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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии
საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman (Кириллица)**, для текста на грузинском языке следует использовать **AcadNusx**. Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - <http://www.spinesurgery.ru/files/publish.pdf> и http://www.nlm.nih.gov/bsd/uniform_requirements.html В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректур авторам не высылаются, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or computer-printed on a single side of standard typing paper, with the left margin of 3 centimeters width, and 1.5 spacing between the lines, typeface - **Times New Roman (Cyrillic)**, print size - 12 (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf

In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

**Articles that Fail to Meet the Aforementioned
Requirements are not Assigned to be Reviewed.**

ავტორთა საქმრალდებოლ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx**. შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრაფიების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შედეგების ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფხიხლებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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IMPORTANCE AND URGENCY OF TREATMENT AND PREVENTION STRATEGIES OF COMPLICATIONS IN ORTHODONTIC PATIENTS - LITERATURE REVIEW

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Abstract.

During orthodontic treatment patients' oral condition changes, thus influencing the overall health. Therefore, the treatment approaches require regular revision and updates to new guidelines. This literature review aims to analyse the oral health status in orthodontic patients focusing on the importance and urgency of treatment, preventive approaches to complications, and effects of the appliances on the oral biome. The review used Google Scholar, PubMed, and Science Direct databases for article searches dating from 2000 to 2024 on the status of the oral cavity changes during orthodontic treatment. Results have shown that changes in the oral cavity do not depend on the type of orthodontic appliances, both qualitative and quantitative changes in the bacterial flora were detected in cases of using all types of appliances. Orthodontic appliances and treatment may deteriorate overall oral hygiene in patients, particularly when patients practice poor oral hygiene habits, increasing the risks of developing dental decays and periodontal diseases.

Key words. Orthodontic treatment, caries, demineralization, oral health.

Introduction.

Oral diseases are among the most widespread illnesses in children [1,2]. Increasing rates of oral health problems have made orthodontic treatment necessary not only among children but among adults as well. Different kind of orthodontic appliances, such as removable and non-removable, are used to correct occlusal misalignments, physiological dysfunctions, and aesthetic problems [3]. Orthodontic pathologies cover anything from local dental problems, such as pathologies of dental size and shape, and number, to gnathic changes with maxillo-mandibular discrepancies or craniofacial asymmetries [4]. Various factors contribute to the development of occlusal pathologies. The major factors are: 1) developmental disturbances during the craniofacial growth, causing pathologies of size, shape, and form of the dentognathic system [5]; 2) premature tooth loss of the deciduous dentition, causing the shortening of the alveolar arch due to dental drift of the teeth towards the empty space and finally, 3) bad habits, such as finger-sucking, breathing with open mouth, etc., [6]. Orthodontic devices apply continuous mechanical forces on patients' dentition and periodontal tissues, based on which the corrections happen. Thus, these forces pose a risk of traumatizing teeth and their surrounding soft and hard tissues, often resulting in inflammatory changes of the entire complex of periodontal tissues [7]. This result is due to the interaction of two factors: weakening the strength of periodontal tissues and functional overload of the dentition [8]. Therefore, if teeth and periodontal tissues are damaged during the treatment,

the advantages of treatment become disputable [9]. Moreover, orthodontic appliances create additional surfaces in the oral cavity, providing better conditions for the bacteria to attach and multiply, serving as another risk factor in decreasing the overall oral hygiene status [10].

Since 1985, the scientific community has paid particular attention to the close link between orthodontic appliances and bacteria [11]. Removable and non-removable orthodontic appliances reduce oral hygiene levels, especially in young patients, which leads to the accumulation of dental plaque on the teeth [8,12], thus harming the overall oral hygiene status.

In orthodontic patients, especially in young ones, where following the hygienic norms is harder, unsatisfactory oral hygiene creates the favorable conditions for the caries development. If caries progresses further, it becomes a source for bacteria to invade the organism, primarily affecting the pulp chamber causing pulpitis and later, if untreated, affecting the surrounding tissues of the tooth - causing periapical lesions and other more complex inflammatory processes [13]. Demineralization of dental hard tissues in orthodontic patients was shown to range from 2% to 97% [14]. Studies reveal that demineralization process is intense during the first 6 months, although the risk of it persists until the very end of treatment [15].

Non-removable orthodontic appliances are mostly fixed on the vestibular surface of the tooth with the help of composites and cements, together with the metal constructions, which increases the intense accumulation of bacterial buckles on the teeth [16], due to increased number of surfaces. As orthodontic treatment is mostly required in children and adolescents, additional risk together with dental caries and periodontal disease is posed.

To fight the side effects of the orthodontic appliances several treatment and preventive protocols are applied, targeting 1. oral hygiene, 2. demineralization processes, and 3. periodontal diseases. It is crucial for orthodontic patients to maintain hygienic requirements and take accurate care of teeth and periodontal tissues during treatment. Therefore, special hygiene protocols are created specifically for orthodontic patients [14]. Additionally preventive measures are taken to boost the remineralization processes, such as fluoride varnishes, selenium-base primers, and P11-4 [17-19].

Fluoride is known to have a cariostatic effect and it is an approved preventive measure against dental caries by forming fluorapatite and also inhibiting bacterial metabolism [20,21]. Therefore, fluoride varnishes are often used in orthodontic patients for remtherapy applied monthly for 6 months to promote remineralization [22]. Research confirms that fluoride varnish has the ability to protect the enamel from demineralization under

orthodontic appliances and facilitate remineralization [23,24]. Selenium-based primers due to its antimicrobial effects are cariostatic as well [19]. Therefore, to suppress demineralization, in addition to fluoride, selenium-based primers are used [25]. The primer does not subject to hydrolysis and retains its antibacterial features for a long time [26]. P11-4 is another important cariostatic agent. It is a synthetic, self-assembling peptide and contains natural amino acids, P11-4 attracts positively charged calcium ions during the natural process of mineralization and helps the mineral crystal formation [18]. Compared with fluoride application, the peptide showed high remineralization rate in already deeply formed demineralized foci [27]. In orthodontic patients, demineralization of dental hard tissues mostly begins on the labial and buccal surfaces of the teeth, where the metal parts of braces are fixed [28], therefore, primarily the preventive measures should be taken on the vestibular surfaces. As the early demineralization process is hard to detect the Quantitative Light-induced Fluorescence (QLF) method is used for detecting and monitoring the de- and remineralized area [29].

This review shows that in the course of orthodontic treatment, under conditions of changes in the oral microflora caused by orthodontic appliances, the risk of demineralization of hard tooth tissues increases, as well as the chances of developing periodontal diseases.

Methods.

Literature search was done through Google Scholar, PubMed and Science-Direct databases. We reviewed 100 articles, and 2 dissertations published from 2000 to 2024. The keywords used were “orthodontic treatment”, “caries”, “demineralization”, “oral health”. In the first stage, all the articles were selected by a title and abstract, for the next step, the texts were analyzed in full and determined how well the mentioned article corresponded to the aim of the research. Eventually we used only the articles that met our criteria in the literary review. Articles with the following criteria were excluded in the literature review: 1. articles with the limited age population, 2. studies that have identified changes of oral health status in orthodontic patients. Overall, 20 articles were selected, see Figure 1 for the diagram of the selection process.

Discussion.

Literature review confirmed that the status of the oral cavity changes during orthodontic treatment (Table 1), along with the quantitative and qualitative changes of oral micro-flora. These quantitative and qualitative changes are manifested by the increase of aggressive forms of gram-positive and gram-negative bacteria, such as gram-positive *S. Mutans*, *Lactobacillus spp.* and gram-negative *P. gingivalis*, *T. forsythia*, and *T. denticola* [30].

The impact of age:

The literature review revealed that the correlation between age and orthodontic treatment complications is remarkable. Therefore, if occlusal anomalies allow for delay, it is preferable to start orthodontic treatment at a late adolescent age [31], when hygienic norms can be optimally followed. Additionally, the risk is higher in case of non-removable orthodontic appliances

[32]. It is important to correctly select an individual treatment and prevention protocol that provides for the maintenance of a satisfactory oral hygiene status considering the patient's age [33].

Importance of oral hygiene habits:

Individual oral hygiene habits are the leading factor in changes of oral biome. Plaque index (PI) increases with orthodontic treatment especially when hygienic norms are not meticulously followed [33-35]. The study by Cantekin et al. (2011) revealed 13% growth rate among 12-18-year-old patients within 24 months of treatment. The same study also showed the 17.8% caries prevalence rate growth among the same group and same time period [13] (Tables 1 and 2). Julien et al. (2013) demonstrated that dental caries growth was detected only in 17% of patients with good oral hygiene, in 24% with satisfactory hygiene, and in 38% cases with poor hygiene [36]. The negative impact of orthodontic appliances increases along with the length of treatment. Out of a total of 127 patients participating in one of the studies, 40% were found to have developed dental caries after 6 months of treatment, and the rate increased to 43% after 12 months of treatment, which was directly related to the deterioration of oral hygiene [37] (Tables 1 and 2).

Duration of treatment:

Durations of the treatment is a major factor as well. A study showed that after 6 months of orthodontic treatment demineralization of dental hard tissue was detected in 38% of cases, whereas in 12 months this figure increased to 46% [38] (Tables 1 and 2). Julien et al. (2013) showed that between 12-36 months of treatment demineralization is accompanied by the development of dental caries, and its prevalence reaches 20%. After 36 months of treatment, this indicator increases up to 26% [36]. Moreover, 26% of patients with no dental caries at the start of the treatment, developed dental hard tissue damage, whereas the number of patients with dental caries at the beginning of treatment increased up to 87% [36]. However, the study revealed a 23% caries prevalence rate growth at 12 months of treatment duration [36] (Tables 1 and 2).

The influence of fixed and removable orthodontic appliances:

Changes in the oral cavity does not depend on the type of orthodontic appliances, both qualitative and quantitative changes in the bacterial flora were detected in cases of using all types of appliances [11]. However, the difference was noted in the case of treatment with removable orthodontic appliances. The qualitative and quantitative changes in oral bacteria were less in removable when compared to non-removable orthodontic appliances [13].

The study by Albhaisi et. al. (2020) revealed a different rate of demineralization depth and spread according to the treatment method, in the case of treatment with a fixed bracket system, the demineralization foci on the surface of the tooth were less, but deep, whereas in the case of treatment with aligners, the abundance of demineralization foci was revealed, although relatively shallow compared to the non-removable brackets. On average, the study found a 20% demineralization rate after just 3 months of treatment with the bracket system [39] (Tables 1 and 2).

Table 1. Summary of reviewed articles – changes observed following the initiation of orthodontic treatment. Plaque index (PI), Gingival bleeding index (GBI), Ortho-plaque index (OPI), Gingival index (GI).

Study	Research design	Study group	Treatment time	Result		
				Hygiene decrease	Caries increase	Prophylaxis success
Lucchese A, Gherlone E, (2013)	Cross-sectional study 127 patients (91 M, 100F)	group I, 59 patients group II, 64 patients	6 month 12 month	NA	40% 43%	NA
Tufekci E, <i>et al.</i> (2011)	Cross-sectional study 100 patients (47 M, 53 F)	group I, 37 patients group II, 35 patients	6 month 12 month	NA	38% 46%	NA
Shrestha S, <i>et al.</i> (2013)	Cross-sectional study 212 patients (72M, 140F)	group I, 49 patients group II, 72 patients group III, 70 patients group IV, 21 patients	6 month 12 month	NA	33% 61%	NA
Julien KC, <i>et al.</i> (2013)	Cross-sectional study 885 patients (378M, 507F)	group I group II	24 months	NA	25%	NA
Almosa NA, <i>et al.</i> (2012)	Cross-sectional study 89 patients (33M, 56F)	group I, 45 patients group II, 44 patients	21 months	NA	22% 67%	NA
Cantekin K, <i>et al.</i> (2011)	The statistical analysis 659 patients (257M, 402F)	group I, 12-year-olds group II, 18-year-olds	24 months	NA	17.8%	NA
Albhaisi Z, <i>et al.</i> (2020)	Prospective randomized clinical study 49 patients (10M, 39F)	group I, 27 patients group II, 22 patients	3 months	NA	20%	NA
Kim SH, <i>et al.</i> (2012)	The statistical analysis 30 patients (M13, F17)	group I group II group III group IV	0 days 1 week 3 months 6 months	25,8% 42,2% 42,2% 65%	NA	NA
Atassi F, <i>et al.</i> (2010)	The clinical trials 50 patients (M32, F18)	NA	6 months	PI 65.24 GBI 19.14 OPI 53.56	NA	NA
Baheti M, <i>et al.</i> (2015)	Simple random sampling 150 patients	group I, 90 patients group II, 48 patients group III, 12 patients	NA	28%	NA	72%
Kudirkaite I, <i>et al.</i> (2016)	The statistical analysis 107 patients (M38, F69)	group I, 57 patients group II, 50 patients	4 months	43% 24,3%	NA	NA
Welk A, <i>et al.</i> (2020)	The clinical trials 23 patients (M10, F13)	NA	6 months	NA	46,7%	43%
Masoe AV, <i>et al.</i> (2015)	Cross-sectional survey 117 patients	NA	6 months	70,5%	NA	44,2%
Farhadian N, <i>et al.</i> (2011)	A cross-sectional study 70 patients (M19, F51)	group I, 35 patients group II, 35 patients	NA	40%	44,2%	22,1
Hsieh TJ, <i>et al.</i> (2005)	Comprehensive clinical assessment 408 patients	group I, 86 patients group II, 322 patients	12 months	55,2%	NA	24%
Chhibber A, <i>et al.</i> (2018)	The clinical trials 71 patients (M41, F30)	group I, 27 patients group II, 22 patients group III, 22 patients	9-12 months	PI 66%-71% GI 51%-69%	NA	NA

Table 2. Changes in the caries prevalence status in orthodontic patients, considering age, gender, and duration of the treatment.

Age group (in years)	Male	Female	Months	Prevalence of caries (%)		Article	
12,5	63	64	6	12	40%	43%	Lucchese A, Gherlone E, <i>et al.</i> (2013)
14,5	38	34	6	12	38%	46%	Tufekci E, <i>et al.</i> (2011)
19,5	72	140	6	12	33%	61%	Shrestha S, <i>et al.</i> (2013)
17,5	378	507	12		23%		Julien KC, <i>et al.</i> (2013)
21,5	19	26	12		61%		Almosa NA, <i>et al.</i> (2012)
12-18	257	402	24-28.5		17.8%		Cantekin K, <i>et al.</i> (2011)
22	10	39	3		20%		Albhaisi Z, <i>et al.</i> (2020)

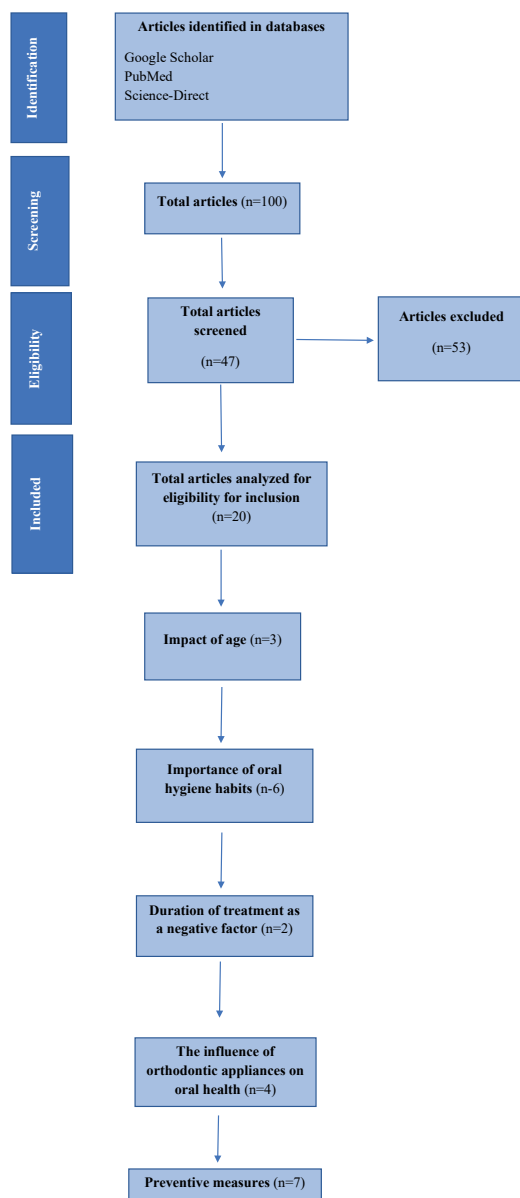


Figure 1. Diagram of articles cited in the literature review.

The literature review agrees with the existing findings of the reviewed articles on changes in oral status during orthodontic treatment. Studies show that the increase of bacteria is closely related to the demineralization of dental hard tissues and the inflammatory processes of periodontal tissues [40]. All oral appliances affect and change the microflora of the mouth, but the fixed ones, such as bracket systems, has shown higher level of soft and hard plaque formation on dental surfaces, when compared to removable appliances [11]. Metal details fixed on the vestibular surface of the teeth make it difficult to clean them and in conditions of increased microflora the pH of saliva changes, which increases the risk of demineralization [13].

Preventive measures:

If patients used cariostatic agents regularly, such as fluoride-replacing oral care products during the treatment period had a caries rate of 28% compared to when no such preventive measures were taken. In such cases dental caries rate was 61% [41].

The importance of fluoride was also revealed in the study by Almosa, et al 2012 [41] where fluoride was an actively used application. Here caries was detected in only 26%, in contrast to the study group where preventive measures were not carried out. There the prevalence of caries reached 61% [41] (Tables 1 and 2).

These studies have also revealed that fluoride application has no curative, but only preventive effect, unlike P11-4 peptide, which has shown both prophylactic and curative effects during the treatment of orthodontic patients [28].

Therefore, meticulous hygienic measures in combination with preventive remineralization topical applications showed the best effect to prevent increase in dental caries rate [14,42,43].

Summary of risk factors:

Literature review has revealed the main risk factors for worsening of the oral health status during the orthodontic treatment:

a) young individual age of the patient; b) poor oral hygiene; c) long duration of the treatment; d) fixed orthodontic appliance; e) neglect of preventive measures. The review has shown that the age and orthodontic treatment complications are related, as the hygienic norms cannot be meticulously followed among younger children. Therefore, if occlusal anomalies allow for delay, it is preferable to start orthodontic treatment at an older age [31], when hygienic norms can be optimally followed. Even though, all oral appliances affect and change the microflora of the mouth, the risk is higher in case of non-removable orthodontic appliances [32].

Due to the posing risk for developing dental caries, along with worsened hygiene, the use of curative preventive means is of great importance during orthodontic treatment [44]. The results proved the need to implement special protocols in orthodontic patients. It also revealed the lack of access to the research-based information for doctors as well as patients, that would strengthen orthodontists' opinion about the necessity of the protocols [45].

For optimal orthodontic care, it is important to correctly select an individual treatment and prevention protocol that provides for the maintenance of a satisfactory oral hygiene status considering the patient's age [33].

Conclusion.

Based on the reviewed literature, we can conclude that it is important to evaluate the status of the oral cavity before the treatment as well as in the process of orthodontic treatment to avoid development and progression of the pathological processes of the dental hard and its surrounding tissues. It is important to calculate the risks during treatment and it is crucial to instruct patients on proper oral care, hygiene and quality of nutrition [34]. Affective factors such as: age, poor oral hygiene, prolonged orthodontic treatment, types of orthodontic appliances, and neglect of preventive measures especially increase the risk of complications in patients with non-removable orthodontic appliances [16]. Studies have shown that timely diagnosed orthodontic patients with strict oral hygiene control, treatment and preventive measures, dramatically reduced the demineralized areas of dental hard tissue, as well as inflammatory processes of periodontal tissues [46,47]. Consequently, deep destructive processes in the oral

cavity can be avoided in orthodontic patients when preventive and treatment protocols are strictly abided to.

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REFERENCES

1. Manana K. Prevalence and risk factors of dental diseases in children with endemic goiter. 2003.
2. Marthaler TM. Changes in dental caries 1953-2003. *Caries Res.* 2004;38:173-181.
3. Naidu S, Suresh A. Evolution of Orthodontic Appliances-Then and Now!!! *Int J Dent Heal Sci.* 2018;5:319-329.
4. Kozanecka A, Sarul M, Kawala B, et al. objectification of orthodontic treatment needs: does the classification of malocclusions or a history of orthodontic treatment matter. *Adv Clin Exp Med.* 2016;25:1303-1312.
5. Türp JC, Schindler H. The dental occlusion as a suspected cause for TMDs: Epidemiological and etiological considerations. *J Oral Rehabil.* 2012;39:502-512.
6. Alexander SA, Askari M, Lewis P. The premature loss of primary first molars: Space loss to molar occlusal relationships and facial patterns. *Angle Orthod.* 2015;85:218-223.
7. Morii A, Miyamura Y, Sago MI, et al. Orthodontic force-induced oxidative stress in the periodontal tissue and dental pulp elicits nociception via activation/sensitization of TRPA1 on nociceptive fibers. *Free Radic Biol Med.* 2020;147:175-186.
8. Perkowski K, Baltaza W, Conn DB, et al. Examination of oral biofilm microbiota in patients using fixed orthodontic appliances in order to prevent risk factors for health complications. *Ann Agric Environ Med.* 2019;26:231-235.
9. Saloom HF, Mohammed-Salih HS, Rasheed SF. The influence of different types of fixed orthodontic appliance on the growth and adherence of microorganisms (in vitro study). *J Clin Exp Dent.* 2013;5:e36.
10. AlHudaithi FS, Alshammery DA. Screening of biochemical parameters in the orthodontic treatment with the fixed appliances: A follow-up study. *Saudi J Biol Sci.* 2021;28:6808-6814.
11. Lucchese A, Bondemark L, Marcolina M, et al. Changes in oral microbiota due to orthodontic appliances: a systematic review. *J Oral Microbiol.* 2018;10.
12. Awadh Al-Shahrani M. Microbiology of Dental Caries: A Literature Review. *Ann Med Health Sci Res.* 2019;9:655-659.
13. Cantekin K, Celikoglu M, Karadas M, et al. Effects of orthodontic treatment with fixed appliances on oral health status: A comprehensive study. *J Dent Sci.* 2011;6:235-238.
14. Lapenaite E, Lopatiene K, Ragauskaitė A. Prevention and treatment of white spot lesions during and after fixed orthodontic treatment: A systematic literature review. *Stomatologija.* 2016;18:3-8.
15. Salmerón-Valdés EN, Lara-Carrillo E, Medina-Solís CE, et al. Tooth demineralization and associated factors in patients on fixed orthodontic treatment. *Sci Rep.* 2016;6:1-6.
16. Robo I, Heta S, Surgery P, et al. Changes in the Contents of the Oral Flora, in Gingival Hypertrophy Caused by Fixed Orthodontic Appliances. 2021;1-20.
17. Meyer F, Schulze Zur Wiesche E, Amaechi BT, et al. Caries Etiology and Preventive Measures. *Eur J Dent.* 2024;18:766-776.
18. Dawasaz AA, Togoo RA, Mahmood Z, et al. Effectiveness of Self-Assembling Peptide (P11-4) in Dental Hard Tissue Conditions: A Comprehensive Review. *Polymers (Basel).* 2022;14:1-15.
19. Deepak P, S Priya AKR. To Evaluate the Effects of Antimicrobial Primer containing Selenium on Development of White Spot Lesion: An in vitro study. *World J Dent.* 2024;15:389-393.
20. Saunders RH, Meyerowitz C. Dental Caries in Older Adults. *Dent Clin.* 2005;49:293-308.
21. Baik A, Alamoudi N, El-Housseiny A, et al. Fluoride varnishes for preventing occlusal dental caries: A review. *Dent J.* 2021;9:1-15.
22. Sonesson M, Brechter A, Abdulaheem S, et al. Fluoride varnish for the prevention of white spot lesions during orthodontic treatment with fixed appliances: A randomized controlled trial. *Eur J Orthod.* 2020;42:326-330.
23. Tüfekçi E, Pennella DR, Mitchell JC, et al. Efficacy of a fluoride-releasing orthodontic primer in reducing demineralization around brackets: An in-vivo study. *Am J Orthod Dentofac Orthop.* 2014;146:207-214.
24. Daneshkazemi P, Sadeghian S, Khodaei M. Shear bond strength of orthodontic brackets on intact and demineralized enamel after application of resin infiltrant, fluoride varnish and casein phosphopeptide-amorphous calcium phosphate remineralizing agents: in-vitro study. *Int Orthod.* 2021;19:259-268.
25. Amaechi BT, McGarrell B, Luong MN, et al. Prevention of white spot lesions around orthodontic brackets using organoselenium-containing antimicrobial enamel surface sealant. *Heliyon.* 2021;7:e06490.
26. Sardana D, Zhang J, Ekambaram M, et al. Effectiveness of professional fluorides against enamel white spot lesions during fixed orthodontic treatment: A systematic review and meta-analysis. *J Dent.* 2019;82:1-10.
27. Jablonski-Momeni A, Nothelfer R, Morawietz M, et al. Impact of self-assembling peptides in remineralisation of artificial early enamel lesions adjacent to orthodontic brackets. *Sci Rep.* 2020;10:1-10.
28. Welk A, Ratzmann A, Reich M, et al. Effect of self-assembling peptide P11-4 on orthodontic treatment-induced carious lesions. *Sci Rep.* 2020;10:1-10.
29. Korkut B, Korkut D, Yanikoglu F, et al. Clinical assessment of demineralization and remineralization surrounding orthodontic brackets with Fluore Cam. *Asian Pac J Trop Biomed.* 2017;7:373-377.

30. Kim SH, Choi DS, Jang I, et al. Microbiologic changes in subgingival plaque before and during the early period of orthodontic treatment. *Angle Orthod.* 2012;82:254-260.
31. Hsieh TJ, Pinskaya Y, Roberts WE. Assessment of orthodontic treatment outcomes: Early treatment versus late treatment. *Angle Orthod.* 2005;75:162-170.
32. Chhibber A, Agarwal S, Yadav S, et al. Which orthodontic appliance is best for oral hygiene? A randomized clinical trial. *Am J Orthod Dentofac Orthop.* 2018;153:175-183.
33. Baheti M, Toshniwal N. Survey on oral hygiene protocols among orthodontic correction-seeking individuals. *J Educ Ethics Dent.* 2015;5:8.
34. Atassi F, Awartani F. Oral hygiene status among orthodontic patients. *J Contemp Dent Pract.* 2010;11:25-32.
35. Kudirkaite I, Lopatiene K, Zubiene J, et al. Age and gender influence on oral hygiene among adolescents with fixed orthodontic appliances. *Stomatologija.* 2016;18:61-65.
36. Julien KC, Buschang PH, Campbell PM. Prevalence of white spot lesion formation during orthodontic treatment. *Angle Orthod.* 2013;83:641-647.
37. Lucchese A, Gherlone E. Prevalence of white-spot lesions before and during orthodontic treatment with fixed appliances. *Eur J Orthod.* 2013;35:664-668.
38. Tufekci E, Dixon JS, Gunsolley JC, et al. Prevalence of white spot lesions during orthodontic treatment with fixed appliances. *Angle Orthod.* 2011;81:206-210.
39. Albhaisi Z, Al-Khateeb SN, Abu Alhaja ES. Enamel demineralization during clear aligner orthodontic treatment compared with fixed appliance therapy, evaluated with quantitative light-induced fluorescence: A randomized clinical trial. *Am J Orthod Dentofac Orthop.* 2020;157:594-601.
40. Wishney M. Potential risks of orthodontic therapy: a critical review and conceptual framework. *Aust Dent J.* 2017;62:86-96.
41. Almosa NA, Lundgren T, Aldrees AM, et al. Diagnosing the severity of buccal caries lesions in governmental and private orthodontic patients at debonding, using the icdas-ii and the diagnodent pen. *Angle Orthod.* 2014;84:430-436.
42. Masoe AV, Blinkhorn AS, Taylor J, et al. An assessment of preventive care offered to orthodontic patients by oral health therapists in NSW Australia. *Int Dent J.* 2015;65:196-202.
43. Wang Y, Qin D, Guo F, et al. Outcomes used in trials regarding the prevention and treatment of orthodontically induced white spot lesions: A scoping review. *Am J Orthod Dentofac Orthop.* 2021;160:659-670.e7.
44. Shrestha S, Shrestha L, Shrestha N, et al. Effect of Orthodontic Treatment in Occurrence of Dental Caries. *Orthod J Nepal.* 2013;3:31-36.
45. Farhadian N, Miresmaeili AF, Sabounchi SS, et al. Evidence-based caries preventive measures applied in orthodontic practices in Iran. *Iranian Journal of Orthodontics.* 2011;6:1-6.
46. Tasios T, Papageorgiou SN, Papadopoulos MA, et al. Prevention of orthodontic enamel demineralization: A systematic review with meta-analyses. *Orthodontics and Craniofacial Research.* 2019;22:225-235.
47. Shaik JA, Reddy RK. Review Article Prevention and Treatment of White Spot Lesions in Orthodontic Patients. *Contemp Clin Dent.* 2017;8:11-19.