MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
SUMY STATE UNIVERSITY
ACADEMIC AND RESEARCH MEDICAL INSTITUTE

Eastern Ukrainian Medical Journal

116, Kharkivska st., Sumy 40007, Ukraine eumj.med.sumdu.edu.ua
e-mail: eumj@med.sumdu.edu.ua ISSN: 2663-5909 (print)/2664-4231 (online)

How to cite: Palii T, Tsyhanok O. The "chairside" concept in the treatment of orthopedic dental pathology (literature review). *East Ukr Med J*. 2025;13(2):397-406

DOI: https://doi.org/10.21272/eumj.2025;13(2):397-406

ABSTRACT

Taras Palii
https://orcid.org/0009-0005-7108-1949
Department of Dentistry, Academic and Research Medical Institute, Sumy State University, Sumy, Ukraine

Olexandr Tsyhanok
https://orcid.org/0000-0002-5442-1922
Department of Dentistry, Academic and Research Medical Institute, Sumy State University, Sumy, Ukraine

THE "CHAIRSIDE" CONCEPT IN THE TREATMENT OF ORTHOPEDIC DENTAL PATHOLOGY (LITERATURE REVIEW)

Introduction. Today, digital dentistry is represented by a wide range of equipment, techniques, concepts, and services that have emerged as a result of the introduction of modern technologies into dental practice. This also refers to the "chairside" concept. The aim of this study was to search for and analyse relevant data on the use of the "chairside" concept for the treatment of orthopedic dental pathology.

Methods. The literature review was conducted using PubMed, Web of Science, SCOPUS, and Google Scholar until 1 October 2024. There were no restrictions on the date of publication or language of scientific sources. Searches were conducted using the MeSH (Medical Subject Headings) terms using the following search terms: "chairside concept", "chairside dentistry", "digital dentistry", "additive manufacturing". Methods used: bibliographic and analytical.

Results and discussion. The concept of "chairside" within the framework of prosthetic dentistry is the process of restoring lost hard tooth tissue by placing structures made directly in the clinic near the patient. This is possible due to the use of an intraoral scanner, modelling software and equipment for manufacturing of future restoration. All procedures are performed in 1 session. In addition, the advantages include: the possibility of making modifications to the future restoration at different stages of the workflow; the survival rate of such restorations is approximately 90%; finished restorations are not inferior in accuracy to laboratory restorations and fully meet clinical requirements. However, the concept has a few disadvantages, including the need for specific equipment, limitations in the number of restorations that can be made in 1 session, and the types of orthopedic structures.

Conclusion. The "chairside" concept is a progressive approach to the treatment of orthopedic pathologies, which makes the prosthesis

possible in 1 day. However, this concept is still lacking in its drawbacks. The “chairside” concept requires further study and improvement.

Keywords: chairside concept, chairside dentistry, digital dentistry, additive manufacturing.

Corresponding author: *Taras Palii, Department of Dentistry, Academic and Research Medical Institute, Sumy State University, Sumy, Ukraine, e mail: t.palij@med.sumdu.edu.ua*

РЕЗЮМЕ

Тарас Палій
https://orcid.org/0009-0005-7108-1949
Кафедра стоматології, Навчально-науковий медичний інститут, Сумський державний університет, Суми, Україна

Олександр Циганок
https://orcid.org/0000-0002-5442-1922
Кафедра стоматології, Навчально-науковий медичний інститут, Сумський державний університет, Суми, Україна

ВИКОРИСТАННЯ КОНЦЕПЦІЇ «CHAIRSIDE» В ЛІКУВАННІ ОРТОПЕДИЧНОЇ СТОМАТОЛОГІЧНОЇ ПАТОЛОГІЇ (ОГЛЯД ЛІТЕРАТУРИ)

Вступ. На сьогоднішній день цифрова стоматологія представлена широким асортиментом обладнання, методик, концептів та послуг, які з’явились саме завдяки введенню сучасних технологій у стоматологічну практику. Це стосується і концепції «chairside». Метою даної роботи був пошук та аналіз актуальних даних щодо використання концепції «chairside» для лікуванні ортопедичної стоматологічної патології.

Методи. Огляд літератури проводився за допомогою PubMed, Web of Science, SCOPUS, Google Scholar до 1 жовтня 2024 року. Не було обмежень щодо дати публікації чи мови наукових джерел. Пошуки проводилися за термінами MeSH (Medical Subject Headings) з використанням таких пошукових термінів: "chairside concept", "chairside dentistry", "digital dentistry", "additive manufacturing". Використані методи: бібліографічний та аналітичний.

Результати та їх обговорення. Концепція «chairside» в межах ортопедичної стоматології представляє собою процес відновлення втрачених твердих тканин зубів шляхом встановлення конструкцій, що виготовлені безпосередньо в клініці, біля пацієнта. Це можливо завдяки використанню інтраорального сканеру, програмного забезпечення для моделювання реставрацій та апарату для виготовлення віртуального моделі реставрації. Всі процедури відбуваються за 1 сеанс. Окрім цього, до переваг можна віднести: можливість вносити модифікації в майбутню реставрацію на різних стадіях робочого процесу; виживаність таких реставрації складає приблизно 90%; готові реставрації не поступаються в точності лабораторним та повністю задовольняють клінічні вимоги. Однак, концепція має ряд недоліків, серед яких потреба в наявності специфічного обладнання, обмеження в кількості реставрацій, що можуть бути виготовлені за 1 сеанс, та видах ортопедичних конструкцій.

Висновок. Концепція «chairside» є прогресивним підходом в лікуванні ортопедичних патологій, який робить можливим протезування за 1 день. Однак, ця концепція не позбавлена недоліків. Концепція «chairside» потребує подальших вивчення та вдосконалення.

Ключові слова: концепція «chairside», стоматологія у кабінеті лікаря, цифрова стоматологія, технологія адитивного виробництва.

Автор, відповідальний за листування*: Тарас Палій, Кафедра стоматології, Навчально-науковий медичний інститут, Сумський державний університет, Суми, Україна, e-mail: t.palij@med.sumdu.edu.ua*

ABBREVIATIONS

MeSH – Medical Subject Headings
DT – digital technologies
DD – digital dentistry
IOS – intraoral scanners

INTRODUCTION

Humanity has long since passed the point in history when digital technologies (DT) were something unusual, unknown, and unimaginable. Step by step, DT has been and continues to be closely intertwined with various aspects of life, professions and sciences, thus creating something new. Digital dentistry (DD) is no exception. A feature of this area of dentistry is the use of DT at any stage of interaction with the patient, beginning with the initial examination and ending with the final visit [1]. Examples: preparation, diagnostics, planning and forecasting of future results of the chosen treatment plan [1, 2, 3, 4, 5, 6, 7, 8, 9]; manufacturing of models, individual impression spoons, temporary and permanent structures, splints, mouth guards, aligners [5, 10, 11, 12, 13, 14]; plastic surgery of soft and hard tissues, reconstructive surgery (bone augmentation, replacement of defects and fragments of bones of the maxillofacial apparatus with printed biocompatible objects, etc.) [1, 5, 15, 16]. These are just a few examples of the use of DT, and they all have one thing in common: facilitating both the work of a doctor and improving the quality of services provided.

Despite numerous innovations over the past few decades, the time spent on dentist – dental technician, as well as doctor – patient interaction, remains a burning issue. Manufacturing and fixation of indirect restorations takes several visits, as the dentist makes impressions and sends them to a dental laboratory. The pursuit of ways to shorten the workflow without affecting the quality of the final structure has given rise to a new concept, the "ideology" of which is prosthetics in one visit. It is called "chairside".

The aim of the work: search, accumulation and analysis of relevant data based on a review of literature sources on the use of the "chairside" concept for the indirect restoration of lost hard tooth tissues.

MATERIAL AND METHODS

A literature review was carried out to identify publications on application of the "chairside" concept for the indirect restoration of lost hard tooth tissues. The bibliographic research was conducted between May 1 2024 and October 1 2024 to analyse the most recent evidence. Searches using the MeSH (Medical Subject Headings) terms were conducted using synonyms and combinations of the following search terms: "chairside concept", "chairside dentistry", "digital dentistry", "additive manufacturing". In addition to the electronic search, an analogical search was carried out in the bibliographic references of the selected articles. Used methods: bibliographic and analytical.

RESULTS AND DISCUSSION

Chairside Dentistry, or the "chairside" concept as a phenomenon, appeared more than 40 years ago [8]. This term has synonyms less scientific and more advertising-oriented, but conveying the meaning correctly, so they are used abroad both in the scientific community and in advertising: *"Same Day Crowns", "Same Day Dentistry" and "Single Visit Dentistry"*. Different names, yet the essence is the same – prosthetics in one visit [8, 17], with the doctor personally managing the entire process, from start to finish [10].

Despite the fact that the first systems, such as Chairside Economical Restoration of Esthetic Ceramic (CEREC), appeared in the 1980s [18], this principle did not immediately receive wide support from clinicians – the procedure for scanning teeth took a long time; intraoral scanners (IOS) had limitations in accuracy [19]; only inlays and onlays could be manufactured [1, 8, 20], while first crown was printed 15 years later [1]. However, the idea itself gave (boost) to the further development of the DD. The elements of this system were developed and improved both as independent units and by intersecting with each other [9, 11, 20]. When these elements reached an accuracy that met clinical requirements, researchers and clinicians returned to the chairside concept, armed with new data and capabilities [1, 18, 21, 22].

The components of the "chairside" concept are:

1. IOS;
2. Software;
3. Equipment that directly produces the object [1, 9].

The cycle of the "chairside" system has the following sequence. The patient comes to the clinic and, if prescribed and conditioned, has his teeth milled. After the tooth/teeth preparation, the operator scans the upper and lower dentition, compares their three-dimensional models in the central occlusion position. After checking the digital impression, the doctor or assistant preliminarily designs, checks, and marks the boundaries of the future restoration. The next step is to send the file to the equipment located in the clinic [9]. The most common format is STL (stereolithography, Standard Triangle Language) [19, 23]. After manufacturing (in the same clinic) [24], the future restoration is corrected and modified if necessary [25], additionally baked,

polished [26] and fixed. If the clinic does not have the necessary equipment, the doctor sends the file to a dental laboratory and can receive the finished restoration within 48 hours, even if the laboratory is in another city [27].

Intraoral scanning. Digital impressions obtained are created by optically measuring the shape of the surface of the patient`s teeth or tissues directly in the mouth. The data obtained through IOS is synthesised into a three-dimensional model using software. To make changes to this model (modelling, editing, creating restorations), other software is required [9].

There are two large groups of scanners: for use in the clinic (intraoral) and in the dental laboratory (extraoral). In the "chairside" context, it is the IOS that is used. Firstly, it is specially designed for interaction with patient. Secondly, it has a more realistic reproduction of the situation in the oral cavity than an extraoral scanner [28].

IOS is divided into two subgroups: with the use of special powders (the scanning surface is coated) and powder free. Most modern scanners are those that do not require additional tools [9].

What difficulties do a doctor and a patient face during such a manipulation as classic impression taking? Why did clinicians start looking for an alternative? Classic procedure is stressful and psychologically challenging, as the patient has to sit with the mouth open for a while, fighting the urge to close it, swallow saliva, or perform any other action. The process can also be complicated by a gag reflex [7, 9]. This may affect the quality of the models and increase the chance of repeated manipulation.

Scanning is devoid of this drawback. This is primarily due to the minimal contact of the scanner with the patient`s oral tissues. The chance of a gag reflex and the risk of infection to the patient are reduced for the patients [9]. Working time also plays a crucial role. The procedure for obtaining digital impressions takes almost as much time [7] or even less than the conventional impression taking [8, 19, 29], what is more pleasant for patients [7, 8, 9, 10, 19, 21].

The quality of digital impressions is equal to the quality of impressions obtained by the traditional method or demonstrates even greater accuracy [1, 8, 21, 30, 31]. The same statement will be true when comparing extraoral and IOS [32].

If we talk about the characteristics of IOS, the devices on the market are on the same quality level. There are flagships among them, indeed, but most devices have a minimal difference in accuracy [33].

Software. The role of software as a connecting link for the interaction of the two previous elements is difficult to overestimate. After all, the disclosure of their potential directly depended on the available functions of the software [34].

Software for modelling dental constructions has virtual tooth form libraries, which are used as templates; then operators adjust and modify them according to the clinical situation of each individual patient [1, 8, 35, 36].

It should be noted that there are several digital tools that make it possible to customise designs for each individual case.

These include:

- Bioreference – the design of the future restoration takes into account the anatomical features of the teeth on the opposite side [23] (if any);
- Biocopy – an exact reproduction of the tooth(s) before the intervention [14, 37, 38];
- Biogeneric – the software analyses the morphology of existing teeth to predict the correct form and function [39, 40, 41].

It is fair to say that each new generation of software becomes smarter, more user-friendly [1, 8, 11] and is constantly updated with new digital tools [8, 14, 21, 35, 36, 41, 42].

Equipment for the manufacturing of restorations in the clinic. Historically, scientists and researchers have been working on both equipment for the manufacturing of restorations and its improvements, as well as materials used for this purpose[18].

Milling is a widespread technology for manufacturing (prosthetic) structures [11]. A block of material, under water cooling, is processed according to the specified parameters by burs that move in three planes around it, thereby cutting out a structure of the required shape and size [8]. The blocks differ in shape (rectangular, oval) and size (for the manufacture of a single structure (crown or bridge) or several structures) [8, 38].

Milling machines can be large-sized (for industrial production/dental laboratories) and compact (for manufacturing structures in a medical facilities). The size of the equipment is directly proportional to the capacity of the units [8, 43].

Zirconium dioxide was the first material used to manufacture prosthetic structures in this way, because zirconium restorations combine the advantages of metal restorations, namely minimal invasive tooth preparation and ease of cementation; low thermal conductivity, as in all-ceramic crowns, and even higher aesthetic characteristics [44].

Today, there are entire groups of materials used for restorations in the clinic, some of them have several subgroups and great number of representatives in the dental market [18, 22, 45].

In the last 10 years, the technology of additive manufacturing/rapid prototyping (AM/RP) has emerged. Structures are literally "printed", which is why AM has

become an alternative to milling [1]. It is already possible to print a zirconia restoration [46] that will meet clinical requirements and will be no worse than a milled one [1].

As a result of processing the collected data, the authors concluded that there is a growing scientific interest in the use of 3D printing for dental purposes. After obtaining positive results in a pilot study of the accuracy of printed inlays [47], the authors pointed out the need for further research.

Due to the growth in the use of AM in general, the popularity of RP in dentistry has also increased [15,48]. Most of printers are used in dental laboratories, as AM products are useful at any laboratory stage: printing models, prototypes for casting, metal frames, temporary and permanent crowns, etc.

The printing capabilities of dental products, such as the number of units, speed, accuracy, etc., are limited only by the printing technology that is used. Representatives: Stereolithography, Digital Light Projection, Fused Deposition Modelling, Selective Laser Sintering, Photopolymer Jetting, Powder Binder Printer, Computed Axial Lithography, and others [46].

Unlike milling machines, 3D-printers have a wider range of applications: prototypes of future structures, frameworks for fixed and removable dentures, temporary and permanent restorations, post-and-cores, surgical guides, templates, replica dental models and models for training [1, 5, 11, 15, 38, 46, 48, 49, 50, 51, 52].

In the context of the comparison between milling and AM, we present data from several studies. A recent article claims that printed crowns are slightly lower in accuracy than milled structures, which have a better marginal fit and a thinner cement layer [53]. Subsequently, another group of researchers published data showing that 3D printing yields better results than milling [54].

The concept of "chairside" and non-standard clinical situations. The uniqueness of DT lies in the possibility of implementation of creative approaches to solving clinical problems not only in the field of prosthetics, but also in other areas of dentistry [11, 21]. Here are just some examples of clinical cases where the "chairside" concept is used in an original way:

- A clinician could not accurately determine the required shade for a future restoration. Therefore, he printed a model with different shades in the clinic, experimented with dyes, and after choosing the right one, he sent the data to the laboratory. The resulting restorations did not require any changes[55];
- A patient came to the clinic to have a single tooth covered with a crown. But the situation was complicated by the fact that this tooth was used for the fixation of bugle prosthesis. The doctor decided to scan the tooth before preparation, and after preparation and re-scanning, he made an exact copy. The result was positive: the quality of fixation of the bugle prosthesis remained unchanged, which indicates the accuracy and effectiveness of DT[56];
- After performing a pulpotomy, the doctor placed biomaterial at the bottom of the cavity and, instead of a filling or restoration, fabricated an endocrown and fixed it during the same visit. Within 12 months, there were no symptoms of pulpitis or other complications. Also, comparing the X-rays in the dynamics, the formation of protective dentin was noted [12].
- The doctors were faced with the task of removing a tumour located on the lower jaw. Due to its size, it was necessary to perform resection and reconstruction of hard tissues for further rehabilitation of the patient. To study the anatomical features in detail, plan and prepare for the operation, a three-dimensional model of the jaw was created and printed. The next step was to compare the prototype with the surgical template, which was used to plan the surgery [15].
- There is data about the success of manufacturing restorations in one visit for an entire quadrant of teeth. The experiment was successful, and the patient expressed a desire to undergo this procedure for other quadrants of teeth [57].

Advantages and disadvantages of working according to the "chairside" concept

The advantages include:

- *Accuracy*. "Chairside" restorations do not inferior in the accuracy of marginal fit and strength [54, 58] to those made in a dental laboratory. Other studies indicate that "clinical" restorations can be even more accurate, as the decisive factor is clinical experience, not experience with CAD (Computer-aided design) [59]. The doctor determines and corrects the occlusion, the density of the contact points [24] and the edges of the future restoration [60]. Such restorations fully met clinical requirements [21, 61, 62] and ISO standards [63].
- *Survival rate*. According to available data, 95–98.66% of structures successfully perform their function during the first 7 years of operation [64, 65, 66, 67, 68, 69], and 85–95% – for 10 years or more [10, 65, 70, 71].
- *Redistribution of time and resources*. The use of this technology saves time [72], optimises the

workflow and increases the doctor`s "efficiency" [7, 73, 74].

- *Production time*. All designs are made during the day, in the clinic, in a single visit [8, 10, 72].
- *Convenience*. Chairside procedures are user and patient friendly. [7, 8, 9, 10, 19, 21].

Despite its advantages, the "chairside" concept has a number of disadvantages. These include:

- *Lack of esthetics*. Dental technicians, due to their specialty, have more experience in modelling than clinicians, and therefore create more aesthetically pleasing restorations. At the same time, the clinical experience [59], the availability of virtual libraries [1, 8, 35, 36] and the possibility of involving the patient at the designing process [1, 25, 35], play an important role.
- *Complications*. More than 90% of "chairside" restorations successfully perform their function, but there is a certain percentage of failures. This is due to various complications: The fracture of the restorations or/and the teeth they are fixed on; removal of structures due to hard and soft tissue damage (caries and endodontic problems); the shape of the restoration and the group of teeth; decontamination and increased sensitivity after fixation of the restoration; increased abrasion of antagonists [64, 65, 66, 67, 68, 69, 71, 75, 76, 77], which is also common for constructions, which are manufactured according to the conventional protocols.
- *Marketing*. It is necessary to be critical of any product on the dental market, as marketing techniques are also used in the medical field. Not always the declared characteristics are true. In the context of the "chairside" concept, the following examples are given: sometimes "novelties" perform worse than materials that have long proven themselves [78]; some materials for the manufacturing of restorations has been on the dental market for only a few years, and there is no reliable data on the long-term results of its use [18]; polishing tool kits designed specifically for working with temporary printed crowns do not always produce the results stated by the manufacturer [79].

Obstacles in applying the "chairside" concept. There are a number of obstacles and limitations that clinicians face when trying to implement DD. These include:

1. *Material support*. In order to be able to manufacture structures in a clinical setting, appropriate equipment is needed, namely: IOS; a computer with the capacity to process and work with the array of data obtained through digital impressions and work with virtual models; licensed software; milling machine/3D printer; sintering oven and consumables; grinding and polishing kit; equipment maintenance, calibration; space for storage and use of equipment, etc.[80]

All these elements are essential. Without any position, it is impossible to fully work according to the "chairside" concept. And each element has its own price. So, significant investments are required to get started [9, 10, 11, 43]. Sometimes, this is the reason why doctors do not use CAD/CAM capabilities [81].

2. *Lack of virtual modelling skills*. It should be remembered that regardless of the technology used, the accuracy and quality of the final restoration depends on the clinical skills, the operator`s skill [82] and his ability to use CAD/CAM capabilities to achieve the optimal clinical result. According to researchers, a minimum of 12 scans [83] and the same number of modelling procedures are required to start getting positive results. It should be noted that the type of IOS chosen and the quality of the scan do not matter if the residual tooth is inadequately prepared [84];

3. *Adaptation period*. A dentist who decides to use digital dentistry should make the necessary changes in their practice [10], as well as spend time learning the intricacies of the production process and software [85]. A good example is an intraoral scanning session. Initially, this manipulation takes a lot of time, but with experience, scanning two jaws will take a few minutes [9]. That is, it takes a certain period of time to master the technology;

4. *Unsatisfactory production capacity*. Clinical milling machines and 3D-printers have lower production capacity than the equipment of dental laboratories. Depending on the model, it is possible to produce up to 3 units in 1 session in a clinical setting, while in the laboratory this figure is much higher (20 units per 1 milling session) [43]. On the other hand, a doctor can make and fix a structure in a day, and if doctor cooperate with a laboratory, the process will take several visits.

5. *Internal psychological barriers*. Fears about possible negative consequences due to the refusal of the usual format of work, fear of the unknown, difficulty in mastering digital tools [74], the size of the equipment, uncertainty about the chosen colour, staining, strength and durability of the restorations [10].

CONCLUSIONS

The "chairside" concept is a modern and progressive approach to the treatment of prosthetic pathologies, which makes prosthetics possible in one day. This is confirmed by the published research and scientific papers. However, this concept is not without its

drawbacks. To start working with it, you need to meet a number of conditions related to the material base and changes in the usual work schedule. The range of designs is limited, as well as the number of units that can be produced in a single session. The chairside concept requires further research. We believe that the priority areas are the research and development of 3D-printing technologies, expanding the constructions assortment, and the creation of technologies that lower the threshold for entry into modern digital treatment protocols.

AUTHOR CONTRIBUTIONS

All authors substantively contributed to the drafting of the initial and revised versions of this paper. They take full responsibility for the integrity of all aspects of the work.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ARTIFICIAL INTELLIGENCE DISCLOSURE

No artificial intelligence (AI) technologies were used during manuscript writing or editing.

REFERENCES

1. Rekow ED. Digital dentistry: The new state of the art - Is it disruptive or destructive?. *Dent Mater*. 2020;36(1):9-24. https://doi.org/10.1016/j.dental.2019.08.103
2. Wesemann C, Muallah J, Mah J, Bumann A. Accuracy and efficiency of full-arch digitalization and 3D printing: A comparison between desktop model scanners, an intraoral scanner, a CBCT model scan, and stereolithographic 3D printing. *Quintessence Int*. 2017;48(1):41-50. https://doi.org/10.3290/j.qi.a37130
3. Raffone C, Gianfreda F, Antonacci D, Pompeo MG, Bollero P, Canullo L. Chairside virtual patient protocol. Part 3: In vitro accuracy of a digital facebow. *J Dent*. 2023;137:104622. https://doi.org/10.1016/j.jdent.2023.104622
4. Reich S, Hartkamp O, Reiss B. A chairside concept for increasing the vertical dimension of occlusion in the maxilla and mandible. *Int J Comput Dent*. 2019;22(1):81-98.
5. Khorsandi D, Fahimipour A, Abasian P, et al. 3D and 4D printing in dentistry and maxillofacial surgery: Printing techniques, materials, and applications. *Acta Biomater*. 2021;122:26-49. https://doi.org/10.1016/j.actbio.2020.12.044
6. Donker VJJ, Raghoebar GM, Vissink A, Meijer HJA. Digital Workflow for Immediate Implant Placement and Chairside Provisionalization in the Esthetic Zone. *Case Rep Dent*. 2022;2022:5114332. Published 2022 Apr 1. https://doi.org/10.1155/2022/5114332
7. Glisic O, Hoejbjerre L, Sonnesen L. A comparison of patient experience, chair-side time, accuracy of dental arch measurements and costs of acquisition of dental models. *Angle Orthod*. 2019;89(6):868-875. https://doi.org/10.2319/020619-84.1
8. Blatz MB, Conejo J. The Current State of Chairside Digital Dentistry and Materials. *Dent Clin North Am*. 2019;63(2):175-197. https://doi.org/10.1016/j.cden.2018.11.002
9. Suese K. Progress in digital dentistry: The practical use of intraoral scanners. *Dent Mater J*. 2020;39(1):52-56. https://doi.org/10.4012/dmj.2019-224
10. Baroudi K, Ibraheem SN. Assessment of Chair-side Computer-Aided Design and Computer-Aided Manufacturing Restorations: A Review of the Literature. *J Int Oral Health*. 2015;7(4):96-104.
11. Dawood A, Marti Marti B, Sauret-Jackson V, Darwood A. 3D printing in dentistry [published correction appears in Br Dent J. 2016 Jan 22;220(2):86. https://doi.org/ 10.1038/sj.bdj.2016.50]. *Br Dent J*. 2015;219(11):521-529. https://doi.org/10.1038/sj.bdj.2015.914
12. Munoz-Sanchez ML, Linas N, Decerle N, Nicolas E, Hennequin M, Cousson PY. A Combination of Full Pulpotomy and Chairside CAD/CAM Endocrown to Treat Teeth with Deep Carious Lesions and Pulpitis in a Single Session: A Preliminary Study. *Int J Environ Res Public Health*. 2020;17(17):6340. Published 2020 Aug 31. https://doi.org/10.3390/ijerph17176340
13. Wang KP, Ye HQ, Chen H, Wang Y, Sun YC, Zhou YS. *Beijing Da Xue Xue Bao Yi Xue Ban*. 2019;51(2):349-355. https://doi.org/10.19723/j.issn.1671-167X.2019.02.028
14. Zimmermann M, Koller C, Hickel R, Kühnisch J. Chairside treatment of amelogenesis imperfecta, including establishment of a new vertical dimension with resin nanoceramic and intraoral scanning. *J Prosthet Dent*. 2016;116(3):309-313. https://doi.org/10.1016/j.prosdent.2016.02.010
15. Wimpenny DI, Pandey PM, Kumar LJ, editors. Advances in 3D printing & additive manufacturing technologies. Singapore, Singapore: Springer; 2018.

16. Mishchenko O, Yanovska A, Sulaieva O, et al. From Synthesis to Clinical Trial: Novel Bioinductive Calcium Deficient HA/β-TCP Bone Grafting Nanomaterial. *Nanomaterials (Basel)*. 2023;13(12):1876. Published 2023 Jun 17. https://doi.org/10.3390/nano13121876
17. Kallala R, Chaouch MH, Nasr K, Courset T. Step-by-Step Esthetic Rehabilitation with Chairside System. *Case Rep Dent*. 2021;2021:5558158. Published 2021 Mar 25. https://doi.org/10.1155/2021/5558158
18. Marchesi G, Camurri Piloni A, Nicolin V, Turco G, Di Lenarda R. Chairside CAD/CAM Materials: Current Trends of Clinical Uses. *Biology (Basel)*. 2021;10(11):1170. Published 2021 Nov 12. https://doi.org/10.3390/biology10111170
19. Takeuchi Y, Koizumi H, Furuchi M, Sato Y, Ohkubo C, Matsumura H. Use of digital impression systems with intraoral scanners for fabricating restorations and fixed dental prostheses. *J Oral Sci*. 2018;60(1):1-7. https://doi.org/10.2334/josnusd.17-0444
20. Rinke S, Pfitzenreuter T, Leha A, Roediger M, Ziebolz D. Clinical evaluation of chairside-fabricated partial crowns composed of zirconia-reinforced lithium silicate ceramics: 3-year results of a prospective practice-based study. *J Esthet Restor Dent*. 2020;32(2):226-235. https://doi.org/10.1111/jerd.12542
21. Jurado CA, Lederman R, Cohen J, Tsujimoto A. Intraoral Scanning with Rubber Dam Isolation in Place for Fabrication of a Chairside Computer-assisted Design and Computer-assisted Manufacture Ceramic Restoration. *J Contemp Dent Pract*. 2021;22(8):943-946. Published 2021 Aug 1.
22. Amesti-Garaizabal A, Agustín-Panadero R, Verdejo-Solá B, et al. Fracture Resistance of Partial Indirect Restorations Made With CAD/CAM Technology. A Systematic Review and Meta-analysis. *J Clin Med*. 2019;8(11):1932. Published 2019 Nov 9. https://doi.org/10.3390/jcm8111932
23. He M, Pu T, Ding Q, et al. Occlusal contact and clearance of posterior implant-supported single crowns designed by two different methods: a self-controlled study. *BMC Oral Health*. 2023;23(1):151. Published 2023 Mar 15. https://doi.org/10.1186/s12903-023-02847-w
24. Graf T, Güth JF, Diegritz C, Liebermann A, Schweiger J, Schubert O. Efficiency of occlusal and interproximal adjustments in CAD-CAM manufactured single implant crowns - cast-free vs 3D printed cast-based. *J Adv Prosthodont*. 2021;13(6):351-360. https://doi.org/10.4047/jap.2021.13.6.351
25. Gold D, Hahnel SF, Schierz O, Rauch A. Practicability of a chairside approach for characterizing CAD/CAM resin-based composites. *J Oral Sci*. 2020;62(4):430-434. https://doi.org/10.2334/josnusd.19-0507
26. Kozmacs C, Hollmann B, Arnold WH, Naumova E, Piwowarczyk A. Polishing of Monolithic Zirconia Crowns-Results of Different Dental Practitioner Groups. *Dent J (Basel)*. 2017;5(4):30. Published 2017 Nov 14. https://doi.org/10.3390/dj5040030
27. Griffin JD Jr. Tooth in a bag: same-day monolithic zirconia crown. *Dent Today*. 2013;32(1):124-131.
28. Cai H, Zhao BC, Tian Y, et al. Design of a Single-Tooth Model and Its Application in Oral Scan System Assessment. *Scanning*. 2021;2021:8891396. Published 2021 Mar 21. https://doi.org/10.1155/2021/8891396
29. Renne WG. Chairside CAD/CAM technology: a positive "disruption" in dentistry. *Compend Contin Educ Dent*. 2014;35(2):126-127.
30. Anadioti E, Aquilino SA, Gratton DG, et al. 3D and 2D marginal fit of pressed and CAD/CAM lithium disilicate crowns made from digital and conventional impressions. *J Prosthodont*. 2014;23(8):610-617. https://doi.org/10.1111/jopr.12180.
31. Ahmed WM, Shariati B, Gazzaz AZ, Sayed ME, Carvalho RM. Fit of tooth-supported zirconia single crowns-A systematic review of the literature. *Clin Exp Dent Res*. 2020;6(6):700-716. https://doi.org/10.1002/cre2.323
32. Zarone F, Ruggiero G, Ferrari M, Mangano F, Joda T, Sorrentino R. Accuracy of a chairside intraoral scanner compared with a laboratory scanner for the completely edentulous maxilla: An in vitro 3-dimensional comparative analysis. *J Prosthet Dent*. 2020;124(6):761.e1-761.e7. https://doi.org/10.1016/j.prosdent.2020.07.018
33. Róth I, Czigola A, Fehér D, et al. Digital intraoral scanner devices: a validation study based on common evaluation criteria. *BMC Oral Health*. 2022;22(1):140. Published 2022 Apr 26. https://doi.org/10.1186/s12903-022-02176-4
34. Agustín-Panadero R, Ferreiroa A, Pascual-Moscardó A, Fons-Font A, Solá-Ruíz MF. *In vivo* evaluation of three-dimensional of volumetric changes using a CAD/CAM chair-side system: Technical procedure. *J Clin Exp Dent*. 2017;9(3):e489-e493. Published 2017 Mar 1. https://doi.org/10.4317/jced.53531
35. Coachman C, Georg R, Bohner L, Rigo LC, Sesma N. Chairside 3D digital design and trial restoration workflow. *J Prosthet Dent*. 2020;124(5):514-520. https://doi.org/10.1016/j.prosdent.2019.10.015
36. Leeson D. The digital factory in both the modern dental lab and clinic. *Dent Mater*. 2020;36(1):43-52. https://doi.org/10.1016/j.dental.2019.10.010
37. Sannino G, Germano F, Arcuri L, Bigelli E, Arcuri C, Barlattani A. CEREC CAD/CAM Chairside System. *Oral Implantol (Rome)*. 2015;7(3):57-70. Published 2015 Apr 13.
38. Zimmermann M, Ender A, Egli G, Özcan M, Mehl A. Fracture load of CAD/CAM-fabricated and 3D-printed composite crowns as a function of material thickness. *Clin Oral Investig*. 2019;23(6):2777-2784. https://doi.org/10.1007/s00784-018-2717-2
39. Arslan Y, Karakoca Nemli S, Bankoğlu Güngör M, Tamam E, Yılmaz H. Evaluation of biogeneric design techniques with CEREC CAD/CAM system. *J Adv Prosthodont*. 2015;7(6):431-436. https://doi.org/10.4047/jap.2015.7.6.431
40. Wang F, Tang Q, Xi S, Liu R, Niu L. Comparison and evaluation of the morphology of crowns generated by

biogeneric design technique with CEREC chairside system. *PLoS One*. 2020;15(1):e0227050. Published 2020 Jan 16. https://doi.org/10.1371/journal.pone.0227050
41. Bohner LO, Neto PT, Ahmed AS, Mori M, Laganá DC, Sesma N. CEREC Chairside System to Register and Design the Occlusion in Restorative Dentistry: A Systematic Literature Review. *J Esthet Restor Dent*. 2016;28(4):208-220. https://doi.org/10.1111/jerd.12226
42. Raffone C, Gianfreda F, Pompeo MG, Antonacci D, Bollero P, Canullo L. Chairside virtual patient protocol. Part 2: Management of multiple face scans and alignment predictability. *J Dent*. 2022;122:104123. https://doi.org/10.1016/j.jdent.2022.104123
43. Turkyilmaz I, Yun S. Chairside versus external laboratory milling in fabricating CAD/CAM surgical and restorative products in dental practice. *Prim Dent J*. 2022;11(4):53-55. https://doi.org/10.1177/20501684221132916
44. Wiedhahn K, Fritzsche G, Wiedhahn C, Schenk O. Zirconia crowns - the new standard for single-visit dentistry?. *Int J Comput Dent*. 2016;19(1):9-26.
45. Taylor R, Fuentealba R, Brackett WW, Roberts HW. 24 hour polymerization shrinkage of resin composite core materials. *J Esthet Restor Dent*. 2021;33(5):775-785. https://doi.org/10.1111/jerd.12788
46. Sulaiman TA. Materials in digital dentistry-A review. *J Esthet Restor Dent*. 2020;32(2):171-181. https://doi.org/10.1111/jerd.12566
47. Ahlholm P, Sipilä K, Vallittu P, Kotiranta U, Lappalainen R. Accuracy of inlay and onlay restorations based on 3D printing or milling technique - a pilot study. *Eur J Prosthodont Restor Dent*. 2019;27(2):56-64. Published 2019 May 30. https://doi.org/10.1922/EJPRD_01814Ahlholm09
48. Zaharia C, Gabor A-G, Gavrilovici A, Stan AT, Idorasi L, Sinescu C, et al. Digital Dentistry — 3D Printing Applications. J Interdiscip Med [Internet]. 2017;2(1):50–3. Available from: http://dx.doi.org/10.1515/jim-2017-0032
49. Sun Y, Ding Q, Yuan F, Zhang L, Sun Y, Xie Q. Accuracy of a chairside, fused deposition modeling three-dimensional-printed, single tooth surgical guide for implant placement: A randomized controlled clinical trial. *Clin Oral Implants Res*. 2022;33(10):1000-1009. https://doi.org/10.1111/clr.13981
50. Sun Y, Ding Q, Tang L, Zhang L, Sun Y, Xie Q. Accuracy of a chairside fused deposition modeling 3D-printed single-tooth surgical template for implant placement: An in vitro comparison with a light cured template. *J Craniomaxillofac Surg*. 2019;47(8):1216-1221. https://doi.org/10.1016/j.jcms.2019.03.019
51. Patzelt SB, Bishti S, Stampf S, Att W. Accuracy of computer-aided design/computer-aided manufacturing-generated dental casts based on intraoral scanner data. *J Am Dent Assoc*. 2014;145(11):1133-1140. https://doi.org/10.14219/jada.2014.87
52. Muta S, Ikeda M, Nikaido T, et al. Chairside fabrication of provisional crowns on FDM 3D-printed PVA model. *J Prosthodont Res*. 2020;64(4):401-407. https://doi.org/10.1016/j.jpor.2019.11.004
53. Camargo B, Willems E, Jacobs W, et al. 3D printing and milling accuracy influence full-contour zirconia crown adaptation. *Dent Mater*. 2022;38(12):1963-1976. https://doi.org/10.1016/j.dental.2022.11.002
54. Suksuphan P, Krajangta N, Didron PP, Wasanapiarnpong T, Rakmanee T. Marginal adaptation and fracture resistance of milled and 3D-printed CAD/CAM hybrid dental crown materials with various occlusal thicknesses. *J Prosthodont Res*. 2024;68(2):326-335. https://doi.org/10.2186/jpr.JPR_D_23_00089
55. An H. Ceramic veneer shade evaluation using a multicolored 3D-printed model-A case report. *J Esthet Restor Dent*. 2024;36(3):415-420. https://doi.org/10.1111/jerd.13138
56. Patel D. Retrofitting a Crown Supporting a Removable Partial Denture Using "Biogeneric Copy" to Replicate Tooth's Preoperative Condition. *Compend Contin Educ Dent*. 2016;37(2):126-130.
57. Klim J. Aesthetic quadrant dentistry using a chairside CAD/CAM system: a case presentation. *Pract Proced Aesthet Dent*. 2006;18(3):153-160.
58. Moslemian N, Koulivand S, Zeighami S, Nankali A, Alikhasi M. Evaluation of the effect of milling mode and margin definition on adaptation of chairside digitally designed and fabricated ceramic veneers. *Int J Comput Dent*. 2022;25(3):277-285. https://doi.org/10.3290/j.ijcd.b2588153
59. No-Cortes J, Ayres AP, Son A, et al. Does Clinical Experience Affect Chairside Digital Waxing of Single Crowns More Than Software Training?. *Int J Prosthodont*. 2022;35(5):684-689. https://doi.org/10.11607/ijp.7838
60. de Andrade GS, Tribst JP, Dal Piva AO, et al. A study on stress distribution to cement layer and root dentin for post and cores made of CAD/CAM materials with different elasticity modulus in the absence of ferrule. *J Clin Exp Dent*. 2019;11(1):e1-e8. Published 2019 Jan 1. https://doi.org/10.4317/jced.55295
61. Schneider O. Long-term Cerec 3D chairside bridges milled from IPS e.max CAD LT blocks. *Int J Comput Dent*. 2016;19(3):239-255.
62. Kim JH, Lee H, Son SA, Hong SJ, Park JK. Evaluation of the intaglio surface trueness and fit of zirconia crowns fabricated using different machining strategies with a chairside CAD/CAM system. *Int J Comput Dent*. 2024;27(2):191-198. https://doi.org/10.3290/j.ijcd.b3840499
63. Vichi A, Sedda M, Del Siena F, Louca C, Ferrari M. Flexural resistance of Cerec CAD/CAM system ceramic blocks. Part 1: Chairside materials. *Am J Dent*. 2013;26(5):255-259.
64. Scutella F, Weinstein T, Redaelli S, Cerutti A, Testori T, Özcan M. Reliability of Chair-side Monolithic CAD-CAM Generated Lithium Disilicate Single Crowns with Knife- Edge Finish Line: Up to 5-Year Retrospective Analysis of Clinical Performance. *Eur J Prosthodont Restor Dent*.

2020;28(2):10.1922/EJPRD_1930Scutella04. Published 2020 May 28. https://doi.org/10.1922/EJPRD_1930Scutella04
65. Rinke S, Pabel AK, Rödiger M, Ziebolz D. Chairside Fabrication of an All-Ceramic Partial Crown Using a Zirconia-Reinforced Lithium Silicate Ceramic. *Case Rep Dent*. 2016;2016:1354186. https://doi.org/10.1155/2016/1354186
66. Lu T, Peng L, Xiong F, et al. A 3-year clinical evaluation of endodontically treated posterior teeth restored with two different materials using the CEREC AC chair-side system. *J Prosthet Dent*. 2018;119(3):363-368. https://doi.org/10.1016/j.prosdent.2017.04.022
67. Rinke S, Brandt A, Hausdoerfer T, Leha A, Ziebolz D. Clinical Evaluation of Chairside-Fabricated Partial Crowns Made of Zirconia- Reinforced Lithium Silicate Ceramic - 2-Year-Results. *Eur J Prosthodont Restor Dent*. 2020;28(1):36-42. Published 2020 Feb 27. https://doi.org/10.1922/EJPRD_2001Rinke07
68. Fages M, Raynal J, Tramini P, Cuisinier FJ, Durand JC. Chairside Computer-Aided Design/Computer-Aided Manufacture All-Ceramic Crown and Endocrown Restorations: A 7-Year Survival Rate Study. *Int J Prosthodont*. 2017;30(6):556–560. https://doi.org/10.11607/ijp.5132
69. Aziz A, El-Mowafy O, Tenenbaum HC, Lawrence HP, Shokati B. Clinical performance of chairside monolithic lithium disilicate glass-ceramic CAD-CAM crowns. *J Esthet Restor Dent*. 2019;31(6):613-619. https://doi.org/10.1111/jerd.12531
70. Otto T, Mörmann WH. Clinical performance of chairside CAD/CAM feldspathic ceramic posterior shoulder crowns and endocrowns up to 12 years. *Int J Comput Dent*. 2015;18(2):147-161.
71. Otto T. Up to 27-years clinical long-term results of chairside Cerec 1 CAD/CAM inlays and onlays. *Int J Comput Dent*. 2017;20(3):315-329.
72. Baroudi K, Ibraheem SN. Assessment of Chair-side Computer-Aided Design and Computer-Aided Manufacturing Restorations: A Review of the Literature. *J Int Oral Health*. 2015;7(4):96-104.
73. Sirona Dental Inc. Sirona's CEREC technology: win-win for patients and practitioners. *Compend Contin Educ Dent*. 2013;34(6):464.
74. Planmeca PlanScan™ CAD/CAM system eases transition to chairside dentistry. *Compend Contin Educ Dent*. 2014;35(2):132.
75. Zaim B, Serin Kalay T, Purcek G. Friction and wear behavior of chairside CAD-CAM materials against different types of antagonists: An in vitro study. *J Prosthet Dent*. 2022;128(4):803-813. https://doi.org/10.1016/j.prosdent.2021.09.024
76. Wang YG, Xing YX, Sun YC, Zhao YJ, Lü PJ, Wang Y. *Zhonghua Kou Qiang Yi Xue Za Zhi*. 2013;48(6):355-358.
77. Naik VB, Jain AK, Rao RD, Naik BD. Comparative evaluation of clinical performance of ceramic and resin inlays, onlays, and overlays: A systematic review and meta analysis. *J Conserv Dent*. 2022;25(4):347-355. https://doi.org/10.4103/jcd.jcd_184_22
78. Jurado CA, Lee D, Cortes D, et al. Fracture Resistance of Chairside CAD/CAM Molar Crowns Fabricated with Different Lithium Disilicate Ceramic Materials. *Int J Prosthodont*. 2023;36(6):722-729. https://doi.org/10.11607/ijp.7802
79. Jurado CA, Barkmeier WW, Alshabib A, et al. Effectiveness of Different Polishing Kits for Chairside CAD/CAM Provisional Restorative Materials. *Oper Dent*. 2022;47(6):670-677. https://doi.org/10.2341/21-147-L
80. Skramstad M, DiTolla MC. Single-Visit Chairside Zirconia. *Dent Today*. 2016;35(8):84-87.
81. Choukse V, Kunturkar A, Nirmal Aidasani A, Masih Gottlieb A, Agrawal R, Bumb PP. Survey of Indian Dental Professionals Regarding the Use of Computer-Aided Design/Computer-Aided Manufacture (CAD/CAM) Technology. *Cureus*. 2023;15(6):e40392. Published 2023 Jun 13. https://doi.org/10.7759/cureus.40392
82. Abduo J, Elseyoufi M. Accuracy of Intraoral Scanners: A Systematic Review of Influencing Factors. *Eur J Prosthodont Restor Dent*. 2018;26(3):101-121. Published 2018 Aug 30. https://doi.org/10.1922/EJPRD_01752Abduo21
83. Waldecker M, Trebing C, Rues S, Behnisch R, Rammelsberg P, Bömicke W. Effects of Training on the Execution of Complete-Arch Scans. Part 1: Scanning Time. *Int J Prosthodont*. 2021;34(1):21-26. https://doi.org/10.11607/ijp.6903
84. Renne W, Wolf B, Kessler R, McPherson K, Mennito AS. Evaluation of the Marginal Fit of CAD/CAM Crowns Fabricated Using Two Different Chairside CAD/CAM Systems on Preparations of Varying Quality. *J Esthet Restor Dent*. 2015;27(4):194-202. https://doi.org/10.1111/jerd.12148
85. Harsono M, Simon JF, Stein JM, Kugel G. Evolution of chairside CAD/CAM dentistry. *Tex Dent J*. 2013;130(3):238-244.

Received 28.11.2024 ***Accepted 01.02.2025***

INFORMATION ABOUT THE AUTHORS

Taras Palii – PhD student, Department of Dentistry, Academic and Research Medical Institute, Sumy State University, Sumy, Ukraine, e-mail: t.palij@med.sumdu.edu.ua

Olexandr Tsyhanok - Head of the Department of Dentistry, Academic and Research Medical Institute, Sumy State University, Sumy, Ukraine, PhD, e-mail: o.tsyhanok@med.sumdu.edu.ua