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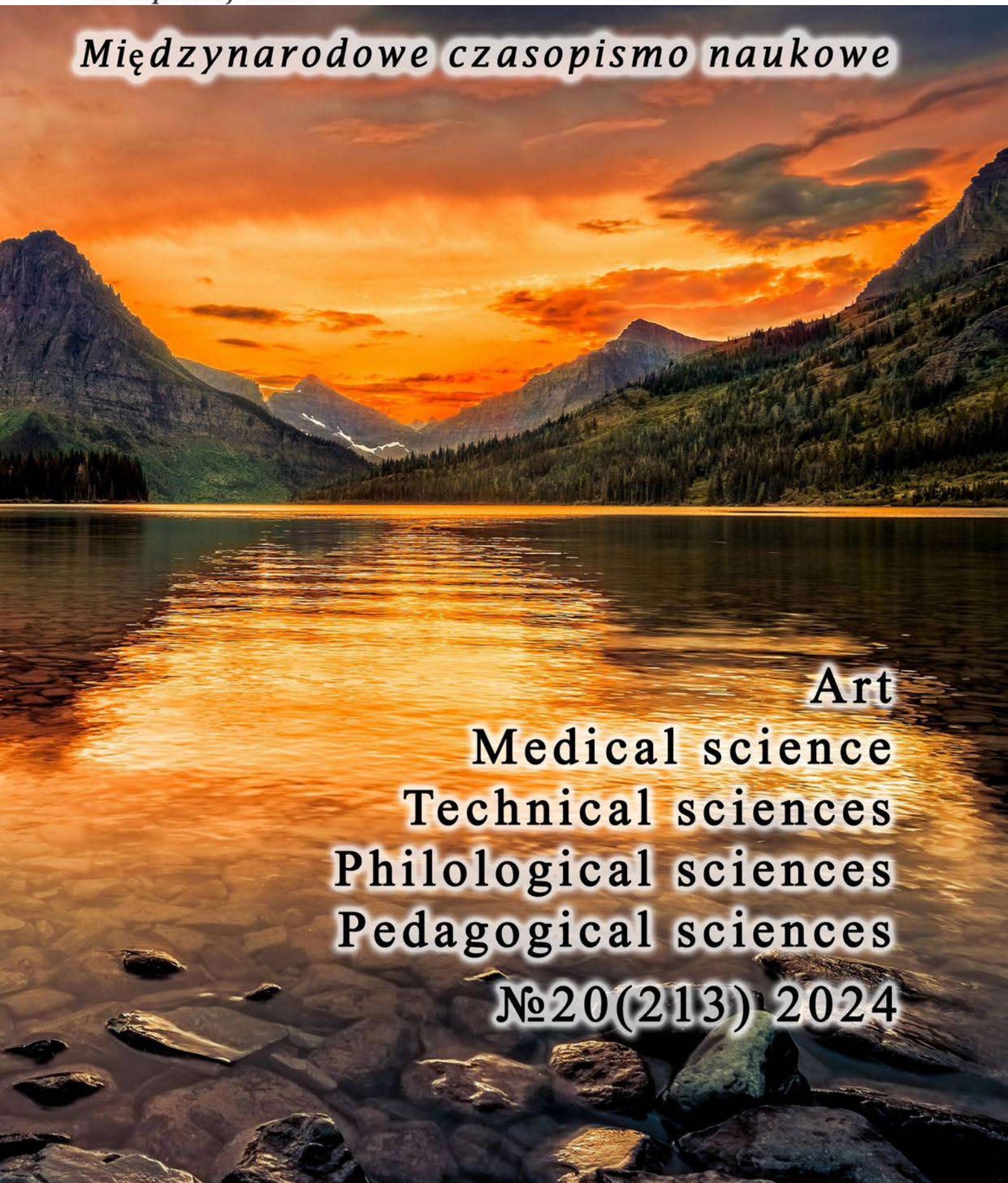

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MODERN VIEWS ON THE CLASSIFICATION OF BONE TISSUE ARCHITECTURE FOR IMPROVING THE METHODS OF PROSTHETICS OF LOST TOOTHES (literature review)

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СУЧАСНІ ПОГЛЯДИ НА КЛАСИФІКАЦІЮ АРХІТЕКТОНІКИ КІСТКОВОЇ ТКАНИНИ ДЛЯ ПОКРАЩЕННЯ МЕТОДІВ ПРОТЕЗУВАННЯ ВТРАЧЕНИХ ЗУБІВ (огляд літератури)

Abstract.

For a considerable period of time, the primary classification of tooth loss was the classification proposed in 1928 by Kennedi. As dentistry progressed, it became evident that a more nuanced approach was necessary to classify dental defects beyond their mere localisation.

Consequently, none of the classifications provides comprehensive information and does not encompass all the clinical features of partial tooth loss. It is therefore evident that a rational treatment plan can be formulated on the basis of morphological and functional classification features, including the relative position of the retained teeth and edentulous areas, conditions for the perception and distribution of the chewing load, in particular the degree and type of atrophy of the collar ridge, as well as the number of occlusal support zones in the areas of premolars and molars. A review of the scientific literature and the authors' current views on the treatment of partial tooth loss in dental care reveals a significant need for qualified orthopedic treatment in Ukraine, in accordance with modern requirements, in particular the use of prosthetic restorations. The intimate connection between oral health and other aspects of patients' quality of life underscores the necessity for novel interdisciplinary collaboration and presents a compelling rationale for enhancing the clinical and laboratory aspects of dental rehabilitation, thereby ensuring predictable outcomes.

Анотація.

Тривалий час основною класифікацією втрати зубів була класифікація запропонована у 1928 р. Kennedi J. З подальшим розвитком стоматології, виявилося недостатнім класифікувати дефекти зубного ряду тільки за їхньою локалізацією.

Таким чином, жодна з класифікацій не містить вичерпної інформації та не враховує усі клінічні особливості часткової втрати зубів. Саме тому, урахування таких морфо-функціональних класифікаційних ознак як взаємне розташування збережених зубів і беззубих ділянок, умови для сприйняття та розподілу жувального навантаження, зокрема – ступінь і тип атрофії коміркового відростка, а також кількість оклюзійних опорних зон у ділянках премолярів і молярів дає усі підстави для обґрунтування раціонального плану лікування. Аналізуючи дані наукової літератури, сучасні погляди авторів на способи вирішення проблем, зумовлених частковою втратою зубів у структурі надання стоматологічної допомоги, слід підкреслити значну потребу населення України у кваліфікованому ортопедичному лікуванні згідно сучасних вимог, зокрема з використанням покривних протезів. Тісний взаємозв'язок стоматологічного здоров'я з іншими показниками якості життя пацієнтів вимагає нових підходів у міждисциплінарній співпраці і надає усі можливості для удосконалення клінічної та лабораторної складових для забезпечення прогнозованих результатів стоматологічної реабілітації.

Keywords: *stomatology, classification of tooth loss, partial tooth loss, classification of dentition defects, treatment methods.*

Ключові слова: *стоматологія, класифікація втрати зубів, часткова втрати зубів, класифікація дефектів зубного ряду, методи лікування.*

For a considerable period of time, the primary classification of tooth loss was the classification proposed in 1928 by Kennedi J. [1-4]. As dentistry progressed, it became evident that a more nuanced approach was necessary to classify dental defects beyond their mere localisation. The advent of novel therapeutic modalities necessitated the differentiation of the nature and extent of jawbone damage in the event of tooth loss, as well as the determination of the characteristics of subsequent prosthetics. Nevertheless, the most common classification in the field of prosthetic dentistry is the Kennedy J. classification of partial tooth loss, which is supplemented by the Applegate O.C. classification.

In 1954, Fiset J. published a paper on the subject. The Kennedy-Applegate-Fiset classification is a visual, practice-oriented classification based on the ratio of retained teeth to edentulous areas. It is used to determine the rational design of partial dentures and, accordingly, certain physiological and mechanical principles of their functioning. It is also important to note that in certain cases, additional studies may be required to assess the complexity of the clinical situation. This is in accordance with the findings of studies. [5, 6] This classification was developed further by Misch K.E. and Judi K.W. [7], with a particular focus on dental implantation. Each class is further subdivided into subgroups A, B, C and D. The classification is based on the determination of three main parameters of the bone: height, width and mediodistal length of its body. According to this classification, there are four classes of partial tooth loss, which are further subdivided into four groups (A, B, C and D). In the event of complete loss of the lower jaw teeth, a fifth group is formed.

Classes 1 and 2, subgroup A comprise patients with natural teeth in the anterior areas of the dentition. These patients have sufficient bone volume to accommodate dental bridges in the event of included or terminal defects of the dentition. It is possible to place bridges with either tooth or implant support, or on a single implant. The number of implants required is dependent on the number of missing teeth and the number of opposing teeth.

Class 2. Subgroup B: In patients of this group, the quantity of bone is slightly diminished, yet it remains sufficient for the placement of small screw and cylindrical implants. In certain instances, the placement of multiple implants may be necessary to distribute the load. Additionally, flat implants may be utilized in instances where smaller bone volumes are present. Subgroup C: In patients in this category, the quantity of bone is insufficient for the placement of cylindrical and screw implants. Subgroup D: Atrophy of the bone is observed at a depth. In cases where conventional removable dentures are indicated, augmentation of the cellular part of the lower jaw with bone substitutes is recommended in the event of a risk of fracture.

Classes 3 and 4. Subgroup A: patients present with missing teeth or groups of teeth, yet the bone volume is adequate for the placement of screw, cylindrical, and flat implants. The number of implants required is contingent upon the length of the edentulous area and the type of prosthesis planned. The prosthesis may be supported by implants alone or by teeth and implants. Subgroup B: patients present with extensive edentulous areas, yet the bone volume remains sufficient to accommodate implant-supported fixed bridges. Subgroup C: patients have extensive edentulous areas. The bone volume is insufficient for the placement of endosseous implants. In certain instances, a sinus lift or mandibular nerve relocation may be employed. It is advisable to exercise caution when using short screw and cylindrical implants in class 4 situations. Subgroup D: The severe atrophy of the bone precludes the placement of intraosseous implants. The use of partial removable dentures is indicated in such cases. In the event of a risk of fracture of the lower jaw, the cellular part of the denture is augmented with biomaterials.

At present, there are multiple classifications of jaw bone structure that have been adapted for the purposes of dental implantology. In accordance with the well-known classification of jaw bone architecture proposed by Lekholm and Zarb [8-10], there are four classes: Class 1: The jaw bone tissue is represented by an almost completely homogeneous compact layer.

Class 2: A thick compact layer surrounds, in a ratio of 1:1, a well-developed spongy layer.

Class 3: A thin compact layer, in a ratio of 1:3, surrounds a well-developed spongy layer. The developed network of muddy trabeculae of the spongy layer has no clear orientation.

Grade 4: A thin (1-2 mm) compact layer, 1:4, surrounds a spongy layer with low trabecular bone density.

In terms of architectural classification, jaw bone tissue can be divided into three distinct categories.

Type 1 - bone is characterized by a high-density spongy layer with powerful trabeculae, with a ratio of compact and spongy layers of 2:1.

Type 2 - bone is medium-density bone, with a well-developed network of strong trabeculae in the spongy layer, surrounded by a compact layer of bone 2-3 mm thick.

Type - 3 bone is characterized by a few thin trabeculae in the spongy layer, surrounded by a compact layer of up to 1 mm. The ratio of the compact and spongy layers is 0.5:1.0.

For each type of bone density, the author has developed a distinct set of surgical protocols, implant designs, treatment plans, and subsequent loading times [11, 12]. The author proposes that the use of different types of implants and prosthetic tactics should be considered on a case-by-case basis, depending on the specific characteristics of the bone in question. The frequency of bone types in different parts of the jaws is described in detail by Misch SE (1999) according to the classification he used [13-17].

With regard to the quality of bone tissue, the classification proposed by Misch C. distinguishes four types of bone:

D1: Flat compact bone devoid of a spongy layer.

D2: Cortical layer of varying density on the exterior, spongy bone on the interior.

D3: Thin cortical layer on the exterior, spongy bone on the interior.

D4: Absence of cortical layer, cellular cancellous bone within.

The most prevalent type of D1 bone is found in the lower jaw in approximately 9 % of cases, with a higher prevalence in the anterior region compared to the lateral region. Bone of D2 quality is most typical for the lower jaw, with a prevalence of 50 % in the distal parts. It is somewhat more frequently observed in the anterior region, with a prevalence of 66 %. D2 density is also observed in 25 % of cases in the anterior part of the upper jaw and in 10 % of cases in its lateral parts. Bone type D3 is more typical for the upper jaw (65 % and 50 % in the anterior and posterior regions, respectively), although it occurs in less than half of the cases in the distal regions of the lower jaw and even less often (25 % in the anterior region). Bone quality D4 is exceedingly rare in the lower jaw, occurring in approximately 4 % of cases.

In terms of the ability to osseointegrate, there are three types of bone quality:

1. Bone with normal healing potential (BHP-1)
2. Bone with an average healing potential (BHP-2)
3. Bone with a low healing potential (BHP-3)

This latter category is found in the anterior region (10 %) and even more often in the posterior region of the upper jaw (40 %).

The principal disadvantage of the previous classifications is that they are two-dimensional representations, which fail to reflect the three-dimensionality of the anatomical structures. This is evidenced by the findings of studies such as those by [11, 14, 18-20].

Currently, a doctor can combine a three-dimensional assessment of the maxillofacial vascular system and image-guided surgery with the help of CRT. Software for diagnostic and planning purposes is available to assist in the creation of diagnostic and implant positioners (e.g. Virtual Implant Plan (VIP), Implant Logic Systems (ILS), Cedarhurst, USA; Simplant, Materialize, Belgium; Easy Guide, Keystone Dental, USA. [21, 22]

The authors (Juodzbalys Y, et al., 2004) proposed a classification (eJDS) of jawbone anatomy for implantation based on anatomical, clinical and radiological assessment of the jaw [23]. However, this classification does not allow for variations in mandibular anatomy and the risk of damage to the LJ nerve. The advent of cone beam computed tomography has led to a significant enhancement in radiographic technology, thereby facilitating more accurate diagnostic capabilities, particularly in the context of the assessment of the LJ canal.

American researchers Misch KE and Judy KW [7] classified the available bone into four sections: abundant; barely adequate; compromised; and deficient (AD). Bone classified as abundant does not require augmentation and is more than 5 mm wide, 10-13 mm high and 7 mm long. Barely adequate bone is defined as being between 2.5 and 5 mm wide, greater than 10 to 13 mm in height and greater than 12 mm in length. This bone can be modified with osteoplasty or hard or soft tissue augmentation, depending on the nature of the defect. Bone deficits necessitate substantial hard tissue restoration from extraoral sources and are typically incompatible with implant rehabilitation.

American researchers Misch K and Judy K [7] have identified four categories of partial tooth loss based on the degree of atrophy and the potential for prosthetic restoration.

Group A: The quantity of bone is sufficient to permit the placement of implants in the lower and upper jaws. Nevertheless, even under such favorable conditions, the lower jaw is subject to limitations due to its anatomical features. In such cases, the recommended treatment is the provision of a removable or distal cantilever bridge.

Group B: the bone volume is less substantial. Screw and cylindrical implants can be placed on both the lower and upper jaws, although they are smaller in size. However, the prognosis may be less favorable, depending on the quality of the bone.

Group C: The existing lower jaw bone allows for the placement of short screw and cylindrical implants in the area between the natural chin canals. In certain instances, it may be necessary to relocate the inferior cervical nerve, which may necessitate cervical ridge augmentation or sinus lift.

Group D: The cellular component and areas of the basal bone of the mandible are atrophied.

In any case, the placement of intraosseous dental implants is contraindicated. Implant prosthetics is possible only after mandibular plastic surgery and bone augmentation.

A Ukrainian scientist (Ugryn M.M.) proposed a definition of four levels of implant intervention in different methods of rehabilitation of patients with complete absence of teeth using implants in accordance with the characteristics of the four levels of implant rooting tactics, depending on the time from the moment of tooth loss to implantation and prosthetics [25].

Misch CE presented five options for prosthetics using dental implants [4, 7, 11, 12, 14, 15]. The first three types of prostheses are fixed, fully or partially restore the dentition, and are fixed with cement or screws. The last two types of prostheses are removable, but their use is limited not by the form of the prosthesis but by the number of implants[18].

Conclusion. Consequently, none of the classifications provides comprehensive information and does not encompass all the clinical features of partial tooth loss. It is therefore evident that a rational treatment plan can be formulated on the basis of morphological and functional classification features, including the relative position of the retained teeth and edentulous areas, conditions for the perception and distribution of the chewing load, in particular the degree and type of atrophy of the collar ridge, as well as the number of occlusal support zones in the areas of premolars and molars. A review of the scientific literature and the authors' current views on the treatment of partial tooth loss in dental care reveals a significant need for qualified orthopedic treatment in Ukraine, in accordance with modern requirements, in particular the use of prosthetic restorations. The intimate connection between oral health and other aspects of patients' quality of life underscores the necessity for novel interdisciplinary collaboration and

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