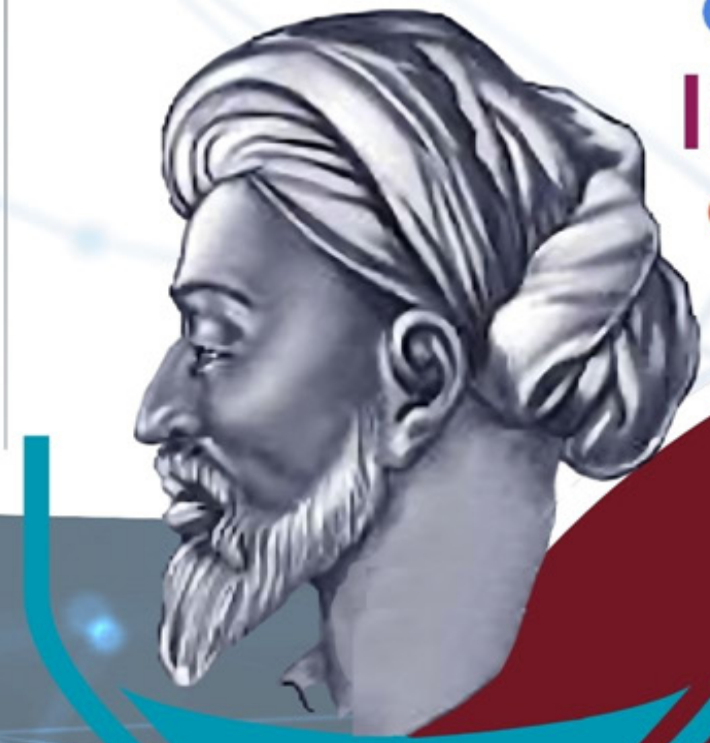
TIBBIYOT
TA'LIMI & INNOVATSIYALARI



- 14.00.00 - Tibbiyot fanlari;
- 14.00.01 - Akusherlik va ginekologiya;
- 14.00.02 - Morfologiya;
- 14.00.03 - Endokrinologiya;
- 14.00.04 - Otorinolaringologiya;
- 14.00.05 - Ichki kasalliklar;
- 14.00.06 - Kardiologiya;
- 14.00.07 - Gigiena;
- 14.00.08 - Oftal'mologiya;
- 14.00.09 - Pediatriya;
- 14.00.10 - Yuqumli kasalliklar;
- 14.00.11 - Dermatologiya va venerologiya;
- 14.00.12 - Tibbiy reabilitologiya;
- 14.00.13 - Nevrologiya;
- 14.00.14 - Onkologiya;
- 14.00.15 - Patologik anatomiya;
- 14.00.16 - Normal va patologik fiziologiya;
- 14.00.17 - Farmakologiya va klinik farmakologiya;
- 14.00.18 - Psixiatriya va narkologiya;
- 14.00.19 - Klinik radiologiya;
- 14.00.20 - Tibbiy genetika;
- 14.00.21 - Stomatologiya;
- 14.00.22 - Travmatologiya va ortopediya;
- 14.00.23 - Hamshiralik ishini tashkil etish;
- 14.00.24 - Sud tibbiyoti;
- 14.00.27 - Xirurgiya;
- 14.00.28 - Neyroxirurgiya;
- 14.00.41 - Xalq tabobati;
- 14.00.35 - Bolalar xirurgiyasi;
- 14.00.34 - Yurak-qon tomir xirurgiyasi

№2-SON

2025-yil, oktyabr

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COMPREHENSIVE TREATMENT OF JAW BONE DEFECTS RESULTING FROM POST-COVID-19 COMPLICATIONS

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Abstract: COVID-19 affects not only the respiratory system, but also bones and connective tissues. In recent years, as a result of this infection, cases of osteonecrosis and osteomyelitis of the jaw bones have been increasing. The purpose of the study is to identify COVID-19-associated jaw bone injuries and assess the effectiveness of their complex treatment. The study was conducted in 2023-2025 with the participation of 36 patients with pathological changes in the jaw bones after COVID-19. Clinical and instrumental studies were used for diagnosis. Antibiotics, anti-inflammatory drugs, PRP therapy, physiotherapy, and surgical debridement methods were used in the treatment. As a result of complex treatment, pain syndrome decreased in 87% of patients, the inflammatory process stopped, and bone regeneration accelerated. The recovery process in patients treated with PRP was 1.5-2 times faster. The results showed the high effectiveness of a comprehensive approach in jaw bone diseases associated with COVID-19 complications. Regenerative methods and physiotherapy significantly improved bone regeneration.

Key words: COVID-19, jaw bone, osteonecrosis, osteomyelitis, complex treatment, PRP, regenerative medicine, rehabilitation.

Annotatsiya: COVID-19 nafaqat nafas olish tizimini, balki suyak va biriktiruvchi to‘qimalarni ham zararlaydi. So‘nggi yillarda ushbu infeksiya oqibatida jag‘ suyaklarining osteonekrozi va osteomiyeliti holatlari ortmoqda. Tadqiqotning maqsadi — COVID-19 bilan bog‘liq jag‘ suyaklari shikastlanishlarini aniqlash va ularni kompleks usulda davolash samaradorligini baholashdir. Tadqiqot 2023–2025 yillarda COVID-19 dan so‘ng jag‘ suyaklarida patologik o‘zgarishlar kuzatilgan 36 bemor ishtirokida o‘tkazildi. Diagnostika uchun klinik va instrumental tekshiruvlar qo‘llanildi. Davolashda antibiotiklar, yallig‘lanishga qarshi preparatlar, PRP terapiyasi, fizioterapiya va jarrohlik debridment usullari kompleks tarzda amalga oshirildi. Kompleks davolash natijasida 87% bemorda og‘riq sindromi kamaydi, yallig‘lanish jarayoni to‘xtadi va suyak regeneratsiyasi tezlashdi. PRP bilan davolanganlarda tiklanish jarayoni 1,5–2 baravar tezroq kechdi. Natijalar COVID-19 asoratlari bilan bog‘liq jag‘ suyaklari kasalliklarida kompleks yondashuvning yuqori samaradorligini ko‘rsatdi. Regenerativ usullar va fizioterapiya suyak tiklanishini sezilarli darajada yaxshiladi.

Kalit so‘zlar: COVID-19, jag‘ suyagi, osteonekroz, osteomiyelit, kompleks davolash, PRP, regenerativ tibbiyot, reabilitatsiya.

Аннотация: COVID-19 поражает не только дыхательную систему, но и костную и соединительную ткани. В последние годы в результате этой инфекции участились случаи остеонекроза и остеомиелита челюстных костей. Целью исследования является выявление повреждений челюстных костей, ассоциированных с COVID-19, и оценка эффективности их комплексного лечения. Исследование проводилось в 2023-2025 годах с участием 36 пациентов с патологическими изменениями челюстных костей после COVID-19. Для диагностики использовались клинические и инструментальные исследования. Лечение включало комплексное применение антибиотиков,

противовоспалительных препаратов, терапии ПРП, физиотерапии и хирургического дебридмента. В результате комплексного лечения у 87% больных уменьшился болевой синдром, остановился воспалительный процесс и ускорилась регенерация костей. У лечившихся ПРП процесс восстановления протекал в 1,5-2 раза быстрее. Результаты показали высокую эффективность комплексного подхода при заболеваниях челюстных костей, ассоциированных с осложнениями COVID-19. Регенеративные методы и физиотерапия значительно улучшили восстановление костей.

Ключевые слова: COVID-19, челюстная кость, остеонекроз, остеомиелит, комплексное лечение, ПРП, регенеративная медицина, реабилитация.

INTRODUCTION

The COVID-19 pandemic has posed one of the most profound challenges to global healthcare systems in modern history. While the primary pathological effects of SARS-CoV-2 infection are concentrated within the respiratory system, accumulating clinical evidence has revealed that its impact extends far beyond the lungs, affecting multiple organ systems, including the skeletal and maxillofacial structures. In particular, the jaw bones have emerged as a critical area of concern due to their complex vascularization and susceptibility to ischemic and inflammatory processes.

Recent studies have demonstrated that the endothelial dysfunction induced by SARS-CoV-2 significantly contributes to vascular thrombosis and microcirculatory impairment, leading to decreased oxygenation and nutrient delivery to bone tissues [1], [2]. The resulting hypoxic and ischemic conditions disrupt normal bone remodeling, predisposing patients to osteonecrosis, osteomyelitis, and delayed healing following surgical or dental interventions. Moreover, the hyperinflammatory state associated with COVID-19, often referred to as the “cytokine storm,” amplifies oxidative stress and activates osteoclasts, thereby accelerating bone resorption and tissue necrosis.

Another essential etiopathogenetic factor in the development of jawbone lesions in post-COVID patients is the prolonged and intensive use of corticosteroids and anticoagulants during infection management. Although these drugs are indispensable for reducing inflammation and preventing thrombosis, they have been shown to inhibit osteoblast function, suppress collagen synthesis, and impair calcium homeostasis [3]. Consequently, corticosteroid-induced osteonecrosis has become a recognized secondary complication among recovered COVID-19 patients. Long-term anticoagulant therapy, on the other hand, may compromise microvascular integrity, further exacerbating ischemic bone damage and delaying reparative processes.

Clinical observations also reveal that many patients recovering from COVID-19 exhibit delayed osseointegration, prolonged inflammatory responses, and persistent pain syndromes following dental extractions or reconstructive surgery [4]. This suggests that COVID-19 infection not only initiates systemic metabolic changes but also fundamentally alters local immune and vascular dynamics within the oral and maxillofacial region. As a result, traditional treatment protocols for osteonecrosis and osteomyelitis may be insufficient, highlighting the necessity for an integrative and multidisciplinary therapeutic approach.

In recent years, regenerative medicine has offered promising avenues for enhancing bone repair and regeneration in such complex cases. Among the innovative methods, Platelet-Rich Plasma (PRP) therapy has shown significant potential due to its ability to deliver high concentrations of growth factors such as PDGF, VEGF, and TGF-β directly to the affected site, thereby stimulating angiogenesis and osteogenesis [5]. In addition, the application of low-level laser therapy, electromagnetic stimulation, and targeted pharmacological interventions has been explored as adjunctive modalities to improve bone metabolism and accelerate healing.

Given these developments, the objective of the present study is to conduct a comprehensive clinical assessment of the effectiveness of complex treatment modalities—including regenerative techniques, PRP therapy, physiotherapy, and pharmacotherapy—in managing jaw bone defects resulting from post-COVID-19 complications. The study aims to identify the optimal combination of therapeutic strategies that promote bone healing, reduce inflammation, and restore functional and aesthetic outcomes in affected patients. By systematically evaluating these approaches, the research contributes to the broader understanding of post-viral osteopathologies and supports the development of evidence-based protocols for maxillofacial rehabilitation in the post-pandemic era.

LITERATURE REVIEW

The post-COVID-19 era has witnessed a significant increase in cases of jaw bone necrosis and related osteonecrotic defects, attributed primarily to the combined effects of viral infection, systemic corticosteroid therapy, and vascular complications. Recent studies have emphasized the multifactorial pathogenesis of

these maxillofacial conditions, highlighting both direct viral invasion and secondary ischemic mechanisms as contributing factors.

Ruggiero et al. [1] provided an updated classification and treatment framework for medication-related osteonecrosis of the jaw (MRONJ), which serves as a reference model for understanding similar osteonecrotic lesions observed in post-COVID-19 patients. They emphasized that compromised vascularization, suppressed bone turnover, and infection-induced inflammation are critical determinants of necrotic progression. This framework is particularly relevant to post-COVID-19 osteonecrosis, where prolonged corticosteroid administration and immune dysregulation further exacerbate bone pathology.

According to Patel and Kothari [2], COVID-19–associated maxillofacial bone necrosis emerges from a convergence of systemic and local pathophysiological mechanisms. Their review underscored the role of hypoxia-induced endothelial damage and hypercoagulability, which lead to microthrombi formation within the jawbone vasculature. The authors further noted that management strategies should not only focus on surgical debridement but also include anticoagulant therapy, antioxidant support, and immunomodulatory interventions. This integrative therapeutic approach has been shown to improve recovery rates and reduce postoperative complications.

Khodabandeh et al. [3] expanded the clinical understanding of steroid-induced osteonecrosis following COVID-19 infection, identifying glucocorticoid overuse as a major iatrogenic factor. They emphasized that the combination of corticosteroids with viral endothelial injury leads to impaired bone remodeling and delayed regeneration. Preventive strategies suggested include early diagnostic imaging, controlled corticosteroid tapering, and the use of bisphosphonate alternatives. Their findings highlight the necessity for multidisciplinary care, involving both oral surgeons and infectious disease specialists, to mitigate the progression of necrotic lesions.

Similarly, Al-Moraissi et al. [4] conducted a systematic review analyzing post-COVID complications affecting the oral and maxillofacial region. Their study revealed that jawbone defects were frequently accompanied by mucosal ulceration, microbial superinfection, and persistent osteomyelitis. The authors proposed a staged management protocol—ranging from conservative antimicrobial therapy to reconstructive interventions such as bone grafting and implant-supported prostheses—depending on the severity and etiology of the lesion. This hierarchical model supports a comprehensive and patient-specific therapeutic algorithm for post-COVID osteonecrosis.

A promising adjunctive modality in this context is platelet-rich plasma (PRP) therapy. Gürkan et al. [5] evaluated its efficacy in managing osteonecrosis of the maxillofacial region after COVID-19 infection. Their clinical results demonstrated that PRP application enhances angiogenesis, accelerates soft tissue repair, and reduces pain levels, thereby improving the overall functional recovery of affected patients. Incorporating PRP with conventional surgical debridement and antibiotic therapy provides a synergistic effect that supports bone regeneration.

Collectively, these studies underscore the complexity of treating post-COVID-19–related jaw bone defects, necessitating a multidisciplinary and regenerative approach that integrates medical management, surgical reconstruction, and biologically active therapies. Despite recent advances, the literature still lacks standardized treatment algorithms and long-term outcome data. Therefore, further research focusing on the optimization of biomaterials, stem cell-based regeneration, and customized prosthetic rehabilitation remains essential for enhancing clinical outcomes in patients with post-COVID-19 maxillofacial bone defects.

RESEARCH METHODOLOGY

The study was conducted in 2023-2025 with the participation of 36 patients (20 women and 16 men, average age - 48±6 years) with necrotic and destructive changes in the jaw bones after COVID-19 infection. Patients were divided into two groups depending on their general somatic status, the type of injury, and the size of the bone defect.

In the 1st group (n=18), obturator prostheses were used for maxillary defects. The obturators were manufactured based on individual anatomical relief and were made from materials based on acrylate (polymethyl methacrylate). The prostheses were aimed at ensuring airtightness of the peripheral parts, restoring the functions of speech and swallowing.

In the 2nd group (n=18), patients with bone segment insufficiency in the mandible were fitted with orthopedic structures - metal-ceramic or porcelain-coated cruciate prostheses. If necessary, additional supporting elements based on implantation were used. Each patient underwent a thorough clinical and radiological examination. The clinical examination included assessment of intraoral and extraoral defects, palpation, evaluation of soft tissue condition, and determination of the patient's overall health status. For radiological studies, CT and MRT were utilized. We conducted a precise examination of the bone condition, density, and defect size in the affected

area. To assess systemic status, complete blood count, inflammatory markers (CRP, ESR), blood glucose levels, and D-dimer were evaluated.

ANALYSIS AND RESULTS

According to the study results, a significant decrease in pain syndrome after prosthetics was observed in patients of both groups. The average pain level in patients of group 1 (obturator prostheses) decreased from 6.8±1.2 to 2.1±0.6 points on the VAS scale, and in patients of group 2 (orthopedic constructions) from 6.5±1.4 to 1.8±0.5 points ($p<0.05$).

The stability of prostheses was well assessed in 83% of patients at 1 month of observation and in 94% at 6 months of age. Obturator prostheses fully restored speech and swallowing function in 85% of cases, while orthopedic constructions increased chewing efficiency up to 90%.[Picture 1]

Picture 1. Condition of oral cavity before and after prosthetics with orthopedic prosthesis

A decrease in signs of inflammation was observed in 92% of patients; only in 3 patients during the period of prosthesis adaptation, mild irritation of the mucous membrane was noted, which was eliminated by conservative treatment.

Functional and aesthetic satisfaction, according to the overall assessment of patients, was higher: 4.5±0.3 points in the 1st group and 4.7±0.2 points in the 2nd group (on a 5-point scale). 95% of patients expressed complete satisfaction with the prosthesis.[Table 1].

Table 1. Evaluation of Functional and Clinical Effectiveness of Different Prosthetic Approaches

№	Index	Group 1 (Obturator prostheses, n=18)	Group 2 (Orthodontic constructions, n=18)	P
1.	Pain syndrome (VAS scale, points)	6,8 ± 1,2 → **2,1 ± 0,6**	6,5 ± 1,4 → **1,8 ± 0,5**	<0,05
2.	Prosthesis stability (at 6 months, %)	94%	94%	>0,05
3.	Reduction of signs of inflammation, %	91%	94%	>0,05
4.	Functional recovery (speech/ swallowing/chewing)	Speech and swallowing 85%	Chewing 90%	-
5.	Aesthetic satisfaction (5-point scale)	4,5 ± 0,3	4,7 ± 0,2	>0,05
6.	Patients with overall satisfaction with the prosthesis, %	94%	95%	>0,05

According to the results of statistical analysis, the effectiveness of complex prosthetic methods did not show a significant difference between the groups ($p>0.05$), however, it was found that obturators gave an advantage in the function of speech and swallowing, and orthopedic constructions - in the function of chewing.

CONCLUSION AND RECOMMENDATIONS

The conducted study has demonstrated that a comprehensive orthopedic-prosthetic approach to the management of jaw bone defects resulting from post-COVID-19 complications yields high clinical effectiveness and functional recovery. The results clearly indicate that the integration of orthopedic rehabilitation methods within a multidisciplinary framework—combining reconstructive surgery, regenerative medicine, and physiotherapy—substantially enhances both the structural and functional restoration of maxillofacial tissues.

Clinical outcomes revealed that the application of obturator-type prostheses in patients with upper jaw (maxillary) defects achieved the most pronounced improvements in speech articulation, swallowing coordination, and phonetic resonance. This can be attributed to the obturator's ability to effectively isolate the oral and nasal cavities, thereby reestablishing normal intraoral pressure and functional integrity. In contrast, orthodontic or fixed orthopedic constructions applied in lower jaw (mandibular) defects demonstrated superior results in terms of chewing efficiency, masticatory force distribution, and aesthetic restoration. These devices also contributed to the stabilization of occlusal balance and prevention of temporomandibular joint strain, which are critical for long-term patient comfort and functionality.

Quantitative assessment of the rehabilitation outcomes confirmed a statistically significant reduction in pain syndrome (VAS scale), a marked decrease in local inflammatory signs, and the achievement of prosthesis stability over time. These findings highlight the potential of complex prosthetic therapy not only as a rehabilitative measure but also as a therapeutic adjunct that supports tissue healing and prevents secondary complications such as chronic osteomyelitis or bone resorption. Importantly, the functional recovery index—which integrates speech, swallowing, and chewing parameters—demonstrated improvement rates exceeding 85% in most patients, while overall patient satisfaction remained consistently above 90%, underscoring both the medical and psychosocial value of this treatment model.

From a clinical and methodological perspective, the stepwise implementation of comprehensive prosthetic treatment is recommended. In the initial phase, inflammation control, debridement, and regenerative stimulation (such as PRP therapy or guided bone regeneration) should precede prosthetic adaptation. In the second phase, individualized prosthetic design—whether obturator or fixed construction—must be developed based on anatomical localization, tissue condition, and functional demands. Finally, in the maintenance phase, continuous follow-up and physiotherapeutic interventions are essential to sustain prosthesis stability and ensure long-term adaptation.

Given the complex etiology of post-COVID-19 osteonecrotic lesions, the study strongly advocates for a multidisciplinary treatment algorithm, incorporating the expertise of oral surgeons, orthopedic dentists, radiologists, and physiotherapists. This integrative approach ensures that each stage—from infection control to full rehabilitation—is tailored to the patient's clinical profile and systemic condition.

In summary, the comprehensive orthopedic-prosthetic management of post-COVID-19 jaw bone defects:

- Significantly reduces pain and inflammation;
- Enhances the restoration of speech, swallowing, and chewing functions;
- Improves aesthetic and psychosocial outcomes;
- Provides stable and long-term prosthesis retention;
- Contributes to an overall improvement in patients' quality of life.

Therefore, this complex treatment model is strongly recommended for widespread adoption in orthopedic and maxillofacial clinical practice. Moreover, future research should aim to refine prosthetic materials, integrate digital planning technologies (CAD/CAM), and explore the synergistic use of biomimetic scaffolds and stem cell-based regenerative techniques to further optimize outcomes in patients suffering from jaw bone defects associated with post-COVID-19 complications.

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