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COMPARATIVE ANALYSIS OF THE EFFECTIVENESS OF REMOVABLE AND NON-REMOVABLE PROSTHODONTICS IN PATIENTS WITH CHRONIC KIDNEY DISEASE AND PARTIAL EDENTULISM

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Abstract: Currently, orthopedic dentistry focuses on the comprehensive rehabilitation of patients, taking into account not only local but also general somatic backgrounds. In particular, the oral health of patients suffering from chronic kidney failure (CKF) has become one of the most urgent problems. This is because the overall immune, metabolic and regenerative capabilities of the body are sharply reduced in such patients, leading to dental problems, specifically a high incidence of premature tooth loss and partial edentulism [1,2].

During the course of kidney disease, under the influence of uremic toxins, dysbiosis, gingival inflammation, mucositis, and atrophic changes in periodontal tissues occur in the oral cavity. This reduces tolerance to materials during the prosthodontic process, complicates the adaptation process, and accelerates tooth loss [3,4]. When choosing the appropriate type of prosthesis specifically for such patients, there are psychological and functional advantages which are of important significance, in addition to there are morphological-mechanical aspects.

Each type of removable and non-removable prosthesis has its own specific advantages and limitations, and when choosing them, the patient's stage of kidney failure, oral cavity status, number of remaining teeth, hygiene level, and general condition must be taken into consideration [5,6]. From this perspective, a mutual comparison of the clinical effectiveness of these two types of prostheses in cases of partial edentulism in patients with kidney disease can serve as a basis for developing an optimal rehabilitation strategy.

Keywords: chronic kidney disease, partial edentulism, removable denture, fixed denture, prosthodontics.

INTRODUCTION

Chronic Kidney Disease (CKD) is a polyetiological and, in most cases, irreversible pathological condition characterized by structural kidney damage and/or a reduction in exocrine and endocrine functions lasting for at least three months, with a tendency toward progressive development. According to modern nephrological concepts, CKD is recognized not simply as a condition limited to renal failure, but as a **systemic syndrome** involving all organs and systems of the body, including the maxillofacial and stomatognathic systems [2, 11].

According to the World Health Organization and data from large-scale epidemiological studies, CKD occurs in approximately **10–13%** of the world's population and is one of the

leading factors causing disability, following cardiovascular diseases. The effectiveness of dental, and specifically prosthodontic, rehabilitation in patients with CKD is directly related to the glomerular filtration rate (GFR) of the kidney and the level of uremic intoxication [19, 20].

Main Etiological Factors of Chronic Kidney Disease

Chronic kidney disease has a polyetiological nature, where factors of various origins ultimately lead to a single final morphological outcome — **a progressive decrease in the number of nephrons and sclerosis of the renal parenchyma.** Etiological factors can be divided into the following main groups based on their pathogenetic direction and clinical significance.

1. Metabolic and Endocrine Factors

Diabetes mellitus, especially type II, is the most leading cause of CKD development. Under conditions of diabetic nephropathy:

- the glomerular basement membrane thickens;
- proliferation of mesangial cells increases;
- glomerulosklerozis is formed.

As a result, this factor accounts for **40–50%** of CKD cases [1, 12]. Microcirculatory insufficiency arising against the background of metabolic disorders leads to trophic changes and decreased regeneration in the oral mucosa, which carries important clinical significance in the practice of orthopedic dentistry.

2. Vascular and Hemodynamic Factors

Arterial hypertension can be both a cause and a consequence of kidney disease. Within the renal arterioles, it induces processes such as:

- hyalinosis;
- destruction of elastic fibers;
- intraglomerular hypertension;

which leads to the secondary destruction of nephrons [8, 14]. Atherosclerotic nephrosclerosis, on the other hand, sharply reduces renal perfusion, accelerating chronic hypoxia and fibrotic processes.

3. Immune-Inflammatory and Autoimmune Processes

Chronic glomerulonephritis (IgA nephropathy, membranous nephritis, membranoproliferative nephritis) belongs to the severe and rapidly progressing forms of CKD. In these cases:

- immune complexes deposit in the glomeruli;
- the complement system is activated;
- fibrosis and sclerosis processes accelerate [7, 9].

According to scientific research, the immunodeficiency state that develops in such patients significantly increases the risk of fungal and bacterial infections in the denture-bearing tissues [19].

4. Nephrotoxic and Medication-Related Factors

Long-term or uncontrolled use of nonsteroidal anti-inflammatory drugs (NSAIDs), aminoglycoside antibiotics, and contrast media leads to processes such as:

- tubulointerstitial nephritis;
- necrosis of tubular epithelial cells;
- interstitial fibrosis [4, 15].

This condition causes the rapid accumulation of nitrogen metabolism products in the body.

5. Obstructive and Urological Factors

Hydronephrosis, which develops against the background of kidney stone disease, urinary tract anomalies, or prostate adenoma, leads to mechanical compression, ischemia, and subsequent atrophy of the renal parenchyma [5, 12]. Table 1.

Table 1. Main etiological factors of chronic kidney disease and their pathogenetic consequences

Etiological Group	Main Diseases	Leading Pathogenetic Mechanism	Dental Significance
Metabolic	Diabetes mellitus	Glomerulosclerosis	Mucosal trophics decrease
Vascular	Arterial hypertension	Intraglomerular hypertension	Periodontal resorption accelerates
Immune	Glomerulonephritis	Immune complex deposition	Risk of infectious complications
Nephrotoxic	NSAIDs, aminoglycosides	Tubulointerstitial fibrosis	Uremic stomatitis
Obstructive	Hydronephrosis	Parenchymal atrophy	Prosthetic adaptation becomes difficult

MATERIALS AND METHODS

This study was organized in a **prospective, randomized, clinical-controlled, and comparative** design. The study focused on the comparative evaluation of the clinical, functional, and psychological effectiveness of **removable, non-removable, and combined orthopedic prostheses** in patients suffering from chronic kidney disease (CKD) with partial edentulism of the dentition.

Research Objective

The objective of the research is to determine the **most optimal orthopedic rehabilitation strategy in patients with CKD**, taking into account the stage of renal failure and the condition of oral tissues, as well as to evaluate the impact of prosthesis types on long-term clinical outcomes.

Number of Patients and Distribution by Groups

A total of **120 patients** were enrolled in the study. The sample size was calculated in advance in order to ensure statistical power (power ≥ 80%, $p<0.05$).

Distribution by groups:

- **Group 1 (n=40)** — patients rehabilitated with non-removable prostheses (bridge, metal-ceramic, or zirconium-based constructions)
- **Group 2 (n=40)** — patients treated with removable prostheses (bugel/clasp, acrylic, or thermoplastic-based prostheses)
- **Group 3 (n=20)** — patients treated using a combined orthopedic approach (implant-supported fixed prostheses + removable elements)
- **Group 4 (n=20)** — control group (healthy individuals without CKD but with partial edentulism of the dentition)

The control group was involved to determine neutral and general changes related to prosthodontics.

Orthopedic treatment in patients suffering from chronic kidney disease (CKD) with partial edentulism of the dentition was performed on the basis of **individual planning.** When choosing the type of prosthesis, the patient's general somatic status, the stage of renal failure, the condition of the periodontium and jaw bones, as well as the trophic capabilities of the oral mucosa were taken into account. Taking into account clinical, technological, and biomechanical aspects regarding removable and non-removable prostheses, the following sequential steps were implemented.

Thus, the planning and manufacturing stages of removable and non-removable prostheses were carried out based on an individual, cautious, and step-by-step approach in patients with CKD. Taking into account the condition of the periodontium and bone tissue, the sensitivity of the mucosa, and the general somatic background in each clinical case was an important factor ensuring the success of orthopedic treatment.

Chronic kidney disease (CKD) is accompanied not only by metabolic and somatic changes, but also by profound disorders in the central and peripheral nervous systems. In the process of dental orthopedic rehabilitation, especially when choosing the type of prosthesis, the neurological status of the patient (uremic neuropathy, cognitive functions, and psychoemotional stability) plays a decisive role. Towards the terminal stages of CKD, peripheral uremic neuropathy develops in patients, which alters the sensitivity (paresthesia or hypoesthesia) of the oral mucosa. The decrease in sensitivity leads to late detection by the patient of pressure ulcers (erythemas) in the denture-bearing area. For this reason, when designing removable prostheses in patients with low neurological status, high-precision functional impression methods and consideration of neuromuscular balance are mandatory.

Depressive disorders and high levels of anxiety (according to the HADS scale) are detected in 35–55% of patients with CKD. From a neurological point of view, this condition complicates biopsychosocial adaptation to the prosthesis.

As determined in our research, the adaptation period to removable prostheses in patients with an existing depressive background lasts 1.5–2 times longer compared to somatically healthy individuals. In patients with high scores according to the Hamilton scale, neuromuscular adaptation (the formation of a chewing stereotype) is inhibited, which increases the risk of refusing to use the prosthesis by up to 25–30%. Disorders of mineral metabolism (renal osteodystrophy) and calcium-phosphorus imbalance affect not only the bone, but also neuromuscular conduction.

A neurology consultation helps to detect pathological tone (hypertonicity or hypotonia) of the masticatory muscles. In the research, it was found that chewing efficiency was reduced by an average of 20–30% in patients with stage III CKD. In this scenario, neurological correction (B-complex vitamins, sedative therapy) is considered an integral part that increases the effectiveness of orthopedic treatment. When choosing the type of prosthesis (removable or non-removable) in patients with CKD, it is necessary to consider the patient's neurotransmitter balance and psychovegetative status, rather than relying solely on bone density and tooth condition. This approach improves "doctor-patient" cooperation and guarantees long-term clinical outcomes.

RESULTS

It is recommended to administer HADS (Hospital Anxiety and Depression Scale) and SF-36 (Quality of Life) questionnaires to all patients with CKD prior to prosthodontic treatment. In patients with symptoms of uremic neuropathy (numbness or burning sensation of the tongue), bioinert materials such as zirconium or thermoplastics should be used in the fabrication of the denture base.

In cases where neuroemotional instability is identified, carrying out orthopedic treatment in parallel with psychoprophylactic procedures prescribed by a neurologist shortens the adaptation period.

During the research, a direct correlation was identified between the filtration capacity of the kidney and the adaptation of patients to orthopedic prostheses. From a neurological point of view, as renal failure deepened (from stage G2 to stage G3), an increase in sensory and motor dysfunctions was observed in the patients.

The screening results conducted using the HADS scale showed that a high level of anxiety and depressive states are present in **42% of patients** with stage III CKD. This condition negatively affects the formation of neuromuscular memory:

In the G2 group: The period for patients to accept the prosthesis "as their own teeth" averaged 14 days.

In the G3 group: Due to signs of uremic intoxication and neuropathy, the adaptation period extended up to 25–30 days.

The effectiveness of orthopedic rehabilitation in patients with CKD depends not only on the prosthetic construction, but also **on the reactivity of the central nervous system**, which is

related to the functional state of the kidneys. In patients with a GFR rate lower than 45 ml/min, conducting orthopedic treatment under neurological monitoring is a scientifically justified necessity. Concluded research has shown that the orthopedic rehabilitation of partial edentulism of the dentition in patients suffering from chronic kidney disease (CKD) is not only a dental problem, but a profound **biopsychosocial and neurological** one.

A comparative analysis conducted using neurological status (HADS scales) showed that for patients with symptoms of uremic neuropathy, prostheses fabricated from **bioinert materials (zirconium dioxide, thermoplastic)** are the most effective means to normalize mucosal sensitivity and accelerate neuromuscular adaptation.

Before formulating an orthopedic treatment plan for patients with CKD, it is strictly recommended to evaluate the patient's psychoemotional status (according to the HADS scale) along with the kidney filtration capacity (GFR).

For patients with identified neurological and psychoemotional instability, it is recommended to administer **sedative therapy and Nucleo CMF medications** under the supervision of a neurologist in parallel with dental procedures during the adaptation period (the first 1 month).

CONCLUSION

Practical recommendations developed based on these results allow for the implementation of **an individual, biologically safe, and prognosis-oriented approach** in the orthopedic rehabilitation of patients with CKD. The integration of these recommendations into clinical practice serves to improve the patients' quality of life, minimize the risk of complications, and stabilize the outcomes of orthopedic treatment.

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