanical and ultrasonic debridement, antimicrobial medications, and laser tools, which reduce the depth of the periodontal pocket and create healthy tissue conditions. For patients of fixed prostheses with secondary caries, the treatments include restoration replacement, endodontic treatment, and the use of contemporary high-radiopacity materials in an effort to minimize the risk of recurrence.

Conclusion

The article emphasizes the need for complication prevention and treatment of removable and fixed dental prosthesis application in an integrated manner. Facts presented in the paper indicate that the most severe risk factors contributing to complications are poor oral health, failure to follow prosthesis care guidelines, and the anatomical and functional features of patients' oral cavities.

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