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Microbiological Condition in Parodont Tissue in Law Enforcement Officers

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Abstract. Periodontal tissue diseases, particularly gingivitis, remain highly prevalent among occupational groups exposed to chronic psychological and physical stress, including law enforcement officers. This study aimed to assess the clinical, hygienic, and microbiological condition of periodontal tissues in law enforcement personnel and to evaluate the efficacy of a complex treatment protocol combining traditional therapy with vacuum-laser massage and phytotherapeutic adjuncts. A total of 145 officers underwent clinical dental examination, hygienic and caries-intensity indexing, quality-of-life questionnaires, and microbiological analysis of oral fluid and gingival-pocket exudate. Patients were divided into a traditional-treatment group (n=60) and a complex-treatment group (n=62) receiving additional oral hydromassage, herbal rinses, pomegranate seed oil application, and vacuum-laser therapy. Catarrhal gingivitis was diagnosed in 84.12% of cases, hypertrophic in 5.52%, and ulcerative in 10.34%. The KPO caries index was 17.94±0.23. Quantitative microbiological analysis revealed high titers of periodontopathogenic and conditionally pathogenic species, including B. gingivalis (7.29±0.28 log CFU/ml) and S. epidermidis (6.6±0.37 log CFU/ml). Following complex treatment, microbial counts of periodontopathogenic and cariogenic species decreased substantially compared with traditional treatment alone, and positive clinical dynamics were observed in 91.9% of cases. These findings support the integration of vacuum-laser and phytotherapeutic adjuncts into standard periodontal-care protocols for high-stress occupational populations.

Keywords: gingivitis; periodontal microbiota; oral hygiene index; law enforcement officers; vacuum-laser therapy; KPO index

1. Introduction

Periodontal and gingival diseases remain among the most prevalent oral conditions worldwide. Plaque-induced gingivitis constitutes a well-defined, site-specific inflammatory condition of the periodontium that, if left unaddressed, may progress to more severe periodontal destruction [1]. Standardized diagnostic and classification frameworks for periodontal and peri-implant diseases and conditions have been developed to unify case definitions across clinical and research settings, reflecting the growing recognition that periodontal health requires systematic, criteria-based assessment [2].

In preventing the development of gingivitis, the primary focus is oral hygiene. Regular removal of the pellicle that forms on the tooth surface interrupts the inflammatory process, and patients are therefore taught the correct dental-cleaning technique and provided individual hygiene recommendations. Contemporary preventive dentistry considers the prevention of dental disease as a

population-level system encompassing improved oral hygiene, regular professional cleaning, fluoride use, and periodic dental examination, all of which reduce bacterial microflora and the risk of disease. According to current scientific understanding, dental disease is closely linked to general health: periodontal inflammation has been associated with systemic conditions such as diabetes mellitus [3], as well as other chronic disorders, including cardiovascular and metabolic disease [4]. Prevention therefore extends beyond the oral cavity to encompass overall health promotion, proper nutrition, and avoidance of harmful habits, underscoring the importance of strengthening preventive approaches within the broader health system.

At the microbiological level, the subgingival microbiota is organized into characteristic bacterial complexes whose composition differs between periodontal health and disease [5]; certain low-abundance species can act as keystone pathogens capable of remodeling a normally benign microbiota into a dysbiotic, disease-associated community [6]. Occupational populations subject to chronic psychological and physical stress, including police and military personnel, have been shown to exhibit poorer periodontal status than the general population, suggesting that occupational stress is itself a modifiable risk factor for periodontal disease [7].

Despite this body of evidence, data characterizing the clinical, hygienic, and microbiological condition of periodontal tissues specifically among law enforcement officers remain limited, and the relative efficacy of complex treatment protocols incorporating physiotherapeutic and phytotherapeutic adjuncts in this population has not been well established. This study therefore aimed to assess the dental and periodontal status of law enforcement officers using standardized clinical, hygienic, and microbiological methods, and to compare the clinical and microbiological outcomes of traditional periodontal treatment with a complex treatment protocol incorporating vacuum-laser therapy and herbal adjuncts.

2. Methods

2.1 Study Design and Participants

The dental and periodontal status of law enforcement officers was assessed through a combination of survey-questionnaire and traditional clinical-examination methods. All findings were recorded on standardized examination cards developed specifically for this study.

2.2 Subjective (Anamnestic) Examination

Subjective assessment captured participants' main complaints, attitudes toward oral hygiene, dental-cleaning habits, frequency of dental-service utilization, history of previous dental disease, participation in preventive activities, and general medical history (past and chronic diseases). Data were collected through individual interviews and a specially developed medical-social questionnaire; anamnestic data were considered important for interpreting clinical outcomes and identifying factors influencing the formation of dental disease.

2.3 Clinical Examination

Clinical examination comprised a complex assessment of dental hard-tissue condition, caries and its complications (pulpitis, periodontitis), presence of fillings and missing teeth, clinical status of periodontal tissue, signs of gingival inflammation, and changes in the oral mucosa (color, moisture, swelling, pain, tooth imprints, pathological elements). All pathological findings were recorded in the outpatient card and re-assessed longitudinally at primary examination, during treatment, and post-treatment.

2.4 Indices and Instruments

Dental caries intensity was quantified using the KPO index (decayed-missing-filled teeth) in accordance with WHO methodology for oral health surveys [8]. Hygienic status was assessed using the Simplified Oral Hygiene Index (OHI-S) [9], together with the periodontal (PI) index and the Schiller-Pisarev test for gingival inflammation; index values were analyzed in aggregate and grouped into low,

moderate, and high hygienic-state categories to enable modeling of the relationship between oral hygiene and clinical inflammation. Oral health-related quality of life was assessed using the 14-item Oral Health Impact Profile (OHIP-14) [10] and the 36-Item Short Form Health Survey (SF-36) [11], instruments widely used internationally to evaluate the physical, psychological, and social dimensions of health-related quality of life.

2.5 Microbiological Analysis

Microbiological analysis was performed on oral fluid and extracts from gingival (periodontal) pockets at the bacteriological laboratory of the Ministry of Internal Affairs. Bacterial species were quantified in log CFU/ml (colony-forming units per milliliter).

2.6 Treatment Protocol

Depending on the treatment and preventive measures administered, patients were divided into two groups. Group 1 (n=60) received traditional periodontal treatment. Group 2 (n=62) received traditional treatment supplemented with: oral hydromassage and rinsing with chamomile tincture and "Colgate Plax" for anti-inflammatory prophylaxis; daily application of pomegranate seed oil and "Asepta Propolis" gel into dental-gingival pockets using individually prepared caps, reflecting reported antibacterial and anti-inflammatory efficacy of Punica granatum-based preparations as an adjunct in gingivitis management [12]; and vacuum-laser massage therapy using the AVLT "Desna" apparatus with a replaceable glass-tip manipulator. This procedure combines vacuum stimulation of gingival microcirculation, based on the Kulazhenko method, with low-intensity laser exposure — an approach consistent with the reported biostimulatory, anti-inflammatory, and wound-healing effects of low-level laser therapy as an adjunct to conventional periodontal treatment [13]. The device generates controlled negative pressure through a nozzle placed on the gingiva, forming a local vacuum zone that increases capillary blood flow, improves microcirculation, activates lymph flow, accelerates epithelial and connective-tissue regeneration, and stimulates fibroblast activity while remaining minimally traumatic. Treatment sessions lasted 5–10 minutes, applied along the alveolar ridge, over a course of approximately 5–10 sessions.

2.7 Statistical Analysis

Research materials were subjected to statistical processing using parametric and non-parametric analysis methods. Initial data collection, correction, systematization, and visualization were performed in Microsoft Office Excel 2016; statistical analysis was implemented using IBM SPSS Statistics v.26.

3. Results

3.1 Clinical and Anamnestic Findings

Clinical-anamnestic surveys of the research groups identified complaints associated with changes in periodontal tissue. Tooth pain was reported by 5.74% of patients (n=7), and tooth sensitivity by 12.29% (n=15). Halitosis (oral malodor) was noted in 6.56% (n=8) of patients; notably, many patients had become so accustomed to the odor that they no longer perceived it themselves, and none associated it with unsatisfactory oral hygiene, instead attributing it to a possible sign of gastritis. A sensation of aching and itching in the gums was reported by 36.88% of patients (n=45), and oral dryness by 9.84% (n=12).

Food impaction between teeth was reported by 25.41% of patients (n=31), tooth mobility ("dental flutter") by 1.64% (n=2), and inefficient chewing during food consumption by 3.28% (n=4). Complaints regarding dental-row condition and aesthetic defects were reported by 9.84% of patients (n=12). Overall, all patients (100% of cases) exhibited clinical-symptomatic complaints characteristic of gingivitis.

3.2 Hygienic and Caries Indices

The KPO index, reflecting caries intensity, was 17.94±0.23. Of its components, the "O" (missing/removed teeth) indicator averaged 5.21±0.12, teeth affected by active caries averaged

3.32±0.07, and the "P" (filled) indicator averaged 9.41±0.17 teeth. Accumulation of dental plaque underlies both caries and periodontal disease: unsatisfactory hygiene predisposes patients to caries complications as well as inflammatory gingival disease. The hygienic-condition model, formulated from PI and OHI-S index values, allowed classification of participants into low, moderate, and high hygienic-status categories and supported differential planning of preventive measures. The Schiller-Pisarev test, assessing gingival inflammation, scored 1.04.

3.3 Oral Microbiota Prior to Treatment

Prior to treatment, the research groups exhibited a characteristic composition of oral microflora comprising gram-negative anaerobic conditionally pathogenic spore-forming periodontopathogenic species (L. buccalis, F. nucleatum, and Fusobacterium spp.), pathogenic aerobes (S. aureus, S. epidermidis, S. mutans, Neisseria spp.), and aerobic/facultative-anaerobic gram-positive non-spore-forming rods (C. xerosis and C. pseudodiphtericum).

Quantitative analysis showed dominance of streptococcal and staphylococcal species: S. mutans 3.34±0.18 log CFU/ml, S. epidermidis 6.6±0.37 log CFU/ml, and S. aureus 6.02±0.24 log CFU/ml, indicating a high level of colonization by conditionally pathogenic coccal flora. Corynebacterium species were also identified at high titers — C. xerosis at 6.54±0.32 log CFU/ml and C. pseudodiphtericum at 5.37±0.21 log CFU/ml — reflecting active participation of resident flora in oral microbiocenosis. Microorganisms of periodontopathogenic significance were detected at high titers: Neisseria spp. 5.63±0.17, Fusobacterium spp. 4.98±0.24, F. nucleatum 5.27±0.28, B. dentium 5.84±0.31, and B. gingivalis 7.29±0.28 log CFU/ml. These findings indicate a substantial microbiological basis for dysbiotic shifts and inflammatory processes within the periodontal pockets of the study population.

3.4 Treatment Outcomes and Post-Treatment Microbiological Dynamics

Following the course of complex treatment, both groups showed improvement in periodontal-tissue inflammation, though the magnitude of microbial reduction differed. In Group 1 (traditional treatment), post-treatment values were: S. mutans 2.98±0.12, S. epidermidis 5.41±0.21, S. aureus 5.37±0.09, C. xerosis 5.69±0.19, and C. pseudodiphtericum 5.04±0.11 log CFU/ml. In Group 2 (complex treatment), corresponding values were lower: S. mutans 2.17±0.05, S. epidermidis 4.32±0.13, S. aureus 3.99±0.12, C. xerosis 4.26±0.14, and C. pseudodiphtericum 3.99±0.12 log CFU/ml.

For periodontopathogenic species, Group 1 post-treatment values were: Neisseria spp. 4.64±0.15, Fusobacterium spp. 4.56±0.17, F. nucleatum 4.76±0.13, B. dentium 3.44±0.17, B. gingivalis 5.81±0.11, V. parvula 5.17±0.18, L. buccalis 5.13±0.21, and L. salivarius 5.01±0.08 log CFU/ml. In Group 2, the corresponding values were 3.62±0.09, 4.19±0.13, 4.16±0.15, 3.13±0.12, 4.27±0.18, 4.59±0.12, 4.13±0.17, and 3.87±0.16 log CFU/ml, respectively — a consistently greater reduction than in Group 1 across all measured species. Analysis of periodontal-pocket microflora changes confirmed that the recommended complex therapy was associated with a trend toward normalization of the microbial composition of pocket exudate.

4. Discussion

The clinical and microbiological findings of this study confirm that gingivitis is highly prevalent among law enforcement officers, with virtually all examined patients (100%) presenting with symptomatic complaints characteristic of the condition. The predominance of catarrhal gingivitis (84.12%) over hypertrophic (5.52%) and ulcerative (10.34%) forms is broadly consistent with the typical clinical distribution of gingivitis severity reported in general adult populations, though the overall prevalence observed here appears elevated relative to community samples, which may reflect the occupational stress and irregular routines characteristic of law enforcement service.

The quantitative microbiological data support a dysbiotic model of gingival inflammation in this population. High titers of B. gingivalis, F. nucleatum, and Neisseria spp., alongside elevated

coccal flora (S. epidermidis, S. aureus), are consistent with the broader understanding of subgingival microbial ecology, in which characteristic bacterial complexes shift in composition and abundance as periodontal tissue transitions from health to disease. Advances in salivary and microbiome-based diagnostics suggest that such shifts may eventually support earlier, more precise identification of at-risk patients before the emergence of overt clinical signs, complementing traditional clinical-instrumental assessment [14].

The comparative treatment outcomes indicate that the complex protocol — combining traditional therapy with oral hydromassage, phytotherapeutic adjuncts, and vacuum-laser massage — produced a consistently greater reduction in both cariogenic and periodontopathogenic microbial counts than traditional treatment alone, across every species measured. This pattern suggests that a multifactorial, pathogenetically targeted approach to gingivitis management, addressing microcirculation, local antimicrobial burden, and epithelial regeneration simultaneously, achieves superior microbiological control compared with a one-sided approach limited to mechanical debridement and standard hygiene instruction. These findings align with contemporary treatment guidelines for periodontal disease, which emphasize a stepwise approach combining behavioral, mechanical, and adjunctive interventions tailored to disease severity [15].

The high proportion of patients (91.9%) showing positive clinical dynamics after complex treatment further supports the clinical relevance of these microbiological improvements, and the recorded reduction in inflammatory markers justifies consideration of broader implementation of this combined approach in occupational dental-prevention programs for high-stress professional groups such as law enforcement personnel.

This study has several limitations. As a single-center investigation without long-term follow-up, the durability of the observed microbiological improvements beyond the immediate post-treatment period remains unassessed. The absence of a strictly matched, disease-free control group limits direct comparison with periodontally healthy individuals outside the study population. Future research should include longitudinal follow-up, larger and more diverse occupational cohorts, and molecular-level microbiome profiling to further validate and refine the proposed complex treatment protocol.

5. Conclusion

In conclusion, among the 145 law enforcement officers examined, various clinical forms of gingivitis were diagnosed: catarrhal in 84.12% of cases, hypertrophic in 5.52% of cases, and ulcerative gingivitis in 10.34% of cases. Positive dynamics following the complex treatment of gingivitis recommended in this study were observed in 91.9% of cases. For prophylactic purposes, rinsing the mouth with “Colgate Plax” and local application of pomegranate seed oil via individually prepared caps proved effective in preventing inflammatory processes of the periodontal tissue.

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