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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 ВИНИТИ 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 ВИНИТИ 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. Корректура авторам не высылается, 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 compu-ter-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 საყურადღებოდ!

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. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის 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 ფჩხილებში 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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RESULTS OF COMPREHENSIVE TREATMENT OF PATIENTS WITH ORTHODONTIC PATHOLOGY AND PATHOLOGICAL TOOTH WEAR

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Abstract.

Introduction: To analyze the treatment outcomes in patients with orthodontic pathology and pathological tooth wear under different approaches to correcting the position of the occlusal plane.

Materials and Methods: 65 individuals with orthodontic pathology, impaired incisal guidance in the form of absence of the C. Christensen phenomenon, counterclockwise inclination of the occlusal plane, and pathological tooth wear were examined. Patients in Group I received treatment using bracket systems and micro-implants to correct the position of the occlusal plane, while patients in Group II were treated with bracket systems only, without any intervention regarding the occlusal plane. The jaw relationship was assessed according to E. Angle's classification, the level of incisal overlap, the presence of the C. Christensen phenomenon, and lateral cephalometric data were compared to evaluate the position of the occlusal plane relative to the Frankfurt horizontal (angle FH-OP) and the anterior cranial base (angle SN-OP). All patients underwent indirect tooth restorations using reinforced nano-hybrid composite material – 446 restorations in Group I and 489 restorations in Group II, the condition of which was evaluated using a number of criteria.

Results: Before treatment, the FH-OP occlusal plane angle in Group I patients was 1.48±0.61˚, and the SN-OP angle was 8.92±0.78˚. In Group II patients, these values were 2.15±0.66˚ and 7.87±0.70˚, respectively – all values being below the normal range. After treatment, the FH-OP and SN-OP values in Group I approached the normal range, amounting to 8.55±0.61˚ and 13.82±0.54˚, respectively. Sagittal incisal guidance and the C. Christensen phenomenon were fully restored. Eight restorations (1.8%) exhibited marginal adaptation defects, 11 restorations (2.5%) had marginal discoloration, and 3 restorations (0.7%) had cracks; no chipping was observed. In Group II, FH-OP and SN-OP values improved to 2.41±0.67˚ and 8.12±0.48˚, respectively, but did not reach the normal range. Sagittal incisal guidance and the C. Christensen phenomenon were restored in only 6 patients (17.6%). Among the restorations, 43 (8.8%) exhibited marginal adaptation defects, 47 (9.6%) showed marginal discoloration, 57 (11.7%) had cracks, and 67 restorations (13.7%) had chipping.

Conclusions: The results demonstrate the effectiveness of the applied treatment approaches for patients with orthodontic pathology and pathological tooth wear, which should be attributed to the normalization of the occlusal plane position, restoration of the C. Christensen phenomenon, the advantages of using orthodontic micro-implants, and the application of indirect tooth restorations.

Key words. Orthodontic pathology, treatment, occlusal plane, pathological tooth wear, indirect tooth restorations, clinical evaluation.

Introduction.

Orthodontic pathology is quite widespread among both children and adults. It significantly impacts quality of life and requires a comprehensive approach to diagnosis and treatment. According to literature sources, the prevalence of malocclusions based on E. Angle's classification for Class I, II, and III jaw relationships ranges from 52–75%, 19–24%, and 4–6.5%, respectively, depending on the age of the examined population and the geographic location of the studies. Among vertical anomalies, the prevalence of deep bite and open bite is 22% and 5%, respectively, while crossbite is observed in 9% of patients [1-3].

It is well known that in the presence of certain orthodontic pathologies, it is impossible to ensure full sagittal movements of the mandible, which affects the incisal guidance. Incisal guidance plays a key role in the functioning of the dentoalveolar system [4-6]. It determines the trajectory of mandibular incisors sliding along the palatal surfaces of maxillary incisors during sagittal jaw movements, contributing to the even distribution of chewing load and preventing overloading of the posterior teeth and the temporomandibular joint [7].

Another influential factor in maintaining the healthy condition and function of the dentoalveolar system is the spatial orientation of the occlusal plane [5,8]. Deviation of the occlusal plane disrupts the natural biomechanics of mandibular movements, leading to dysfunction of the masticatory muscles and the temporomandibular joint, the development of malocclusion, as well as pathological tooth wear [9-11]. Deviations in the occlusal plane position can be effectively corrected during orthodontic treatment, particularly using bracket systems and microimplants [7,12-14].

Normally, during sagittal movement, the mandible reaches an "edge-to-edge" position of the teeth, and the posterior segments of the dental arches disarticulate, forming a wedge-shaped space that is wider distally and narrower mesially. The formation of this wedge-shaped space, observed in different individuals with varying degrees of expression, was described as a phenomenon by Danish dentist and educator Carl Christensen [15]. The width of this disarticulation in the posterior region is directly proportional to the inclination angle of the sagittal condylar path. Disruptions in sagittal mandibular movements and incisal guidance may result in the loss of the C. Christensen phenomenon and, consequently, the appearance of undesirable contacts between antagonistic teeth in the posterior segments when the incisors are in an edge-to-edge position.

One of the current challenges in modern dentistry is pathological tooth wear, particularly of the posterior teeth [13,16]. According to the literature, the prevalence of pathological wear in primary

teeth ranges from 30% to 50%, and in permanent teeth — from 20% to 45% [17]. The causes and contributing factors to this condition are well described [18,19]. Pathological tooth wear leads to a reduction in tooth height and affects the occlusal vertical dimension, which in turn impacts the condition and function of the temporomandibular joint [11]. In the presence of orthodontic pathology, the progression of pathological tooth wear accelerates and becomes more complicated [20].

In the treatment of pathological tooth wear, modern dental practice employs various approaches, primarily aimed at restoring the anatomical shape and function of the teeth and preventing further abrasion [21]. Prosthetic treatment involves restoring the occlusal height using crowns, veneers, and composite restorations [18,21]. Additionally, the treatment of temporomandibular joint dysfunction contributes to the restoration of occlusal relationships between dental arches and the normalization of mandibular movements [4,14]. However, comprehensive treatment of orthodontic patients with pathological tooth wear remains a relevant and complex clinical challenge. Understanding the interrelations and mutual influences of these pathological processes makes it possible to develop effective diagnostic and treatment methods aimed at restoring the function of the dentoalveolar system and preventing complications associated with pathological tooth wear.

The aim of this study. To analyze the outcomes of comprehensive treatment of patients with orthodontic pathology and pathological tooth wear under different approaches to the correction of the occlusal plane position.

Materials and Methods.

The study design corresponded to the structure of a comparative cohort clinical study, which involved a retrospective-prospective analysis of the effectiveness of comprehensive orthodontic treatment in patients with pathological tooth wear. At a private dental clinic, a total of 435 patients aged 26 to 53 years who presented for the first time for the diagnosis and treatment of orthodontic pathology were examined at the preliminary stage of the study. In 65 patients (14.9% of the total), signs of impaired incisal guidance were identified, namely the absence of contact between the anterior teeth with the presence of occlusal contacts in the posterior segments during sagittal movement of the mandible, which indicates the absence of the C. Christensen phenomenon. Among them were 30 men (46.2% of this number) and 35 women (53.8%). These patients also exhibited signs of pathological tooth wear within the mantle and peripulpal dentin in the posterior segments of the dental arches, direct incisor contact, minimal orthognathic overbite up to 1/4 of the height of the lower incisors, or vertical disocclusion. According to lateral cephalometric radiographs, the examined individuals had a significant inclination (more than 5˚) of the occlusal plane (OP) “counterclockwise” relative to the Frankfort horizontal (FH) and the anterior cranial base (SN).

Patients with identified orthodontic pathology were divided into two groups depending on the chosen treatment strategy. Group I included 31 patients (47.7%) who were offered and consented to comprehensive treatment using bracket systems and orthodontic micro-implants, which provide reliable anchorage for additional correction of the occlusal plane position to acceptable normal values according to lateral cephalometric data and ensure the desired direction of movement and sufficient pressure force on the dental arches [7,22,23]. Micro-implants were placed in the bone tissue of the lateral jaw segments [4,14]. Group II consisted of 34 patients (52.3%) who also underwent treatment of orthodontic pathology using bracket systems but without correction of the occlusal plane position with micro-implants, due to these individuals' unwillingness to be treated with their use.

The study excluded individuals with inflammatory periodontal diseases; with the absence of more than one tooth in each dental arch or absence of antagonist teeth; with bruxism; with crossbite types of malocclusion; with salivary gland diseases; during pregnancy and lactation; with mental disorders, including those resulting from alcohol or drug abuse; with cognitive impairments; with conditions that may affect the treatment outcome (active neoplastic process, immunodeficiency state, tuberculosis, etc.); if the patient refused to sign informed consent for participation in the study; if the patient was participating in another study; if the patient planned to relocate during the observation period; if the patient had somatic pathology that contributes to reduced caries resistance of hard dental tissues and the occurrence of periodontal diseases; if the patient had a history of myocardial infarction or stroke.

The study was conducted in accordance with the main provisions of the "Ethical Principles for Medical Research Involving Human Participants," as approved by the Helsinki Declaration (1964-2013), the Council of Europe Convention on Human Rights and Biomedicine, relevant Ukrainian legislative acts, and regulations of the Ministry of Health of Ukraine. Patients voluntarily participated in the study, as confirmed by their signed informed consent. Each patient was informed about their rights and obligations, as well as the possibility of discontinuing participation in the study at any time without consequences or explanation of reasons. Compliance with the principles and norms of bioethics in the study was confirmed by the conclusion of the Bioethics Committee of Donetsk National Medical University (Conclusion No. 5 dated May 25, 2025, Protocol No. 4 dated May 25, 2025).

Before the placement of the bracket systems, the form and volume of pathologically worn teeth were restored in patients of both groups using indirect restorations made from reinforced nanophotocomposite material designed for restoring teeth in the posterior segments, with a minimally invasive approach to tooth preparation. Each patient had from 11 to 17 posterior teeth restored, depending on the extent of hard tissue loss due to pathological wear. In total, 446 indirect restorations were performed in patients of Group I, and 489 restorations in patients of Group II.

Before and after the treatment, the sagittal jaw relationship according to the E. Angle classification was determined in patients of both groups, and the incisal overlap was measured in the vertical direction. Further, the sagittal movements of the mandible were assessed, and the presence or absence of the C. Christensen phenomenon was recorded [15,23]. Treatment outcomes were also evaluated by comparative analysis of lateral cephalograms regarding the position of the occlusal plane

relative to the Frankfort horizontal (FH-OP) and the anterior cranial base (SN-OP). Orthodontic treatment for patients of both groups was considered completed when the jaw relationship achieved Angle Class I, with tight contact between adjacent teeth and antagonistic teeth, and an orthognathic overbite in the frontal area [9]. At this stage, sagittal incisal guidance, the position of the occlusal plane, and comparison with the initial state were assessed, and any defects in the restorations were evaluated as indicators of increased load in the posterior segments of the dental arches. The observation period varied from 1.5 to 2.5 years, depending on the individual characteristics of the pathology and treatment duration.

The condition of the performed indirect nanophotocomposite restorations of posterior teeth due to pathological wear was assessed according to adapted clinical criteria regarding marginal fit of the restorative material, the presence of marginal discoloration at the restoration margins, cracks, and chipping of the material [24]. Clinical evaluation was performed immediately after fixation, after 1 year, and upon completion of orthodontic treatment. For each criterion, the presence of defects in restorations was determined and recorded at the specified times. In one patient, multiple defects according to different criteria could be observed in one or several restorations on one or different teeth. Therefore, for each group, the number of patients with restorations showing defects and the number of restorations with defects according to the respective criteria were counted.

For the analysis of lateral cephalometric data and the determination of their reliability, methods of variation statistics were used with the Student's t-test. Statistical analysis of restoration status indicators was performed using Microsoft Excel software, and quantitative indicators were presented in absolute and percentage values.

Results and Discussion.

During the determination of the sagittal jaw relationship according to the E. Angle classification, it was found that among patients in Group I, 20 individuals (64.5% of the group) had Class I, 5 individuals (16.1%) had Class II, and 6 individuals (19.4%) had Class III. These results slightly differ from some published data regarding the prevalence of pathological occlusions in the sagittal direction [25]. However, this trend corresponds to the combination of factors such as the counterclockwise inclination of the occlusal plane and disturbances in the sagittal incisal pathway of the lower jaw, with the loss of the C. Christensen phenomenon. In the vertical direction, 15 patients (48.4%) had minimal orthognathic incisal overlap, 13 patients (41.9%) had direct incisal contact, and 3 patients (9.7%) exhibited no overlap. In Group II, the jaw relationship was classified as Class I according to E. Angle in 17 individuals (50.0% of the group), Class II in 2 individuals (5.9%), and Class III in 15 individuals (44.1%). Regarding the incisal relationship in the vertical direction, 19 patients (55.9%) had minimal orthognathic overlap, 8 patients (23.5%) had direct contact, and 7 patients (20.6%) showed no incisal contact (Table 1).

The average position of the occlusal plane relative to the Frankfort horizontal (FH-OP) in patients of Group I was 1.48±0.61˚, which is significantly ($p<0.001$) lower compared to the normal value of 9.3±3.8˚ [26]. Regarding the position of the occlusal plane relative to the anterior cranial base (SN-OP), the average value was 8.92±0.78˚, which also significantly ($p<0.001$) differed from the normal value of 14.0±4.0˚. In Group II, the average FH-OP and SN-OP values were 2.15±0.66˚ and 7.87±0.70˚, respectively, which were significantly ($p<0.001$) lower than the aforementioned normal values. It is important to note that both baseline indicators in patients of Groups I and II differed significantly from the corresponding normal values ($p<0.001$), while no statistically significant difference was observed between the two groups themselves ($p>0.05$), indicating identical conditions at the beginning of the study. These findings indicate a significant counterclockwise inclination of the occlusal plane, which, in turn, leads to changes in the sagittal incisal path, characterized by the loss of contacts between the incisors and the appearance of contact in the molar region (loss of the C. Christensen phenomenon). The consequence of the combined effects of factors such as the loss of the C. Christensen phenomenon, insufficient vertical incisal overlap, and significant occlusal plane inclination is likely to be pathological wear in the posterior segments of the dental arches.

The indirect restorations for pathologically worn posterior teeth in both groups were initially flawless, without any deviations in any of the criteria. One year after the start of orthodontic treatment, the clinical status of the restorations was re-evaluated. In Group I, 12 patients (38.7% of the total group) showed 55 restorations (12.3% of the total restorations in this group) with marginal adaptation defects of the nanophotocomposite material. In 14 individuals (45.2%), 37 restorations (8.3%) showed marginal discoloration, in 9 patients (29.0%) 25 restorations (5.6%) had cracks, and in 18 patients (58.1%) 40 restorations (9.0%) showed chipping.

Similar data, though slightly higher, were obtained in the evaluation of restorations in patients of Group II. Marginal adaptation defects were found in 80 restorations (16.4% of the total restorations in this group) in 16 patients (47.1% of the group), and 59 restorations (12.1%) in 18 patients (52.9%) had marginal discoloration. Additionally, 56 restorations (11.5%)

Table 1. *Distribution of patients into study groups.*

	Number of patients with dental arch relationships according to E. Angle (sagittal dimension), abs. (%)			**Number of patients with different incisal overlaps (vertical dimension), abs. (%)**		
	Class I (neutral relationship)	**Class II (distal relationship)**	**Class III (mesial relationship)**	**Ortho**	**Straight**	**Open**
Group I, n=31	20 (64.5)	5 (16.1)	6 (19.4)	15 (48.4)	13 (41.9)	3 (9.7)
Group II, n=34	17 (50.0)	2 (5.9)	15 (44.1)	19 (55.9)	8 (23.5)	7 (20.6)

in 17 patients (50.0%) exhibited cracks, and 75 restorations (15.3%) in 19 patients (55.9%) had chips.

The results obtained during the clinical evaluation of the restoration condition indicate excessive load in the posterior sections of the dental arches in Group II patients. In contrast, the better outcomes in Group I can be explained by the optimization of the occlusal plane position during orthodontic treatment. In both groups, all identified defects and breakdowns of restorations were corrected or repaired for further monitoring and comparison of the restoration condition, taking into account the normalization of the occlusal plane position in Group I patients and the absence of such corrective measures in Group II.

Upon completion of orthodontic treatment, the FH-OP and SN-OP indicators in Group I patients reached 8.55 ± 0.61˚ and 13.82 ± 0.54˚, respectively, indicating a shift toward normal values with no statistically significant difference from them ($p>0.05$), but with a statistically significant difference from the baseline values ($p<0.001$). On average, the position of the occlusal plane shifted by 5-7˚. Additionally, in all patients in this group, the sagittal incisal guidance and the C. Christensen phenomenon were fully restored, meaning that during the sagittal movement of the lower jaw, contacts were achieved exclusively within the incisors, with complete disengagement in the posterior regions of the dental arches. These improved results are further confirmed by the condition of the restorations, with none exhibiting chipping. Only 8 restorations (1.8% of the total number in this group) in 5 patients (16.1% of the group) showed marginal adaptation defects, 11 restorations (2.5%) in 7 patients (22.6%) exhibited marginal discoloration, and 3 restorations (0.7%) in 2 patients (6.5%) had cracks.

However, the results are particularly impressive when comparing the restoration condition between two observation periods. After the completion of orthodontic treatment, the number of restorations with marginal adaptation defects of the nanophotocomposite material to the enamel of the restored teeth decreased 6.9 times compared to the one-year control, while the number of patients with this deviation decreased 2.4 times. Regarding marginal discoloration at the junction of the nanophotocomposite, the number of restorations with discoloration decreased 3.4 times, and the number of patients decreased by half. The number of restorations with cracks decreased by 8.3 times, and the number of patients with cracks decreased by 4.5 times. As for the chipping of photocomposite material, none were detected after treatment, whereas quite a few were noted at the one-year follow-up. The clinical evaluation of the restoration condition showed the effectiveness of the approaches used in the treatment of orthodontic pathology and pathological tooth wear in Group I patients.

Significantly poorer results were observed in Group II patients after the completion of treatment, according to the data analysis. The position of the occlusal plane, based on the FH-OP and SN-OP values, improved slightly to 2.41±0.67˚ and 8.12±0.48˚, respectively, but these values were still far from normal ($p>0.05$). They also did not differ significantly ($p>0.05$) from the values obtained before the start of treatment (Table 2).

These changes occurred due to the vertical movement of certain teeth during the normalization of the sagittal occlusal curve of Spee and the closure of vertical disocclusion in the frontal area. This influenced the restoration of the sagittal incisal guidance and the appearance of the C. Christensen phenomenon in 6 patients (17.6% of the total number in the group). Regarding the restoration condition, the obtained results clearly reflect the direct connection with other studied parameters. Marginal adaptation defects were found in 43 restorations (8.8% of the total restorations in this group) in 12 patients (35.3%), marginal discoloration was observed in 47 restorations (9.6%) in 15 patients (44.1%), cracks were present in 57 restorations (11.7%) in 18 patients (52.9%), and chipping was registered in 67 restorations (13.7%) in 23 patients (67.6%).

The dynamics of the indicators characterizing the condition of dental restorations in patients of this group at both study time points were less pronounced compared to those in Group I. The number of restorations with marginal adaptation defects of the nanohybrid composite to enamel decreased by only 1.9 times, while the number of patients with such restorations decreased by just 1.3 times. The corresponding values related to the “marginal discoloration” criterion showed even less convincing dynamics, decreasing only 1.3 and 1.2 times, respectively. The number of restorations with cracks and the number of patients with cracked restorations remained virtually unchanged after the completion of orthodontic treatment compared to the previous examination. Moreover, despite a slight decrease in the number of restorations with chipping, there was an increase in the number of patients with such defects. The obtained results indicate certain shortcomings in the treatment approaches for orthodontic pathology and pathological tooth wear applied to the patients in this group.

Thus, according to the results of the study, all patients in Group I, who underwent comprehensive treatment using bracket systems and orthodontic implants for additional correction of the occlusal plane position and for generating a specific direction of tooth movement and pressure on the dental arches, achieved a Class I jaw relationship according to E. Angle, tight contact between adjacent teeth and antagonists, orthognathic overlap in the anterior region of the dental arches, normalization of the occlusal plane position, as well as complete restoration of sagittal incisal guidance and the Christensen phenomenon.

Table 2. *Lateral cephalometric indicators of the occlusal plane position relative to the Frankfurt horizontal (FH-OP) and the anterior cranial base (SN-OP) in patients of different groups.*

	Before treatment		**After treatment**	
	FH-OP	**SN-OP**	**FH-OP**	**SN-OP**
Group I, n=31	1.48±0.61˚	8.92±0.78˚	8.55±0.61˚	13.82±0.54˚
Group II, n=34	2.15±0.66˚	7.87±0.70˚	2.41±0.67˚	8.12±0.48˚

The positive outcomes of such comprehensive treatment were confirmed by the final lateral cephalometric data regarding the occlusal plane position relative to the Frankfurt horizontal (angle FH-OP) and the anterior cranial base (angle SN-OP). In particular, the FH-OP angle increased from an initial value of 1.48±0.61˚ to 8.55±0.61˚, which falls fully within the normal range, and the SN-OP angle increased from 8.92±0.78˚ to 13.82±0.54˚, which also corresponds to normal values. In both cases, the dynamics were statistically significant ($p<0.001$). In contrast, patients in Group II, who also underwent orthodontic treatment with bracket systems but without occlusal plane correction using micro-implants, did not achieve comparable positive results. According to the lateral cephalometric data, the FH-OP value, which was 2.15±0.66˚ at baseline, reached only 2.41±0.67˚ at the end of treatment. The SN-OP value changed from 7.87±0.70˚ to 8.12±0.48˚, and in both cases, the dynamics were statistically insignificant ($p>0.05$). Clearly, both final indicators differ significantly from the normal values ($p<0.001$), indicating that the treatment outcomes in Group II were substantially inferior to those of Group I. Only 6 patients (17.6%) in this group demonstrated restoration of sagittal incisal guidance and the appearance of the C. Christensen phenomenon, which was achieved through vertical repositioning of individual teeth during normalization of the sagittal Spee curve and closure of vertical disocclusion in the anterior region.

Particular attention should be paid to the dynamics of the number of defects in the condition of tooth restorations among patients treated with different approaches. A comparative analysis of the condition of restorations at baseline, at the 1-year follow-up, and after treatment completion in both groups revealed a certain dependence of the number of defects and deviations on the position of the occlusal plane, loss of sagittal incisal guidance, and absence of the Christensen phenomenon.

Although all restorations were in excellent condition immediately after placement, by the 1-year follow-up, a considerable number of complications had occurred across all clinical criteria in both groups, with a significantly higher incidence observed in Group II. A comparative analysis of the condition of dental restorations at the 1-year follow-up and after the completion of treatment in both patient groups demonstrated a clear correlation between the number of defects and deviations in the restorations and the position of the occlusal plane. At the 1-year mark, both groups exhibited a considerable number of complications according to each clinical criterion, though the number was significantly higher in Group II. Restorations with marginal adaptation defects and marginal discoloration at the interface with the nanohybrid composite material were 1.3 times more common in Group II than in Group I. The number of restorations with cracks in Group II was 1.9 times greater, and those with chipping were 1.5 times more frequent. Further analysis of the condition of restorations after orthodontic treatment showed that, in Group II, restorations with marginal adaptation defects and marginal discoloration were 5.4 and 4.3 times more frequent, respectively, than in Group I. Restorations with chipping of the restorative material were even 19 times more common in Group II. Notably, chipping of the nanohybrid composite was observed exclusively in restorations of patients from Group II. Thus, the normalization of the occlusal plane position, complete restoration of sagittal incisal guidance, and the C. Christensen phenomenon achieved in Group I patients can be considered as factors contributing to the preservation and long-term functional performance of indirect photocomposite restorations of pathologically worn teeth in individuals with orthodontic pathology.

Conclusion.

The results of the study confirm the effectiveness of the applied comprehensive treatment approaches in patients with orthodontic pathology and pathological tooth wear. This effectiveness is associated with the normalization of the occlusal plane position, restoration of the C. Christensen phenomenon, the advantages of using orthodontic micro-implants, and the application of indirect restorations to rehabilitate the affected teeth.

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