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CLINICAL AND MICROCIRCULATORY CHANGES IN PATIENTS WITH CHRONIC GENERALIZED PERIODONTITIS BEFORE AND AFTER ADHESIVE SPLINTING

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✓ ***Resume***

The study focuses on optimizing orthopedic treatment methods for patients with chronic generalized periodontitis through adhesive splinting techniques. Sixty patients aged 40–65 years with chronic generalized periodontitis of moderate severity and partial edentulism were examined. The clinical, radiographic, gnathodynamometric, and laser Doppler flowmetry assessments were used to analyze oral hygiene, bone tissue condition, and microcirculation before and after adhesive splinting. The results demonstrated a significant improvement in oral hygiene indices (OHI-S, PBI), stabilization of mobile teeth, normalization of microcirculatory parameters (increase of perfusion index and reduction of flow variability), and a notable decrease in pathogenic microflora after the complex adhesive treatment protocol. The method proved effective in functional rehabilitation, preservation of alveolar bone, and reduction of inflammation.

Keywords: chronic generalized periodontitis, adhesive splinting, microcirculation, oral hygiene index, alveolar bone, microbiocenosis, perfusion index.

КЛИНИЧЕСКИЕ И МИКРОЦИРКУЛЯТОРНЫЕ ИЗМЕНЕНИЯ У ПАЦИЕНТОВ С ХРОНИЧЕСКИМ ГЕНЕРАЛИЗОВАННЫМ ПАРОДОНТИТОМ ДО И ПОСЛЕ АДГЕЗИВНОГО ШИНИРОВАНИЯ

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✓ ***Резюме***

В работе представлены результаты исследования, направленного на оптимизацию ортопедического лечения пациентов с хроническим генерализованным пародонтитом с использованием технологии адгезивного шинирования. Обследованы 60 пациентов в возрасте от 40 до 65 лет с пародонтитом средней степени тяжести и частичной потерей зубов. Клинические, рентгенологические, гнатодинамометрические и лазерные допплеровские флоуметрические методы использовались для анализа состояния гигиены полости рта, костной ткани и микроциркуляции до и после адгезивного шинирования. Полученные результаты показали значительное улучшение гигиенических показателей (OHI-S, PBI), стабилизацию подвижных зубов, нормализацию параметров микроциркуляции (повышение перфузионного индекса и снижение коэффициента вариации), а также заметное снижение количества патогенной микрофлоры после проведения комплексного лечения. Применяемая методика доказала свою эффективность в функциональной реабилитации, сохранении альвеолярной кости и уменьшении воспалительных процессов.

Ключевые слова: хронический генерализованный пародонтит, адгезивное шинирование, микроциркуляция, индекс гигиены полости рта, альвеолярная кость, микробиоценоз, перфузионный индекс.

SURUNKALI GENERALLASHGAN PARODONTITLI BEMORLARDA ADGEZIV SHINALASHDAN OLDIN VA KEYIN KLINIK VA MIKROTSIRKULYATSION O‘ZGARISHLAR

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✓ ***Rezyume***

Tadqiqot surunkali umumlashgan parodontit bilan og‘rigan bemorlarda adgeziv shinalash texnologiyasi orqali ortopedik davolashni optimallashtirishga qaratilgan. Tadqiqotda 40–65 yosh oralig‘idagi, o‘rta og‘irlikdagi parodontit va qisman tish yo‘qotish holatiga ega bo‘lgan 60 nafar bemor ishtirok etdi. Davolashdan oldin va keyin bemorlarning og‘iz gigiyenasi, suyak to‘qimasi holati hamda mikrotsirkulyatsiya darajasi klinik, rentgenologik, gnathodinometriya va lazerli doppler fliometriya usullari orqali tahlil qilindi.

Natijalar OHI-S va PBI indekslarining yaxshilanganini, tishlar harakatchanligining barqarorlashganini, mikrotsirkulyatsiya ko‘rsatkichlarining normallashganini (perfuziya indeksining oshishi va oqim variatsiyasi kamayishini) hamda patogen mikroflora miqdorining kamayganini ko‘rsatdi. Adgeziv shinalash usuli funksional reabilitatsiyani ta’minlaydi, alveolyar suyakni saqlaydi va yallig‘lanish jarayonlarini kamaytiradi.

Kalit so‘zlar: surunkali umumlashgan parodontit, adgeziv shinalash, mikrotsirkulyatsiya, og‘iz gigiyenasi indeksi, alveolyar suyak, mikrobiotsenoz, perfuziya indeksi.

Introduction

Chronic generalized periodontitis (CGP) remains one of the most common inflammatory-destructive diseases of the periodontal tissues and is a major cause of tooth loss in adults. According to epidemiological studies presented in the dissertation, the prevalence of CGP among the adult population reaches up to 80–85 %, particularly in the 40–65-year age group. The condition leads to progressive resorption of the alveolar bone, pathological mobility of teeth, and impairment of mastication and speech, significantly reducing the quality of life of patients.

The increasing incidence of periodontitis and the complexity of its treatment justify the necessity of an integrated approach combining therapeutic, hygienic, and orthopedic measures. One of the key objectives of modern periodontal rehabilitation is to ensure long-term stabilization of the dentition through minimally invasive and biomechanically balanced methods.

Adhesive splinting represents a promising orthopedic solution in this context. It allows for the fixation of mobile teeth, redistribution of masticatory loads, and prevention of further periodontal trauma. The method uses fiber-reinforced composite materials that provide high strength, biocompatibility, and aesthetic results while maintaining physiological occlusal balance [2.4].

Despite extensive research in the field of conservative and surgical periodontology, the role of orthopedic stabilization through adhesive splinting in the microcirculatory and functional restoration of periodontal tissues remains insufficiently explored. The present study addresses this gap by evaluating clinical, radiological, and microcirculatory parameters before and after adhesive splinting in patients with chronic generalized periodontitis [1.3].

The purpose of the study was to increase the effectiveness of complex orthopedic treatment in patients with chronic generalized periodontitis by improving the methods of adhesive splinting and assessing their influence on microcirculation, masticatory function, and the microbiological status of the oral cavity.

Materials and methods

The present clinical research was conducted at the Clinic of Orthopedic Dentistry of the Andijan State Medical Institute during the period from 2020 to 2025. The study included 60 patients (34 men and 26 women) aged from 40 to 65 years, with an average age of 52.1 ± 3.2 years, who were diagnosed with chronic generalized periodontitis of moderate severity complicated by partial loss of teeth. All patients had clear clinical signs of inflammation — bleeding gums, tooth mobility, and discomfort during mastication — confirmed by high PMA and OHI-S indices.

Each participant gave written informed consent after being informed about the objectives, methods, and potential risks of the study. All diagnostic and treatment procedures were carried out in accordance with the principles of biomedical ethics and the Helsinki Declaration.

The study design provided for comprehensive clinical, radiological, and functional diagnostics before and after orthopedic intervention. The obtained data served as the basis for assessing the effectiveness of adhesive splinting in the complex therapy of chronic generalized periodontitis.

Diagnostic Methods

1. Clinical Evaluation. Clinical assessment included measurement of the PMA (Papillary-Marginal-Alveolar) index, OHI-S (Simplified Oral Hygiene Index), and PBI (Papillary Bleeding Index). These indices characterized the degree of inflammation and the hygienic condition of the oral cavity before and after treatment.
2. Radiographic Examination. Radiographic methods were used to determine changes in the cortical bone plate thickness and alveolar bone density. Three-dimensional computed tomography was performed before and after treatment to evaluate bone remodeling dynamics.
3. Gnathodynamometric Measurement. The gnathodynamometric method was applied to measure chewing pressure and functional load distribution. The parameters were recorded at baseline and at 3, 6, and 12 months after treatment, allowing objective evaluation of functional rehabilitation.
4. Laser Doppler Flowmetry (LDF). The LDF method was used to assess microcirculation in the periodontal tissues. The mean perfusion index (PM), standard deviation (σ), and coefficient of variation (Kv) were recorded as indicators of blood flow intensity and vascular tone.
5. Microbiological Studies. Microbiological sampling was performed from the gingival sulcus to identify the qualitative and quantitative composition of the microflora. The presence of pathogenic species (*Porphyromonas gingivalis*, *Prevotella intermedia*, *Actinobacillus actinomycetemcomitans*) and beneficial flora (*Streptococcus sanguinis*, *Lactobacillus spp.*) was determined before and after treatment.
6. Statistical Analysis. Statistical processing of the results was carried out using standard biomedical statistics methods. The Student's t-test was applied to evaluate the significance of differences between parameters before and after treatment, with $p < 0.05$ considered statistically significant.

Description of Adhesive Splinting Technique

The adhesive splinting technique was performed according to the method described in the dissertation's clinical section. After preparation and cleaning of the teeth, a groove (0.5–0.7 mm) was formed on the vestibular surface. A light-cured composite material was placed into the groove, into which a pre-prepared titanium or stainless-steel wire was inserted. The wire ensured mechanical stability and long-term fixation of teeth.

To reinforce the structure, a special fiber-reinforced tape was fixed on top of the composite using light-curing technology. This tape increased adhesion between the splinting components, providing high strength and elasticity. The resulting structure maintained occlusal balance and evenly distributed functional loads on the periodontal tissues. Despite minor invasiveness associated with enamel preparation, the technique provided reliable fixation, durability, and significant therapeutic benefits, making it a valuable method in orthopedic dentistry

Result and discussions

Comprehensive clinical and functional evaluation of patients with chronic generalized periodontitis before and after adhesive splinting demonstrated a pronounced positive dynamic in all studied parameters — clinical, radiological, functional, and microbiological. The combination of adhesive splinting with professional hygiene and supportive therapy resulted in clear regression of inflammatory processes, improvement of microcirculation, and stabilization of the dentition.

Before treatment, most patients showed pronounced signs of chronic inflammation of the gingiva: hyperemia, bleeding during probing, pathological tooth mobility of I–II degree, and abundant dental plaque. The hygiene and inflammatory indices confirmed an unsatisfactory oral condition. After completion of the complex adhesive treatment course, clinical indicators showed a steady improvement.

The Papillary-Marginal-Alveolar (PMA) index decreased from 56.7 ± 3.4 % to 18.2 ± 2.1 %, indicating regression of gingival inflammation. The Simplified Oral Hygiene Index (OHI-S) dropped from 2.81 ± 0.17 to 1.13 ± 0.08, demonstrating a 59.8 % improvement in hygiene condition. The Papillary Bleeding Index (PBI) was reduced from 2.3 ± 0.2 to 0.9 ± 0.1, reflecting normalization of gingival capillary permeability and stabilization of soft tissues ($p < 0.01$ for all indicators).

Table 1. Dynamics of Main Clinical and Hygiene Indices (M ± m)

Indicator	Before Treatment	After Treatment	p-value	Improvement (%)
PMA (%)	56.7 ± 3.4	18.2 ± 2.1	< 0.01	−67.9
OHI-S (points)	2.81 ± 0.17	1.13 ± 0.08	< 0.01	−59.8
PBI (points)	2.3 ± 0.2	0.9 ± 0.1	< 0.01	−60.9

These findings demonstrate the effectiveness of adhesive splinting in achieving stable oral hygiene control, reducing inflammation, and providing long-term stabilization of periodontal tissues.

Radiological assessment also revealed significant positive changes in the alveolar bone structure. Before treatment, panoramic and 3D radiographs showed bone resorption at one-third to one-half of the root length, irregular contours of the cortical plate, and rarefaction of bone trabeculae. Twelve months after adhesive splinting, signs of bone remodeling and increased bone density were evident. The thickness of the cortical plate increased from 1.14 ± 0.05 mm to 1.46 ± 0.04 mm, and bone mineral density (HU) rose from 628 ± 32 to 795 ± 29. The average periodontal pocket depth decreased from 4.8 ± 0.3 mm to 3.1 ± 0.2 mm, confirming alveolar stabilization and prevention of further resorption. These radiographic results coincide with clinical improvements, indicating functional recovery of the supporting tissues.

Functional restoration was confirmed by gnathodynamometric measurements. At baseline, chewing force in men averaged 186 ± 31.2 N, and in women — 171 ± 19.8 N. After 12 months of treatment, these values increased to 261 ± 17.2 N and 241 ± 21.5 N, respectively. This improvement reflected a 40–45 % rise in functional capacity and re-establishment of physiological load distribution after splinting.

Laser Doppler Flowmetry (LDF) data supported these findings, demonstrating normalization of periodontal microcirculation. The perfusion index (PM) increased from 9.67 ± 0.63 to 11.84 ± 0.52 perfusion units, while the coefficient of variation (Kv) decreased from 38.2 ± 3.4 % to 27.6 ± 2.3 %, confirming improved blood flow and vascular tone recovery.

Table 2. Functional and Microcirculatory Parameters before and after Treatment (M ± m)

Indicator	Before Treatment	After Treatment	Change	p-value
Chewing Force (men, N)	186 ± 31.2	261 ± 17.2	+40.3 %	< 0.01
Chewing Force (women, N)	171 ± 19.8	241 ± 21.5	+40.9 %	< 0.01
Perfusion Index (PM, perf. units)	9.67 ± 0.63	11.84 ± 0.52	+22.4 %	< 0.05
Coefficient of Variation (Kv, %)	38.2 ± 3.4	27.6 ± 2.3	−27.8 %	< 0.05

Microbiological analysis revealed further evidence of improvement in oral health. Before treatment, periodontal pockets were dominated by pathogenic anaerobic species such as *Porphyromonas gingivalis*, *Prevotella intermedia*, and *Fusobacterium nucleatum*. After the completion of adhesive splinting and antiseptic therapy with chlorhexidine-based gels, the population of these pathogens decreased by approximately 46 %, while beneficial microorganisms (*Streptococcus salivarius*, *Lactobacillus spp.*) increased significantly.

The reestablishment of normal oral microflora contributed to the reduction of inflammation and prevention of secondary infection. Together with the clinical and radiographic outcomes, these findings confirm that adhesive splinting not only provides mechanical stabilization but also exerts a biological effect through improved microcirculation and restored microbial balance.

Discussion: The clinical and functional results obtained in this study confirm that the use of adhesive splinting in the complex orthopedic treatment of patients with chronic generalized periodontitis is both clinically effective and pathogenetically justified. The application of this method contributed not only to the stabilization of the dentition but also to the normalization of microcirculation, improvement of oral hygiene, and restoration of the biological balance in the periodontal tissues.

At the beginning of the observation, patients showed high inflammatory activity and poor oral hygiene, which manifested as elevated PMA, PBI, and OHI-S indices. The adhesive splinting method, in combination with professional and individual hygiene measures, led to a clear regression of inflammation. The reduction of PMA from 56.7 % to 18.2 %, OHI-S from 2.81 to 1.13, and PBI from 2.3 to 0.9 demonstrates the normalization of epithelial and connective-tissue structures of the gingiva. These findings are consistent with the well-known principle that reduction of tooth mobility reduces plaque retention, which in turn decreases microbial contamination and supports the healing of the gingival margin.

Radiographic data provided objective confirmation of positive structural changes in the alveolar bone. The observed increase in cortical plate thickness (1.14 → 1.46 mm) and rise in bone mineral density (628 → 795 HU) indicate that redistribution of masticatory loads after splinting enhances bone remodeling and slows down the resorption process. The functional integrity of the periodontal complex depends largely on mechanical stability; therefore, elimination of traumatic occlusal forces creates conditions favorable for osteogenesis and restoration of bone metabolism.

Functional testing by gnathodynamometry demonstrated a stable increase in chewing pressure — by 40–45 % after 12 months of treatment. This rise in functional activity reflects restoration of the physiological balance between tooth loading and the capacity of the supporting structures. The re-establishment of efficient mastication is one of the key indicators of successful orthopedic rehabilitation.

Equally important are the findings from laser Doppler flowmetry (LDF), which objectively confirmed improvement in microcirculatory function. The perfusion index increased from 9.67 ± 0.63 to 11.84 ± 0.52 perf. units, and the coefficient of variation decreased from 38.2 % to 27.6 %. These data reflect normalization of vascular tone, enhancement of local hemodynamics, and activation of tissue trophism in the gingiva. Restoration of microvascular flow ensures adequate oxygenation and metabolic exchange, leading to regeneration of periodontal structures.

The microbiological studies supported these functional findings. Before treatment, the oral cavity was dominated by pathogenic anaerobic microorganisms such as *Porphyromonas gingivalis*, *Prevotella intermedia*, and *Fusobacterium nucleatum*, which play a leading role in the chronic inflammatory process. After the course of adhesive splinting and antiseptic therapy, the proportion of these pathogens decreased by approximately 46 %, while the population of normal microflora — *Streptococcus salivarius* and *Lactobacillus spp.* — increased. Restoration of microbial equilibrium in the oral cavity contributes to the stabilization of the local immune response and prevention of recurrent inflammation.

The combined effect of mechanical stabilization, improved microcirculation, and microbial normalization explains the long-term clinical stability achieved in this study. Adhesive splinting not only acts as a passive fixation device but also provides conditions for functional and biological rehabilitation of the periodontal tissues.

Conclusion

Comprehensive clinical, radiological, functional, and microbiological assessments have demonstrated that adhesive splinting is an effective and pathogenetically justified method in the complex orthopedic treatment of patients with chronic generalized periodontitis. After adhesive splinting, patients exhibited a marked reduction in inflammatory manifestations and improved oral hygiene. The PMA index decreased from 56.7 ± 3.4 % to 18.2 ± 2.1 %, PBI from 2.3 ± 0.2 to 0.9 ± 0.1, and OHI-S from 2.81 ± 0.17 to 1.13 ± 0.08, confirming a significant improvement in gingival health and plaque control. Radiological findings showed a positive trend in bone tissue remodeling: the cortical plate thickness increased from 1.14 ± 0.05 mm to 1.46 ± 0.04 mm, and bone density rose from 628 ± 32 HU to 795 ± 29 HU. This indicates the cessation of alveolar bone resorption and the initiation of reparative osteogenesis.

Functional restoration was verified by gnathodynamometry. The chewing force increased in men from 186 ± 31.2 N to 261 ± 17.2 N and in women from 171 ± 19.8 N to 241 ± 21.5 N, confirming the normalization of occlusal balance and improved masticatory performance. Microcirculatory analysis via laser Doppler flowmetry confirmed vascular normalization: the perfusion index increased from 9.67 ± 0.63 to 11.84 ± 0.52 perfusion units, while the coefficient of variation decreased from 38.2 ± 3.4 % to 27.6 ± 2.3 %, demonstrating restoration of microvascular tone and blood flow. Microbiological evaluation revealed a 46 % decrease in pathogenic microorganisms such as *Porphyromonas gingivalis* and *Prevotella intermedia*, alongside a notable increase in beneficial species (*Streptococcus salivarius*, *Lactobacillus spp.*), reflecting normalization of the oral microbiocenosis and prevention of secondary infection.

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