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INFLUENCE OF ORTHODONTIC TREATMENT ON DENTAL HARD TISSUES AND PREVENTION OF COMPLICATIONS IN PATIENTS WITH DENTOFACIAL DEFORMITIES

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Abstract

Orthodontic treatment of dentofacial deformities is carried out using removable and fixed appliances that affect the oral environment and increase the risk of dental caries in hard tissues.

Objective

To comparatively assess oral hygiene and the prevalence of dental caries during orthodontic treatment using removable and fixed appliances.

Materials and Methods

Twenty patients aged 18 to 35 years were examined: 10 patients in Group 1 were treated with aligners, and 10 patients in Group 2 were treated with braces. Oral hygiene was evaluated using the Green-Vermillion (OHI-S) index, and the condition of carious, restored, and extracted permanent teeth was assessed before and after 12 months of orthodontic treatment.

Results

Before orthodontic treatment, the OHI-S index was 0.87 ± 0.68 in Group 1 and 0.9

± 0.75 in Group 2. After 12 months, deterioration of oral hygiene parameters was more pronounced in Group 2, treated with fixed appliances: OHI-S index reached 1.99 ± 0.8. The DMF index before treatment was 7.2 ± 1.33 in Group 1 and 7 ± 1.47 in Group 2. After 12 months, patients treated with braces (Group 2) showed an increase in DMF index to 13.7 ± 1.79, while in Group 1 the DMF index remained nearly unchanged at 8 ± 1.26.

Conclusion

In patients with high susceptibility to caries and non-carious lesions of dental hard tissues, treatment with removable appliances is preferable to prevent the development of complications.

Keywords: enamel, remineralization, white spot lesions, orthodontic treatment, braces, appliances, oral hygiene indices

Влияние ортодонтического лечения на твердые ткани зубов и профилактика осложнений у пациентов с зубочелюстно-лицевыми деформациями

Аннотация: Ортодонтическое лечение зубочелюстно-лицевых деформаций проводится с использованием съемных и несъемных аппаратов, которые влияют на состояние полости рта и повышают риск развития кариеса в твердых тканях.

Цель: Провести сравнительную оценку гигиены полости рта и распространенности кариеса зубов во время ортодонтического лечения с использованием съемных и несъемных аппаратов.

Материалы и методы: Было обследовано двадцать пациентов в возрасте от 18 до 35 лет: 10 пациентам из 1-й группы были установлены

элайнеры, а 10 пациентам из 2-й группы - брекеты. Гигиена полости рта оценивалась с использованием индекса Грина-Вермиллиона (OHI-S), а состояние кариозных, восстановленных и удаленных постоянных зубов оценивалось до и после 12 месяцев ортодонтического лечения.

Результаты: До ортодонтического лечения индекс OHI-S составлял 0,87 ± 0,68 в 1-й группе и 0,9 ± 0,75 во 2-й. Через 12 месяцев ухудшение показателей гигиены полости рта было более выраженным во 2-й группе, получавшей стационарные аппараты: индекс OHI-S достиг 1,99 ± 0,8. Индекс DMF до лечения составлял 7,2 ± 1,33 в 1-й группе и 7 ± 1,47 во 2-й. Через 12 месяцев у пациентов, получавших брекеты (2-я группа), индекс DMF увеличился до 13,7 ± 1,79, в то время как в 1-й группе индекс DMF практически не изменился и составил 8 ± 1,26.

Вывод: У пациентов с высокой предрасположенностью к кариесу и некариозным поражениям твердых тканей зубов предпочтительнее лечение съемными аппаратами, чтобы предотвратить развитие осложнений.

Ключевые слова: эмаль, реминерализация, белые пятна, ортодонтическое лечение, брекеты, аппараты, показатели гигиены полости рта.

Introduction

Orthodontic treatment of dentofacial deformities is performed using removable and fixed appliances, which affect the mineral environment of dental hard tissues and create additional retention sites for plaque accumulation. Poor oral hygiene disrupts the microbiological balance, increasing the risk of dental caries and exacerbating existing non-carious and carious lesions.

Enamel is the hardest and most mineralized tissue in the human body, consisting of 95% mineral components, 3.8% water, and 1.2% organic matter. The mineral

component is mainly calcium hydroxyapatite, forming enamel prisms. The orientation of enamel prisms is not uniform: in the cusps and incisal edges of permanent teeth, they are vertical; in the middle of occlusal surfaces, they are oblique; and in the cervical region, they are parallel to the root. This orientation provides mechanical resistance to masticatory load.

Enamel thickness varies across the tooth surface: maximal thickness (up to 2.5 mm) occurs at the incisal edges of anterior teeth and the occlusal surfaces of premolars and molars; the minimal thickness is observed at the enamel-cementum junction. Additionally, aprismatic enamel layers of 20–30 μm thickness can be found in the cervical region and in pits and fissures. The superficial enamel layer is more mineralized and less permeable than the subsurface layer, providing greater resistance to dissolution. Nevertheless, orthodontic procedures can cause irreversible damage to the enamel surface.

Enamel damage can occur at any stage of orthodontic treatment: acid etching, bracket bonding and debonding, and removal of residual adhesive. The process of enamel etching with orthophosphoric acid was first proposed by Buonocore in 1955. Application of 37% orthophosphoric acid dissolves the cores and boundaries of enamel prisms. The optimal etching time for bracket bonding is 30 seconds. The demineralization effect increases with prolonged acid exposure. Fluoridated enamel (2–4 μm surface layer) is highly resistant, tolerating etching for up to 3 minutes. In cases of dental fluorosis, etching should last 75–90 seconds, with longer durations for more severe fluorosis.

Acid etching dissolves approximately 5–10 μm of hydroxyapatite crystals, allowing micro-mechanical bonding of adhesive to enamel. The bond strength depends not only on acid concentration and exposure time but also on bracket placement, occlusal forces, and type of orthodontic appliance. Acid etching produces by-products such as monophosphate and calcium sulfate, which must be thoroughly rinsed to prevent enamel decalcification and necrotic damage to periodontal tissues.

Self-etch primers are recommended to prevent complications in areas with hypomineralization. These primers contain methacrylated phosphoric acid esters, which dissolve calcium ions in hydroxyapatite and neutralize acid during polymerization, reducing demineralization depth. Flemming et al. (2022) showed that self-etch primers reduce bracket bonding time on upper and lower jaws by an average of 8 minutes.

Fixed appliances complicate individual oral hygiene and increase retention sites for plaque. Moroz & Petrova (2021) reported a mean Fedorov–Volodkina hygiene index of 2.7 ± 0.4 in patients 10–14 days after placement of fixed appliances. Poor oral hygiene during orthodontic treatment increases risk for enamel caries, gingivitis, periodontitis, and alveolar bone resorption.

Both removable and fixed appliances alter oral microbiota composition. Petrova & Saunina (2018) noted an increase in cariogenic microorganisms, including streptococci and lactobacilli, after bracket placement. Traditional brackets with elastic and metal ligatures disrupt microbiological balance more than aligners. High moisture and temperature weaken polyurethane ligatures, facilitating microbial colonization. Microbiological changes are generally short-term, with normalization within 3–4 months.

Fixed appliances also reduce oral immune resistance, decreasing lysozyme, IL-1β, IL-4, and secretory IgA levels, as well as salivary calcium ion concentration, increasing caries risk.

White spot lesions are the most common complication during orthodontic treatment, often appearing within one month after fixed appliance placement. Chapman et al. (2020) reported frequent demineralization in upper lateral incisors. Risk factors for initial caries in orthodontic patients include age, poor oral hygiene, high intake of fermentable carbohydrates, enamel structure defects, and genetic predisposition.

Non-invasive treatment methods have proven the reversibility of enamel damage. Early detection and management of white spot lesions during orthodontic diagnosis are critical, especially in populations with high caries prevalence. In Saint

Petersburg, 83.4% of children aged 3–18 were affected by caries, with 54.8% showing decompensated forms (Kuzmina et al., 2020).

Studies show that the risk of white spot formation is higher with conventional fixed techniques, while aligner treatment minimizes initial enamel demineralization. Aligner therapy is increasingly popular due to digital visualization, high accuracy, and reduced treatment time. Buschang et al. (2019) reported that only 1.8% of aligner-treated patients developed white spot lesions, mainly in cervical and interproximal areas.

White spot lesions significantly impair aesthetic outcomes. Microstructural disruption reduces enamel strength. In patients at high risk of caries, prophylactic measures should be implemented to maintain enamel mineral balance during orthodontic treatment.

Objective

To compare oral hygiene and the prevalence of dental caries over 12 months in patients undergoing treatment with removable and fixed orthodontic appliances.

Materials and Methods

Twenty patients aged 18–35 years were divided into two groups based on the appliance type: Group 1 (n=10) with removable aligners, Group 2 (n=10) with fixed braces. All patients had distal occlusion and no prior orthodontic treatment history. The study was conducted at the Scientific-Practical Dentistry Center, Bukhara State Medical Institute.

OHI-S and DMF indices were assessed before treatment and after 12 months. Diagnostic intraoral photos were taken using retractors and mirrors. Unstimulated saliva microbiology analysis was performed before treatment and after 12 months in both groups.

Results and Discussion

Pre-treatment OHI-S indices were 0.87 ± 0.68 (Group 1) and 0.9 ± 0.75 (Group 2),

with no statistically significant difference. After 12 months, deterioration in oral hygiene was observed mainly in Group 2: OHI-S reached 1.99 ± 0.8. Group 1 remained nearly unchanged at 0.95 ± 0.67.

Pre-treatment DMF indices were 7.2 ± 1.33 (Group 1) and 7 ± 1.47 (Group 2). After 12 months, DMF in Group 2 increased significantly to 13.7 ± 1.79, while Group 1 remained at 8 ± 1.26.

Microbiological analysis revealed Staphylococcus, Streptococcus, and Neisseriaceae as the most common microorganisms. After 12 months, colony counts increased in both groups, higher in fixed appliance patients compared to aligner patients.

Conclusion

Fixed orthodontic appliances are associated with significant deterioration in oral hygiene and changes in oral microbiota, increasing the risk of caries. In patients with high susceptibility or poor compliance, comprehensive prophylactic measures, including professional hygiene every 3–6 months and fluoride gel applications, are recommended. Proper oral hygiene using orthodontic brushes, interdental brushes, super-floss, and irrigators should be encouraged. Regular dental monitoring every 6 months is advised. Early detection and treatment of white spot lesions and prioritization of removable appliances can prevent complications in high-risk patients.

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