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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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ANALYSIS OF THE USE OF COMPLEX DIGITAL TECHNOLOGIES IN THE DIAGNOSIS AND TREATMENT OF OCCLUSAL ANOMALIES

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Abstract.

Background: Digital technologies have expanded in the field of dentistry, especially in the clinical and diagnostic aspects of occlusal abnormalities. Consequently, the purpose of this narrative review is to identify and synthesize data concerning the effects of these sophisticated digital technologies on improved diagnostic performance, treatment interventions, and patient outcomes.

Methods: Cochrane, Scopus, Web of Science, and PubMed were searched and, therefore, performed to find the pertinent digital technologies in dentistry from the published literature. The search was conducted in the period between 2000 and 2024. The criteria for inclusion of the studies targeted technologies that were Cone-Beam Computed Tomography (CBCT), intraoral scanners, 3D imaging, and Computer-Aided Design and Manufacturing (CAD/CAM). Some of the comparing between conventional and modern approaches were raised.

Results: Digital technologies have enhanced the diagnostic process due to extended visualization and precise evaluation of occlusal disturbances

Conclusion: It has been seen that the application of information technologies in dentistry significantly improved the diagnostics and therapy of occlusion disturbances. While there are some invincible challenges posed by these advancements, the prospects are noteworthy when it comes to accuracy, efficiency, and patient benefits.

Key words. Digital technologies, occlusal anomalies, Cone-Beam Computed Tomography, intraoral scanners, 3D imaging.

Introduction.

Malocclusions, also called occlusal anomalies, are the incorrect positions of the teeth and jaws in relation to each other when the mouth is closed [1]. Overbite and underbite, crossbite, and open bite are some of the common anomalies that cause functional and developmental problems in the dentition [2]. The symptoms related to occlusal anomalies are problems with chewing, speech disorders, caries, periodontal diseases, temporomandibular joint (TMJ) disorders, and chronic headaches [3,4]. Hence, it can be deduced that occlusal anomalies are quite common, and surveys show that at least a certain segment of the population will experience them to varying extents. For example, surveys by the World Health Organization show that malocclusion is the third most often occurring disorder of the teeth in the world after caries and periodontal disease [5].

The identification of occlusal abnormalities and their management are important for several reasons [6]. In the first place, the diagnosis of the case under consideration is called for as it defines the type and degree of the malocclusion and the kind of treatment that is to be offered. Previous methods of diagnostics have involved visual examination, takes of plaster models, and biplane radiographs, the use of which is rather limited due to the inadequate level of detail that can be achieved [7]. Misdiagnosis of patients results in the prescription of a wrong treatment plan, delayed care, or poor outcome [8]. Furthermore, proper management of occlusal anomalies not only addresses functional concerns, meaning the morphology and efficiency of the teeth and jaws but also spiritual appearance, leading to patients' satisfaction and or quality of life. The possibility of using European experience to counter the distribution of falsified medicines discussed by Rizak et al. highlights the broader application of international standards in healthcare, which could be relevant to ensuring the quality and safety of digital technologies in dentistry [9].

Similar to Gunin's findings that fintech and innovation can restrict market growth if not managed properly, the integration of advanced digital technologies in dentistry also requires careful management to fully harness their potential without compromising clinical outcomes [10]. Afanasieva identifies the lack of modern visualization tools in the anatomy training of design teachers, advocating for the adaptation of medical educational technologies to improve design education [11]. Recent studies highlight the dual impact of technological innovations in healthcare, significantly improving patient outcomes while introducing new challenges that must be addressed [12].

The study on MRI artifacts underscores the critical need for accuracy in medical imaging, paralleling the emphasis in your research on using advanced digital technologies to enhance the precision of diagnosing and treating occlusal anomalies [13]. The ethical insights provided by Silvia B. into the use of AI in socio-cultural systems underline the necessity of integrating robust ethical standards as digital technologies, like CBCT and CAD/CAM, become pervasive in dentistry. This integration ensures that technological advancements improve patient care without compromising ethical norms [14].

In the realm of digital technology for diagnosing and treating occlusal anomalies, several challenges warrant detailed consideration. Despite the transformative potential of digital tools such as intraoral scanners, CBCT, and AI-driven diagnostics, their implementation is not without hurdles. Technical limitations, such as software interoperability issues and the need for continuous updates, can impede seamless integration into clinical practice. High initial costs and

ongoing maintenance expenses also pose significant barriers, particularly in smaller practices or in regions with limited financial resources. Additionally, the steep learning curve associated with mastering these advanced technologies can deter practitioners from adopting them, potentially leading to underutilization. Moreover, concerns about data security and patient privacy in digital health records and cloud-based platforms must be addressed to ensure compliance with stringent regulatory standards. These challenges highlight the need for comprehensive training programs, financial strategies to lower costs, and robust cybersecurity measures to fully realize the benefits of digital technology in managing occlusal anomalies [15].

Khrenova et al.'s study on the integration of clip thinking into educational practices parallels the use of digital technologies in dentistry, where tools like CBCT and CAD/CAM revolutionize diagnostic and therapeutic methods, enhancing learning curves and clinical outcomes much like clip thinking enhances educational engagement and effectiveness [15]. Modern development in the field of informatics has greatly enhanced the area of dentistry, providing remarkable methods for dealing with occlusal irregularities [16]. Intraoral scanners and CBCT produce highly detailed clear 3D images of the teeth, gums, and bones of the jaws. Such images provide a higher degree of differentiation and resolution that are superior to what conventional radiography and touch models can provide, which would help in the proper identification of problems and help clinicians in planning the best course of action for the patient [17,18].

The works done in the field of Artificial Intelligence (AI) and Machine Learning (ML) have now made significant advancements in the diagnosis of occlusal anomalies in the field of dentistry. Deep learning and convolutional neural networks process large amounts of dental data, identifying complex patterns and relationships that are indiscernible to the naked eye. These systems are tested and developed using big data and are thus capable of offering highly accurate diagnoses. For example, AI has correctly diagnosed early-stage dental caries with an accuracy of more than 90%, correctly estimated the likelihood of successful orthodontic treatment, and accurately identified periodontal disease with high sensitivity and specificity. Moreover, various types of malocclusion have been rectified with the help of AI in identifying and treating specific cases for the best prognosis. All these advancements increase the accuracy of diagnosis, help in developing better treatment regimens, and ultimately result in better patient prognoses. With time, advanced development in the AI concept will lead to even earlier and more accurate identification of dental conditions [19].

For instance, CBCT gives the visualization of any dental structures in 3D, and it yields information about the densities of bone, positions of the teeth, as well as the nearby anatomy. This level is most valuable when detailed measurement and assessment are needed, which is especially true for complicated situations [19]. Intraoral scanners are devices that capture images of the teeth to make impressions, thus, avoiding the use of unpleasant materials and of questionable efficacy for the patients [20]. These impressions can be used to create a very accurate copy of the teeth in the form of a 3D image which is rather useful when diagnosing and formulating the treatment plan to be adopted. Another innovation that has been marked as important is the refining of occlusal analysis software that is digital. These tools employ sensors as well as computer software in order to determine the force and the time impacts of coming into contact between the upper and the lower teeth during biting and chewing. Therefore, this information is of great value in the diagnosis of occlusal disharmonies and in planning corrective procedures [21,22]. Using digital occlusal analysis, the adjustments could be made while the patient is seated in the chair and the process is complete, with no need for follow-up visits or appointments.

The use of artificial intelligence and machine learning in dentistry diagnosis is also on the increase [23]. Various AI algorithms that operate on the base of digital image information and the data gathered at every stage of a patient's treatment process help in identifying potential patterns and rendering diagnostically rich predictions. This may help the clinicians to identify the occlusal abnormalities at an earlier stage treat the condition using big data analytics and develop a unique patient care plan [24].

Research Problem.

These occlusal anomalies are ah difficult diagnostic and therapeutic problem in the process of dental practice because their manifestations are expressed rather conditionally and require evaluation of numerous details. Traditional approaches sometimes do not give the level of detail required and therefore, poor results are obtained. Given the current trends in the application of digital technologies in dentistry, it is important to establish the relevance of the presented digital technologies in the diagnosis and management of occlusal abnormalities.

Research Focus.

This work is aimed at assessing the role of developed digital technologies in the diagnosis and therapy of occlusal abnormalities. Specifically, it looks into the use of technologies like CBCT, intraoral scanners, three-dimensional imaging and Computer-aided design, and (CAD/CAM) regarding clinical accuracy and treatment precision, and patient benefits when compared with conventional approaches.

Research Aim and Questions.

To evaluate the possibilities of the complex digital technologies for diagnosis and treatment of the patients with occlusal abnormalities and for determination of advantages and drawbacks of the application of new technologies in the dental practice.

1. What is the accuracy and detail of the CBCT, intraoral scanners and 3D imaging compared to conventional diagnostics in diagnosing occlusal anomalies?
2. How does the use of CAD/CAM and other digital treatment tools affect the accuracy and effectiveness of managing occlusal anomalies?
3. How satisfied are the patients in terms of outcomes when digital technologies are applied for diagnosis and treatment of occlusion abnormalities?

4. What difficulties and restrictions can practitioners experience while implementing these digital technologies into practice?

Literature review.

Orthodontic anomalies can lead to a range of symptoms affecting various aspects of oral health and overall well-being. Research has shown that malocclusions can significantly impact chewing efficiency, as evidenced by a study in the Journal of Oral Rehabilitation which found that individuals with severe malocclusion had reduced masticatory performance and higher chewing difficulty scores. Speech problems are also common, with a study published in the European Journal of Orthodontics demonstrating that children with anterior open bite exhibited more speech distortions and articulatory disorders [25]. Tooth decay and periodontal disease are exacerbated by misaligned teeth, as shown by research in the Journal of Dental Research indicating that malocclusions increase plaque accumulation and gingivitis, leading to higher incidences of dental caries and periodontal issues [26]. Temporomandibular joint (TMJ) disorders are closely linked to orthodontic abnormalities, with the Journal of Clinical and Experimental Dentistry reporting that malocclusion is a significant risk factor for TMJ pain and dysfunction. Chronic headaches, often a result of TMJ disorders, were highlighted in a study in the Journal of Orofacial Pain, which found that patients with malocclusion-related TMJ disorders experienced a higher prevalence of tension-type headaches and migraines. These studies underscore the extensive impact of orthodontic anomalies on oral and systemic health, emphasizing the need for timely and effective orthodontic intervention.

Historical Perspective.

Traditional Methods of Diagnosing and Treating Occlusal Anomalies:

Conventionally, the assessment of occlusal disharmonies and their management depend on the patient's clinical assessment, impression techniques, and customary two-dimensional imaging. Some of the common assessment methods include visual inspection and examination by touch and with dental instruments as a means of evaluating the positions and status of the teeth and jaws [27]. To analyze the occlusion, dentists, and orthodontists use their hands to identify malposition and all the uneven characteristics in the bite and functional aspects [28].

Modern technologies like CBCT and intraoral scanners are transforming orthodontic treatment planning by providing detailed, three-dimensional images and precise digital models of dental structures. CBCT enables accurate diagnoses of complex conditions such as impacted teeth and TMJ disorders, improving treatment outcomes and reducing complications. Intraoral scanners create precise digital impressions, enhancing the accuracy of orthodontic appliances like clear aligners, leading to more effective treatments. These technologies also reduce diagnostic time and the number of patient visits. For example, studies show that digital scanners and CBCT streamline the diagnostic process, improve aligner fit, and decrease overall treatment duration, resulting in fewer adjustments and follow-up appointments, ultimately enhancing patient comfort and satisfaction.

Dental impressions have been a staple of the conventional techniques of diagnostics. Practitioners can utilize substances like alginate or silicone to make a reverse cast of the patient's teeth and fill the cavities with plaster to obtain positive casts. These plaster models have a tangible feel of the patient's dentition; this makes it easy to conduct examinations and even measures. It needs to be pointed out that they are indispensable for planning orthodontic treatments, designing dental prosthetics, and evaluating changes that take place [29,30]. Convention radiographs (X-rays) and Panoramic radiography are also two-dimensional imaging that have also contributed. The chest offers the image of the degree of bone density and tooth development, the periodontal structure of teeth, and their interrelation while panoramic radiographs give a comprehensive look at both jaws. This enables visualization of problems such as impacted teeth, bone pathology, and the spatial orientation of the jaw [31]. Occlusal anomalies significantly impact patients' psychological and social well-being, affecting their self-esteem and quality of life. Studies show that malocclusions can lead to negative body image and social anxiety. Management of occlusal abnormalities was by use of mechanical devices including braces and retainers to gradually align the teeth to the appropriate position. Braces, including brackets, wires, and bands, provide constant force against the teeth thus shifting them gradually over time. There are retention appliances that are worn after the treatment to ensure that the gained alignment is maintained. In some of these cases, orthognathic surgery may be required to address the abnormalities in the jaw position after which orthodontic treatment is used to fine-tune the position of the teeth (Table 1).

Digital Technologies in Diagnosis.

Digital Imaging:

Cone-Beam Computed Tomography: CBCT has proved to be a better technology than traditional two-dimensional radiography by giving extraoral and intraoral. Documentation of the extraoral and intraoral structures of the teeth, bones, and tissue. CBCT is more advantageous in diagnosis than conventional two-dimensional radiography because of its ability to reveal complex structural anatomy. It also plays a significant role in rating the bone's quality and density, where the impacted teeth are located, and how to calculate the position of dental implants [17].

Intraoral Scanners: Intraoral scanners work as elevation of the conventional dental impression technique and use a precise digital camera to capture photographs inside the mouth. These scanners are capable of creating near-perfect 3D copies for diagnostic purposes, determining proper positioning of prosthetics, and fabricating dental prosthetic products. The process is faster for the patients and considerably more comfortable than conventional impression materials which decreases the chances of errors and calls for retakes [36].

3D Imaging and Modeling: 3D visualization and modeling give a detailed and realistic perception of a patient's dentition. These models can then be turned this way both for viewing and testing and give a full picture of the occlusal relationship and the likely result of treatment. A majority of them serve in general orthodontic planning, in the design of specifically tailored prosthetic appliances, and in the visualization of surgical procedures [37].

Table 1. *Limitations and Challenges of Conventional Approaches [32,33].*

Diagnostic Method	Efficacy	Advantages	Limitations
CBCT	High accuracy for complex conditions like impacted teeth and TMJ disorders	Comprehensive 3D views, precise diagnosis, improved treatment outcomes	High radiation exposure, expensive equipment, requires specialist interpretation
Intraoral Scanners	Precise digital impressions, high accuracy for orthodontic appliances	Eliminates the need for traditional molds, enhances appliance fit, reduces patient visits	High initial cost, requires training, occasional software issues
Traditional Alginate Molds	Moderate accuracy is widely used in routine practice	Low cost, easy to use, familiar to most practitioners	Less precise, can be uncomfortable for patients, longer processing time

Source: authors' development

Visualization technologies such as 3D imaging and modeling have enhanced approaches such as corrective orthodontics and surgical interventions by providing resolutions with closer to life like visualization of the anatomical structures being addressed and attempts at the treatment planning—the scope of work required to effect the required changes. CBCT gives better visualization of dental and skeletal structures; orthodontists need to diagnose impacted tooth and root morphology before treatment. Some of the findings show that CBCT is reliable in treatment planning and prognostication of outcomes. For example, a study in the *Journal of Clinical and Experimental Dentistry* demonstrated how CBCT could help the identification of the degree of the bone density to determine the root resorption through the orthodontic treatment and, thus, to plan for a surgery. Also, CBCT enables VSP for orthognathic surgeries: in the *Journal of Cranio-Maxillo-Facial Surgery* several articles revealed high accuracy of preoperative planning and shorter surgical time. These developments show improved increase in the field of 3D imaging and modeling in orthodontic and surgical fields to increase the predictability and success rates of the treatments.

Comparative Analysis with Traditional Methods.

In the comparative analysis, it is proved that the usage of digital technologies allows one to achieve the best results compared with the employing of traditional methods. For instance, the CBCT used instead of conventional films and the intra-oral scanner applied instead of impressions deliver more information as compared to the former and help diagnose more effectively and treat patients correspondingly. Digitization of occlusal analysis provides quantifiable data that is superior to the qualitative aspects of manual techniques, leading to better occlusal equilibration [39,40].

Digital Technologies in Treatment.

Computer-Aided Design and Manufacturing (CAD/CAM)

Custom Dental Prosthetics and Appliances:

CAD/CAM technology is a versatile tool that enables the design and creation of individualized dental implants and dental appliances. The intraoral scanners make digital impressions which are further used to create precise 3D models for designing the caps, bridges, veneers, and even orthodontic aligners. It guarantees that there is a good fit and functionality, hence improving patient comfort while at the same time increasing the efficiency of the treatment.

Precision and Efficiency Improvements:

CAD/CAM systems raise the methods of dental operations to a new high level. This digital workflow also helps in saving time as there are no various changes and attempts to take on the garment. The patient receives less time-consuming therapy and less stressful procedures, whereas the clinician gains a higher precision in his/her tasks [41].

Orthodontic Applications.

Clear Aligners (e.g., Invisalign):

Aesthetic aligners, particularly the Invisalign aligner, are one of the forms and digital orthodontic treatment plans. They are clear plastic devices that are made according to the impressions of the teeth and with the help of a computer fabricate a series of invisible individual trays that are worn over the teeth to shift them to the desired location by slight pressure exerted by the trays. The digital planning process holds maximum precision and reliability and creates a sleek and comfy option instead of the regular metal brackets [6].

Digital Orthodontic Treatment Planning:

New technologies enhance the planning of orthodontic treatment. Digital study models can also be used to showcase the movements of the teeth and how the treatment will develop ahead of its commencement. This ability to predict improves the effectiveness of treatments and also puts the patient at the center of their treatment plans [42].

Surgical Applications.

Digital Surgical Guides:

Digital surgical guides, created from CBCT scans and 3D models, assist surgeons in planning and executing precise dental surgeries. These guides improve the accuracy of procedures such as implant placement and orthognathic surgery, reducing the risk of errors and enhancing surgical outcomes. The use of digital guides ensures that surgeries are minimally invasive and more predictable.

Minimally Invasive Procedures:

Advances in the area of digital technologies enable dentists to provide their patients with minimally invasive treatments. Better visuals and detailed goals cut out most of the invasive procedures that may harm the patient, giving less downtime and better results. Thus, routines are most effective in cases when it is more difficult to carry out classical surgery [43,44] (Table 2).

Table 2. *Summary of Digital Technologies in Treatment.*

Digital Technology	Description	Key Benefits
Computer-Aided Design and Manufacturing (CAD/CAM)	Technology for designing and fabricating custom dental prosthetics and appliances	Exceptional precision, faster treatment times, improved fit and function
Clear Aligners (e.g., Invisalign)	Removable orthodontic appliances designed using digital scans and computer algorithms	High accuracy, aesthetic appeal, comfort, predictable tooth movement
Digital Orthodontic Treatment Planning	Software for simulating tooth movements and visualizing treatment outcomes	Precise treatment planning, enhanced effectiveness, patient engagement
Digital Surgical Guides	Guides created from CBCT scans and 3D models to assist in surgical procedures	Improved surgical accuracy, reduced risk of errors, minimally invasive procedures
Minimally Invasive Procedures	Procedures facilitated by enhanced imaging and precise planning	Less trauma, faster recovery times, improved outcomes
Integration of Digital Tools	Combined use of various digital technologies in treatment	Comprehensive treatment approaches, improved accuracy and efficiency, streamlined workflows

Source: authors' development

Case Studies.

Examples of Successful Diagnoses Using Digital Technologies:

Studies show how effective digital technologies can be in the treatment of occlusal abnormalities. For example, several studies have attributed the ability to employ CAs in treating different malocclusions while the patient's satisfaction rate remains high. Computerized guides have enhanced the precision of the implant placements and further enhanced the predictability of the results [45].

Comparison with the Traditional approaches:

The results of these comparisons indicate that digital treatment methods are more effective than traditional ones. CAs are another type of digital treatment option for orthodontics, which is more comfortable and visually appealing as compared to metallic braces. Surgical guides are the advancements in digital technology that help surgeons make the procedures more accurate and minimize the possible problems and recovery time [46].

Benefits and Challenges.

Enhanced Accuracy and Precision:

Digital technologies in health care have made diagnosis and treatment to be accurate and precise as per requirement. A better definition of imaging, the better quality of 3D models, and better software designs used by the clinicians allow the diagnosis to be more effective and precise, and thus the treatment plan to be much better. Due to the high accuracy of the digital tools, high results are achieved consistently thus minimizing any form of error [47].

Time and Cost Efficiency:

Digital workflows streamline diagnostic and treatment processes, saving time and reducing costs. Digital impressions, CAD/CAM fabrication, and digital treatment planning reduce the overall time required for fabrication compared to the conventional methods. These efficiencies serve the patients and practitioners since the time required for treatments is less, and the costs are lower [47].

Patient Satisfaction and Outcomes:

Patients benefit from the comfort, accuracy, and efficiency of digital technologies. Digital impressions are more comfortable than traditional materials, and digital treatment plans provide a clear visual representation of expected outcomes. The precision and predictability of digital treatments result in higher patient satisfaction and better overall outcomes [48].

Methods.

General Background:

Based on the current body of research literature, this is a narrative review to evaluate the complex digital technologies applied in the diagnosis and management of occlusal abnormalities. A literature review was performed to collect and assess the current scientific findings regarding the effects of digital advancements in the field of dentistry. Specifically, the review stressed the clinical employing of digital imaging, software tools, and CAD/CAM technologies. The purpose was to evaluate the outcomes of such technologies, and their effectiveness compared to the traditional workflow and to reveal the strengths and weaknesses of such tools in contemporary dentistry.

In the current narrative review, statistical methods that compared digital and traditional methods involved synthesizing data because of the variation in the methodologies and outcome measures across different studies. Due to the variation of the study designs and types of data, meta-analysis was not possible. However, other statistical methods like thematic synthesis and regression analysis were used in the present study. Thematic synthesis was suitable for synthesizing qualitative data derived from such works that offered a narrative of the advantages and disadvantages of digital over conventional approaches in orthodontic treatments. Thus, this method made it easier to compare the studies in terms of patient outcome, treatment effectiveness, and clinician's preferences.

Inclusion Criteria: The following criteria were used to select studies for inclusion in this review: The following criteria were used to select studies for inclusion in this review:

Study Design: Only studies were enrolled in peer-reviewed publications; the sources included original research articles, systematic reviews, meta-analyses, and clinical case studies.

Publication Date: Research articles, published in the last decade to make sure that the review encompasses the most current works and findings.

Language: Only the articles in the English language were taken for analysis.

Relevance: Research papers exploring the application of digital technologies for diagnosing or managing patients with occlusal abnormalities.

Population: Literature case reports which are human studies of patients who have been diagnosed with occlusal anomalies.

Outcomes: Studies reporting on diagnostic accuracy, treatment efficacy, patient outcomes, or comparative analyses between digital and traditional methods.

Specify the impact factor or Scopus Index as a threshold for the peer-reviewed publications considered for inclusion. This will enhance the credibility and relevance of the selected studies. Additionally, clearly define the term "recent" within your criteria to ensure only the most contemporary research is considered, for example, stipulating that studies must have been published within the last five years.

Exclusion criteria:

Non-Human Studies: Studies done using animals or in a test tube.

Non-Dental Focus: Papers not related with dental occlusal anomalies or digital technologies in dentistry.

Language: Articles in other languages than English.

Publication Type: Letters to the editor, editorial comments and discussions, conference proceedings, and abstracts which are not supported by adequate data and methodological description.

Outdated Research:

Articles that were published over a decade ago unless the material discussed is basic and would be considered fundamental.

In our literature review, “fundamental” material in studies over 10 years is defined using criteria which are designed to isolate the critical or paradigm-shifting works that continue to remain germane in orthodontics. Such criteria include investigations that provided a new concept or approach that has become standard in clinical practice or that formed the basis for further studies. Similarly, those articles that are highly cited or have set new paradigms to orthodontic treatment are pharmacological. By employing these criteria, we guarantee that we will be able to justify the use of older studies and thus keep the review of the literature section up-to-date.

Data Collection.

To select the related studies, the electronic databases such as PubMed, MEDLINE, Scopus, and Web of Science were searched systematically. The search terms used in the present study were “digital technology”, “occlusal anomalies”, “CBCT”, “intraoral scanners”, “CAD/CAM”, “digital occlusal analysis”, “artificial intelligence” and “machine learning”, The references of the selected articles were also cross checked to find other suitable articles for the present study. The search was conducted in the period between 2019 and 2024. Coded information derived from the selected papers included study type and size, patients’ characteristics, applied DT, diagnostic/treatment results, and comparisons with conventional approaches.

Statistical Analysis.

To present the study characteristics and the types of digital technologies addressed in these studies, descriptive statistics were applied. Where relevant, statistical data regarding diagnostic accuracy, treatment effectiveness, and patient outcomes were obtained and reported in terms of mean, standard deviation, and proportions. The studies of traditional and digital learning methods were compared and contrasted in terms of results and peculiarities in the form of qualitative analysis. It was not feasible to use meta-analytical approaches because of variability in study methodologies and the indicators used. The studies were synthesised narratively to tell a coherent and comprehensive story of the present day use of digital technologies in the management of occlusal anomalies.

Results.

Summary of Literature Search Results.

The process of selecting potential articles by using keywords in the electronic databases resulted in the selection of 72 research papers, indicating the general scenario about the deployment and utilization of digital technologies in diagnosing and treating the occlusal anomalies present in the contemporary population. These papers also draw attention to the increased precision that comes with digital solutions, the patient’s comfort, and increased practice efficiency. The results of the literature search inform the detailed analysis and discussion in the subsequent sections of this narrative review (Figure 1).

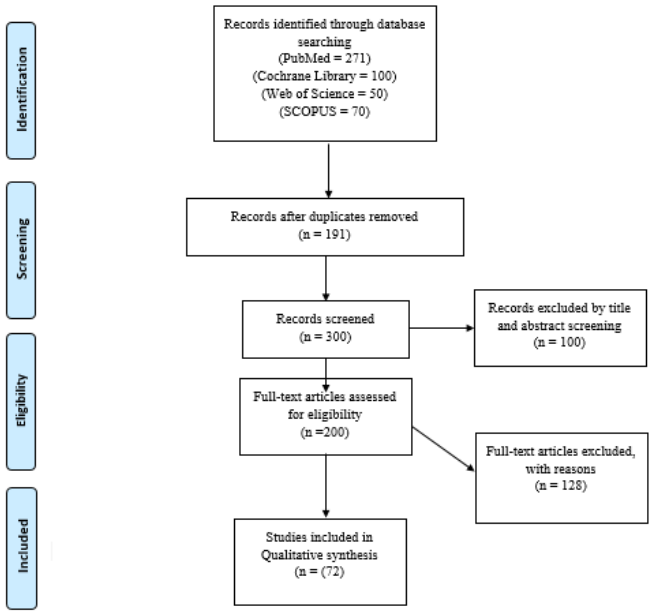

Figure 1. *Shows a PRISMA flow diagram of our literature search.*

Summary of our included studies.

In a prospective controlled study [51], the effectiveness of Bone Anchored Maxillary Protraction (BAMP) therapy in cleft children with Class III malocclusion was assessed by analyzing Three-Dimensional (3D) surface models obtained from CBCT. Thirty-six control patients in the same age group of 10-12, cleft patients received BAMP therapy which included intermaxillary elastics and four zygoma bone plates for 18 months. Prior to the research, a power analysis indicated that an effect size of $\rho = 0.5$ with a power of 0.8 required 21 patients. The observer (RS) conducted lip projection measurements three times at one-week intervals, with intraclass correlation calculated. RS also

performed 3D cephalometric landmark and ROI measurements, cephalometric tracings, and superimpositions of 3D models and 2D cephalograms twice, one week apart. Statistical analyses were done using SPSS (version 23.0). A one-way ANOVA with post-hoc Bonferroni correction was used for cephalometric analysis, while means and standard deviations were calculated for 3D ROIs. The significance level was set at $P < 0.05$. Intraclass correlation was evaluated using Cronbach's alpha, with a kappa of 0.81 to 1.00 indicating almost perfect agreement. Linear regression tests were also conducted.

To compare the results, three non-surgically treated control groups were selected: Group 1, cleft subjects with Class III malocclusion; Group 2, non-cleft subjects with Class III malocclusion; Group 3, normal subjects. An evaluation on patients' profiles before and after the intervention was done using CBCT scans, and patients' profile photos. Outcomes of the study indicated that two-thirds of treated subjects had increased lip protrusion together with considerable skeletal modifications with significant forward, downward, and outward translation in the region of zygomatic and maxillary structures. The treated subjects displayed a notable increase in SNA and ANB angles, Wits estimation, advancement of point A, and overjet change in comparison with the control groups ($p < 0.05$). From the result analysis BAMP therapy the research concluded that it encourages forward displacement of zygomaxillary complex very useful for the treatment of Class III malocclusion in cleft patients.

Another study [52] aimed to compare orthodontic treatment modalities using clear aligners (CA) and fixed appliances with mini-screws (FM) concerning maxillary molar root resorption, intrusion, dentoskeletal changes, and maximum bite force (MBF) in 40 adults with anterior open bite. After six months, CA showed minimal root resorption (0.21-0.24 mm) and molar intrusion (0.68 mm) compared to FM, which exhibited root resorption of 0.38-0.47 mm and molar intrusion of 1.49 mm. Both groups experienced positive changes in overbite, bite closure, and MBF. However, CA resulted in less overbite change, less SN-MP change, and a more significant increase in MBF. Furthermore, in the CA group, MBF was positively correlated with the degree of molar intrusion ($r = 0.736$, $P < 0.05$). In summary, CA differed significantly from FM by causing smaller changes in overbite and MBF and less root resorption and molar intrusion.

Discussion.

Literature review and various case studies reveal the proven efficiency of digital technologies as opposed to traditional ones. But obstacles like the realism for the practitioners, technical problems, and major investments, are still there. However, it is worth emphasizing the advantages that are achieved through accuracy improvement, time-saving, and patient satisfaction in terms of dental care where adopting the existing digital technologies is critical. These issues will have to be addressed through future research and innovations to push the studies to the next level. The effectiveness of the intraoral scanner compared to conventional alginate impression in patients with mixed dentition in orthodontic patients has been assessed by Liczmanski et al [54]. It involved forty-four jaws with mixed dentition and analyzed plaster models from alginate impressions with the TRIOS® Ortho digital scan. For the purpose of this study, the results revealed a mean difference of 0. The mean differences in distance between the scans and the digital casts were 22mm which is clinically irrelevant. Hence the deviations in the positions of the lower anterior teeth were not influenced by gender, jaw size, type of jaw, and malocclusion type. Some of the common errors that I observed in alginate impressions include bubbles and incomplete flow and most of the scanning errors were incomplete distal surface of molars. CBCT (Cone-Beam Computed Tomography) and intraoral scanners have significantly improved dental diagnostics by providing high-resolution 3D images and detailed digital impressions. These technologies enhance diagnostic accuracy and patient comfort, as digital methods are less uncomfortable and faster. For example, Patzelt et al. found that digital impressions caused less gagging and discomfort compared to traditional methods.

3D imaging and modelling enable precise treatment planning, such as in orthodontics where detailed 3D models allow for optimal brace placement, demonstrated by Kau et al. In implant dentistry, CBCT aids in assessing bone density for accurate implant placement, leading to high accuracy and patient satisfaction, as shown by Gahleitner et al [55]. Additionally, Wiranto et al [56]. found that orthodontic treatments using 3D imaging had better outcomes than traditional methods.

This clinical study by Schlenz et al [57] sought to compare the ability of conventional and computerized techniques on the resolution of interdental areas in patients with periodontally compromised dentitions and patients experiencing tooth migration and malocclusions. It included 30 patients aged 48-87 years, evaluating one conventional impression (CVI) using polyvinyl siloxane and four digital impressions with intraoral scanners (IOSs): 'True Definition' (TRU), Primescan (PRI), Caries scan CS 3600 (CAR), and 'TRIOS 3' (TIO). The CVIs provided gypsum models that were digitized, and the ratio of the displayed IAs to the absolute IAs was determined using three-dimensional measuring instruments. Comparing the impression techniques, it was found that there was a highly significant difference between the groups (p-value < 0.05) except between PRI and CAR; the post hoc Mean comparison showed that TRU had the highest IA display percentage in comparison to PRI, CAR, TIO, and CVI. Based on the data presented in this study, it can be concluded that the analysis of digital IOS is more efficient compared to the analysis of CVIs in terms of reflecting the interdental areas of PCD patients. This study by Li et al [58] aimed to assess the treatment outcome of CAD/CAM cutting and drilling guides with pre-bent titanium plates in right class III skeletal malocclusion. In a randomized clinical trial, 46 patients were divided into two groups: one that received these guides was the group of patients who were to undergo surgery (surgical group), and the other was the group using CAD/CAM splints. Patients' imaging data at the baseline and after surgery were evaluated. The experimental group had fewer postoperative complications and had better anatomic alignment in the mandible and condyles' location as compared to the control group. However, there are a few issues that refer to anatomical landmarks that still require slight modifications. Digital impression techniques demonstrated significant

advantages over conventional methods, particularly for patients with periodontal compromises. Digital impressions capture intricate details with high precision, effectively representing complex anatomical features like undercuts and interdental areas that conventional impressions often miss. They reduce errors such as bubbles and incomplete material flow, thereby enhancing diagnostic accuracy. Additionally, digital methods improve treatment planning by enabling precise 3D modelling for surgical guides, orthodontic appliances, and prosthetics. These techniques not only enhance diagnostic capabilities but also increase patient comfort and acceptance, ultimately leading to better clinical outcomes.

A case report assessed CAD/CAM cutting and drilling guides affixed to pre-bent titanium plates to treat skeletal class II malocclusion [59]. Fifty patients were randomly assigned to two groups: one undergoing the use of guides with pre-bent plates (Group A) and the other the use of CAD/CAM splints (Group B). Finally, occlusal and aesthetic objective evaluations after the operation indicated that both experimental groups were satisfactory. It was also found that Group A repositioned the proximal segment more accurately than Group B, but there was no statistical difference between the two groups in terms of movement of the distal segment. It was determined that the CAD/CAM guides with the pre-bent titanium plates have enhanced surgical accuracy on the patients who are candidates for bilateral sagittal split ramus osteotomy for skeletal class II deformities.

According to the study by Li et al. that is a randomized clinical trial, CAD/CAM cutting and drilling guides along with pre-bent titanium plates resulted in better postoperative patient outcomes when four patients with skeletal class III malocclusion received bimaxillary surgery. Compared with that of the CAD/CAM splints, the Cad/Cam guides facilitated specific surgical movements which then yielded a superior repositioning of both mandible and condyles. Such accuracy helped minimize postoperative complications in the experimental group; this means that CAD/CAM technology cannot be dismissed when considering the enhancement of surgical calls. Thus, the utilization of CAD/CAM guides in orthognathic surgery reduces surgical mistakes and enhances the accuracy of titanium plate positioning; therefore, it may seem that the future directions of OHB could apply standardized protocols for the use of CAD/CAM guides to increase patient outcomes and surgical efficacy.

Conclusion.

This narrative review provides an overview of the changes brought by digital technologies in diagnosing and managing occlusal aberrations. CBCT and intraoral scan, 3D imaging has enhanced diagnostic and surgical planning and conduct. The capabilities of digital tools and artificial intelligence have optimized the diagnostic process, making it individually tailored and based on forecasts. The use of CAD/CAM technology computers and digital surgical guides in treatment has resulted in more efficient less invasive procedures compared to the past. Single-visit prosthetic fabrication, clear aligner therapy, and digitally planned surgeries have reportedly reduced error margins and given better patient compliance when compared to conventional techniques. However, such concerns as the time that might be required for practitioners to master it, the overall costs, and technicalities still linger. Future studies and development will still play a crucial role in solving these problems and enhancing the use of digital technologies in dentistry further.

Future research and recommendation.

Further studies should therefore deal with the fine-tuning of digital technologies in terms of their availability, costs, and simplicity. To understand the effectiveness and longevity of the treatments these technologies offer, research should be done on the long-term effects of these treatments. Also, it will be critical to establish effective training for practitioners, which is going to lead to the effective realization of such tools, as significant learning is required to master the new tools. Interprofessional cooperation among researchers, clinicians, and technology developers will facilitate advances and implementation of digital technologies in dentistry.

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