DOI 10.26724/2079-8334-2025-4-94-262-270
UDC 616.311.2-002-036-055

O.O. Pompii, E.S. Pompii
Lugansk State Medical University, Rivne

SEX- AND GENDER-RELATED ASPECTS OF PATHOGENESIS AND CLINICAL COURSE OF GENERALIZED PERIODONTITIS

e-mail: stifler2637@gmail.com

The literature review presents current perspectives on the impact of sex- and gender-related differences among patients on the pathogenesis and clinical course of generalized periodontitis. The biological factors of the disease are analysed in detail, including hormonal background, genetic predisposition, peculiarities of immune responses, and the oral microbiome in people of different sexes. The paper presents indicators of the prevalence of periodontitis depending on the patients' behavioural factors, lifestyle, bad habits, and other gender factors. The article discusses the clinical symptoms of inflammatory lesions of periodontal tissues, which differ between men and women. The article outlines the problematic issues of the gender-oriented approach in dentistry that require further scientific research to improve the clinical effectiveness of the treatment of generalized periodontitis and the development of modern methods of individual prevention.

Key words: generalized periodontitis, sex-related characteristics, gender differences, risk factors, gender-specific medicine.

О.О. Помпій, Е.С. Помпій

СТАТЕВІ ТА ГЕНДЕРНІ АСПЕКТИ ПАТОГЕНЕЗУ І КЛІНІЧНОГО ПЕРЕБІГУ ГЕНЕРАЛІЗОВАНОГО ПАРОДОНТИТУ

В огляді літератури представлені актуальні погляди на вплив статевих та гендерних відмінностей пацієнтів на патогенез і клінічний перебіг генералізованого пародонтиту. Детально проаналізовані біологічні чинники захворювання, зокрема гормональний фон, генетична схильність, особливості імунних відповідей та мікробіому ротової порожнини в осіб різної статі. В роботі наведені показники поширеності пародонтиту залежно від поведінкових факторів пацієнтів, їхнього способу життя, наявності шкідливих звичок та іншої гендерної специфіки. Обговорені клінічні симптоми запальних уражень тканин пародонту, які відрізнялися в осіб різної статі. Окреслені проблемні питання гендерно-орієнтованого підходу в стоматології, що потребують подальших наукових досліджень для підвищення клінічної ефективності лікування генералізованого пародонтиту та розробки новітніх методів індивідуальної профілактики.

Ключові слова: генералізований пародонтит, статеві особливості, гендерні відмінності, фактори ризику, гендерно-специфічна медицина.

The study is a fragment of the research project "Optimization of treatment and prevention of chronic generalized periodontitis in the elderly patients", state registration No. 0124U002382.

Generalized periodontitis and its complications significantly decrease the quality of life of patients. The complexity of the disease, its recurrent nature, the relationship with the patient's general somatic status and the condition of the oral cavity organs explain the increasing prevalence of this pathology in people of different age groups, and the difficulties in its diagnosis and treatment.

The major etiological factor of generalized periodontitis is the occurrence of dysbiosis of dental biofilms due to exogenous and endogenous factors, further activation of immune and inflammatory reactions of the body with subsequent damage to periodontal tissues [10]. A significant number of modifying factors are known to determine the intensity of disease progression, including genetic predisposition, the quality of individual oral hygiene, bad habits, particular systemic diseases, etc. [3]. Currently, the influence of sex- and gender-related aspects of patients on the prevalence, mechanisms of development and clinical course of generalized periodontitis is also of great scientific interest [14, 34].

A significant number of research papers on the etiology and pathogenesis of generalized periodontitis provides no information on sex- or gender-related differences in patients involved in the studies, or these differences are significantly simplified and not considered when interpreting the results [22]. A similar trend can be observed in the papers that describe diagnostic biomarkers of generalized periodontitis and current protocols for the treatment and prevention of the disease [1, 19]. At the same time, genetic factors, hormonal background, age-related changes in metabolism and various immune reactions of patients of different sexes are known to have a significant impact on the intensity and clinical signs of other local and systemic inflammatory diseases, which necessitates the consideration of these factors in the analysis of periodontal tissue lesions [12]. On the other hand, significant differences in the behavioural patterns of men and women, different attitudes towards dental health and oral hygiene, lifestyle features and the prevalence of bad habits also determine the likelihood of the onset of generalized periodontitis and its progression [3].

Understanding the sex- and gender-related aspects of the development of generalized periodontitis will enable to identify specific mechanisms of its progression, develop new diagnostic criteria and individual gender-oriented recovery plans for patients, and predict the risks of pathology.

The purpose of the study was to investigate the influence of sex- and gender-related characteristics of patients on the pathogenesis and clinical course of generalized periodontitis by reviewing specialized scientific sources.

Study Selection and Characteristics. For the analysis of published data, a structured literature search was performed to identify scientific studies addressing the influence of sex- and gender-related characteristics on the pathogenesis and clinical course of generalized periodontitis. The search was conducted in open electronic databases, including PubMed, Google Scholar, and ResearchGate. The following verbatim search queries were used in the search:

Database 1 – PubMed. Search query: ("generalized periodontitis" OR "periodontal disease") AND ("sex differences" OR "gender differences" OR "sex-related characteristics" OR "gender characteristics") AND ("pathogenesis" OR "clinical course" OR "risk factors" OR "hormonal changes" OR "immune response" OR "oral microbiome").

Database 2 – Google Scholar. Search query: ("generalized periodontitis" OR "periodontal disease") AND ("sex differences" OR "gender differences" OR "sex-related characteristics" OR "gender characteristics") AND ("pathogenesis" OR "clinical course" OR "hormonal changes" OR "immune response" OR "oral microbiome").

Database 3 – ResearchGate. Search query: ("generalized periodontitis" OR "periodontal disease") AND ("sex differences" OR "gender differences" OR "sex-related characteristics" OR "gender characteristics") AND ("pathogenesis" OR "clinical course" OR "risk factors" OR "hormonal changes" OR "immune response" OR "oral microbiome").

The last literature search was performed on September 1, 2024. Studies published between 2020 and 2024 were included in the review, while articles published prior to 2020 were excluded. For the review, only articles available in full text format were included, namely systematic literature reviews, meta-analysis and papers containing the results of original clinical and laboratory studies. A total of 40 articles were selected which were published from January 1, 2020 to September 1, 2024.

Initially, a broad set of records was retrieved using predefined search terms. Titles and abstracts were screened for relevance to the topic of the review, and potentially eligible articles were assessed in full text. Studies were included if they contained original clinical, experimental, or laboratory data, or represented systematic or narrative reviews focused on generalized periodontitis and reported outcomes related to biological sex or gender characteristics. Publications such as conference abstracts, editorials, letters to the editor, isolated case reports, and duplicate records were excluded during the selection process (Table 1).

Table 1

Simplified PRISMA Flow

Stage	Description	Number of Records/Studies
1. Identified	Total number of records identified through database searching and other sources	758
2. Duplicates Removed	Number of records removed before screening (e.g., duplicates)	512
3. Screened (Title/Abstract)	Number of records screened after duplicates were removed	246
4. Assessed for Eligibility (Full-text)	Number of full-text articles assessed for eligibility against the inclusion/exclusion criteria	96
5. Included in Review	Total number of primary studies finally included in the systematic review	40

The relevance of the assessment of the impact of patient gender on the clinical signs and effectiveness of treatment of generalized periodontitis was confirmed by the results of a recent meta-analysis of 101 clinical trials conducted in 2018 and 2019 [22]. This paper showed that the authors of only 1 scientific article (1 %) considered sex- and gender-related differences when involving patients in the study. At the same time, researchers in only 3 clinical trials (3 %) mentioned the gender characteristics of participants in the discussion of results and conclusions sections [22]. Thus, the small number of existing research results significantly limited the analysis of the impact of sex and gender on the course of generalized periodontitis. At the same time, many countries were actively implementing gender-specific medicine, which studies how sex biology, cultural and behavioural characteristics related to gender can affect human health and considers differences in the clinical course, prevention and treatment of pathologies, including oral diseases [12].

A significant number of scientific literature reported a higher prevalence and higher severity of generalized periodontitis among adult male patients [12, 21]. According to the results of a retrospective analysis of outpatient dental patient charts, it was found that in men living in Western Europe, generalized periodontitis of stages I–II was 28 % more common than in women, and generalized periodontitis of stages III–IV was 71 % more common. Moreover, the same study reported an earlier onset of generalized periodontitis in young women [12]. These values correlated with the epidemiological data of the National

Health and Nutrition Examination Survey in the United States, according to which men were disproportionately more likely to have periodontal disease compared to women: 56.4 % vs. 38.4 % [21]. The prevalence of generalized periodontitis among men was also higher in another study, that is, 37.4 %, as compared to 28.1 % among women [18]. At the same time, according to the results of a dental examination of 46476 young men under the age of 45 in Asian countries, the prevalence of generalized periodontitis of I–II stages was only 1.7 %, and generalized periodontitis of III–IV stages was 0.6 % [38]. Another study reported a higher prevalence of generalized periodontitis in women living in Taiwan who suffered from generalized periodontitis at 16.68 %, while the incidence in men was lower at 9.02 % [39].

Besides, there were also the results of clinical examination of 6977 patients over the age of 18, all of whom were divided into groups depending on the stage of generalized periodontitis. According to the results of the periodontal examination, the authors found that in the group of patients with generalized periodontitis of stage I, there were 44.42 % of men and 55.58 % of women, in the group of patients with generalized periodontitis of stage II, there were 58.73 % of men and 41.27 % of women, in the group of patients with generalized periodontitis of stage III, there were 48.48 % of men and 51.42 % of women [20].

Significant differences in the prevalence of generalized periodontitis among people of the same sex can be explained by different research methodologies, peculiarities of living in a particular country, access to dental care, etc. At the same time, all the factors that influence the different morbidity of men and women are divided into biological and gender-related ones [12]. Biological factors include hormones, genetic predisposition, immune response, oral microbiome, and gender-related factors include attitudes toward individual oral hygiene and health, dental visits, alcohol and tobacco use, physical activity, and stress [12].

The effect of hormones on the course of generalized periodontitis was explained by the presence of receptors for sex hormones: oestrogens, androgens and progestins, including in periodontal tissues, in particular, in epithelial cells and fibroblasts [7, 18, 21]. In fact, sex hormones played a regulatory function in the metabolic processes in the periodontium [25]. Oestrogen ensured the differentiation of the squamous epithelium in the oral cavity and stimulates the synthesis of collagen in the connective tissue, which determines its importance for tissue regeneration during generalized periodontitis. Besides, this hormone affected the processes of lipid peroxidation and the anti-peroxidation system, inhibits the synthesis of pro-inflammatory cytokines, decreased T-cell-induced inflammation, inhibits leukocyte differentiation by the bone marrow, decreased neutrophil chemotaxis and activates their phagocytosis. Progesterone, in particular, increased the synthesis of prostaglandins, increases the number of neutrophils and prostaglandin E2 (PgE2) in the clavicular fluid, decreased the anti-inflammatory activity of glucocorticoid hormones, damaged collagen and increased vascular permeability, enhancing the inflammatory response [11]. Androgens stimulated the proliferation and differentiation of osteoblasts, stimulate the synthesis of bone matrix, inhibit the production of PgE2 and increased the concentration of osteoprotegerin in tissues, which reduced the activity of osteoclasts and the number of inflammatory mediators. Testosterone and androstenedione also provided antioxidant and anti-inflammatory activity in periodontal tissues [1, 10]. Thus, in men with low testosterone levels, a decrease in the mineral density of the alveolar bone and more intense tooth loss were observed in comparison with healthy patients [38].

Sex hormones cause vasodilation of the gingival vessels, which can be detected with a laser speckle contrast imager [37]. In healthy young patients, after stimulation with acetylcholine or nitric oxide, the degree of vasodilation in laser speckle perfusion units (LSU) was determined and a significantly ($p<0.001$) higher rate was recorded in men (257 ± 18.2 LSU), compared to women (225 ± 18.8 LSU). Increased blood supply to the gum tissues contributes to a more intense inflammatory reaction and complications of periodontal diseases in men [37].

The influence of hormones on the development of generalized periodontitis is more relevant for women, especially during puberty, pregnancy, hormonal drugs, menopause, etc. [19]. In women of reproductive age, oestrogen provides a protective function during the development of generalized periodontitis, which explains its milder course than in men [12]. Meanwhile, oral contraceptives lead to a chronic increase in oestrogen and progesterone, the amount of proteins, sialic acids, hydrogen ions and electrolytes in saliva decreases, thus increasing sensitivity to factors that cause inflammatory reactions [12].

The risk of developing periodontal disease increases during pregnancy, as women undergo physiological, immunological and hormonal changes that cause their susceptibility to infectious diseases, including generalized periodontitis. Iron deficiency anaemia increases the amount of free oxygen radicals in periodontal tissues and impairs female patients' immune responses to altered oral microflora [15]. However, generalized periodontitis can lead to premature birth and preeclampsia, cause low birth weight and delayed foetal development, since during the inflammatory process in periodontal tissues the concentration of prostaglandins, particularly PgE2, increases, which activates an increased number of oxytocin receptors in the myometrium [15, 36].

The study found that 47.1 % of 121 women in the first trimester of pregnancy had generalized periodontitis, of whom only 66.7 % complained of bleeding gums when brushing their teeth. The other

33.3 % of women had no complaints, and the diagnosis was established based on objective symptoms [36]. Among pregnant female patients with generalized periodontitis, 55.4 % of them had profuse bleeding during probing of the gingival sulcus, and 33.3 % of women had minor bleeding. The researchers found that women with profuse bleeding tended to have poor oral hygiene, a high rate of carious, sealed and extracted teeth, and a high body mass index (BMI). Other factors that contributed to minimal bleeding were good hygiene, first childbirth, recent dental checkups, and maintaining professional activity. When analysing the concomitant factors of generalized periodontitis, the authors found that pregnant women with generalized periodontitis were more likely to be over 35 years old (29.0 %, p=0.05), overweight (28,9 %, p=0.06), had an unsanitized oral cavity (94.7 %, p=0.06), and an unsatisfactory level of individual oral hygiene (84.2 %, p=0.15), which explains the need for proper oral care in pregnant patients [36].

During menopause, along with a decrease in oestrogen concentration, women have a lower residual alveolar bone height and thickness, a higher intensity of bone atrophy, and reduced bone mineral density [30]. Thus, the prevalence of generalized periodontal disease in women who do not receive hormone replacement therapy (HRT) during post menopause is two times higher than in premenopausal women [6, 7]. Results of another study revealed 53.2 % of women with generalized periodontitis during menopause [25]. In those cases when women received HRT after menopause, the difference between the prevalence of generalized periodontitis in such patients was not significantly higher (odds ratio (OR)=1.937; 95 % confidence interval (CI): 0.805–4.664; p=0.140) compared to that of premenopausal women [24].

In contrast to these studies, there are results of the other study in which the authors concluded that oestrogen levels do not affect the risk of developing generalized periodontitis in women and men, but globulin binding sex hormones (SHBG), was positively associated with the disease (OR=1.63; 95 % CI: 1.17–2.28; p=0.004), while free testosterone (OR=0.60; 95 % CI: 0.43–0.84; p=0.003), bioavailable testosterone (OR=0.51; 95 % CI: 0.36–0.71; p<0.001) and free androgen index (OR=0.53; 95 % CI: 0.37–0.75; p<0.001) were negatively associated with generalized periodontitis [37].

The other important biological factor in the development of generalized periodontitis is the genetic predisposition of patients to inflammatory diseases, in particular, genes linked to the X-chromosome can alter the immune responses of patients by affecting pathogen recognition receptors and cytokines, including anti-inflammatory ones: interleukin-4 (IL-4) and interleukin-10 (IL-10). One of the possible reasons for the earlier occurrence of generalized periodontitis in women is the natural variations in the genome of patients associated with gender. A total of 20 loci significantly (p<0.0005) demonstrated such a relationship, 3 of which were previously considered risk factors for generalized periodontitis [13].

There are results of testing of blood and gum tissue samples from patients with generalized periodontitis and healthy individuals regarding the concentration of genes involved in the inflammatory process during generalized periodontitis, namely CYFIP1, KDR, RABGGTA and RABGGTB. The gene expression ratio (GER) was determined by polymerase chain reaction (PCR). The GER of the KDR gene was significantly (p=0.02) higher in women with generalized periodontitis compared to healthy women, namely 4.16. The concentration of the RABGGTB gene in the blood of men with periodontal disease, compared to the control group, was significantly (p=0.02) lower – GER=0.2. The KDR gene encodes a receptor for vascular endothelial growth factor (VEGF), the amount of which is increased in the crevicular fluid and saliva of patients with generalized periodontal disease, while the RABGGTB gene modulates the patient's immune response through the secretion of cytokines. The expression of other genes was similar in the blood and gum tissue of patients of both sexes [14].

In a similar study conducted using PCR, the expression of four oxytocin-related genes was determined in gum tissue and blood of patients. According to the obtained results, the authors found that compared to healthy gingival tissues, the tissues of female patients with generalized periodontitis had lower levels of FOS gene expression (GER=0.12, p=0.03) and RCAN1 gene expression (GER=0.17, p=0.01). At the same time, lower expression of two genes was observed in the blood serum of patients with generalized periodontitis, namely FOS (GER=0.23, p=0.06) and ITPR (GER=0.25, p=0.03). In men, the expression of FOS in the blood was lower (GER=0.07, p=0.02), and the expression of ITPR in tissues was reduced (GER=0.08, p=0.02). The RCAN1 gene expression ratio in men's gingival tissues was 0.09 and was significantly (p=0.03) lower than in women [15].

Another study revealed the dysregulation of two long non-coding RNAs (LncRNAs), namely THRIL and PACER, in the development of periodontitis. These RNAs were evaluated in the damaged periodontal tissues and in the blood of patients with generalized periodontitis. The expression of PACER was significantly (OR=3.098, p<0.0001) higher in the blood of women compared to men. There were no significant differences in the GER of PACER in the damaged tissues. THRIL expression was also not different in the test and control groups [27].

Hormones also have a significant impact on the components of the immune response. Thus, progesterone increases the synthesis of IL-6, interleukin-8 (IL-8), and cyclooxygenase-2 (COX-2). Androgen, in its turn, inhibits the activity of IL-6 and interleukin-17 (IL-17). Oestrogen stimulates the synthesis of VEGF, IL-6 and IL-8 [7, 14].

It is known that the immune system of men produces more pro-inflammatory cytokines, namely IL-6 and IL-1β, than the immune system of women. Besides, men have a more significant increase in the amount of lipopolysaccharide-binding protein than women, but they have a lower concentration of PgE2 in the blood in response to the development of generalized periodontitis [18].

Women over 65 years of age have increased levels of IL-17A in their blood serum, which leads to the development of a chronic inflammatory process, which is subsequently complicated by the occurrence of generalized periodontitis. The average concentration of IL-17A in healthy men of similar age was 1.8±0.2 pg/mL, and in women the average level was significantly ($p<0.05$) higher, 5.2±1.3 pg/mL [4].

While examining the cytokine and chemokine levels in the crevicular fluid of 79 young patients under the age of 23 years suffering from generalized periodontitis, men showed significantly ($p<0.05$) higher average concentrations of interferon-γ (IFN-γ) – 0.32±0.09 pg/mL, monocyte chemoattractant protein-1 (MCP-1) – 0.95±0.02 pg/mL, TNF-α – 0.32±0.05 pg/mL, macrophage inflammatory protein-1α (MIP-1α) – 1.25±0.01 pg/mL. In female patients, similar values were 0.09±0.04 pg/mL for IFN-γ, 0.55±0.01 pg/mL for MCP-1, 0.19±0.02 pg/mL for TNF-α and 0.09±0.01 pg/mL for MIP-1α. In the serum of the same patients, no significant ($p>0.05$) differences were observed between the two sexes in the average levels of IL-1β, IL-6, IL-8, IL-10, and TNF-α, but women had significantly ($p<0.05$) increased levels of eotaxin – 1.23±0.21 pg/mL, IFNγ – 1.48±0.32 pg/mL and granulocyte colony-stimulating factor (G-CSF) – 0.98±0.42 pg/mL. In men, these values were on average 0.51±0.23 pg/mL, 0.85±0.21 pg/mL and 0.23±0.06 pg/mL, respectively [35].

There are results of a study in which scientists emphasize that there is no significant difference between the microbiomes of healthy men and women of approximately the same age who live in similar conditions and maintain a high level of individual oral hygiene [8, 18]. In addition, the effect of four sex hormones on the development of oral biofilms in the culture medium was studied in laboratory conditions [9]. No significant differences in the formation of biofilms, their fluorescence and composition were found after 12 days in media containing high concentrations of oestradiol, estriol, progesterone or testosterone. The authors concluded that steroid hormones alone do not affect the microbiome, and that the different prevalence of diseases and different microbiomes are probably related to the peculiarities of immune responses, genetic predisposition of the patient and individual oral hygiene [9]. On the other hand, in most publications devoted to the study of microflora, the authors recognized the differences in the oral microbiome in patients of different sexes during the development of generalized periodontitis, although the results were often contradictory [10, 18, 35].

Regarding the differences in the number of periodontal pathogens in subgingival biofilms of healthy patients, higher levels of Aggregatibacter actinomycetemcomitans and Fusobacterium nucleatum were observed in women compared to men [35]. In patients with generalized periodontitis, a higher number of periodontal pathogens was found in women, in particular, an increase in bacteria of the Synergistota and Spirochaetota types, and an increase in Firmicutes in men [10]. According to the microbiome analysis performed by 16S rRNA-sequencing, in young men with severe generalized periodontitis, the bacteria of the Bacteroides, Pseudomonas, Prevotellaceae, Acinetobacter and Parabacteroides genera significantly ($p<0.05$) prevailed in the microbiome, and in women the number of Tannerella, Eubacterium nodatum and Helicobacter was significantly ($p<0.05$) higher [40].

During the menstrual cycle in women, an increase in the proportion of bacteria of the yellow complex during the menstrual phase; an increase in the concentration of bacteria of the red and green complexes and a decrease in the number of microflora of the blue complex during the follicular phase was observed [5].

The diversity of the microbiome composition in saliva and dental biofilms in pregnant women is higher than in non-pregnant women due to certain types of bacteria, in particular Firmicutes, Bacteroidetes and Actinobacteria, especially in the first trimester [26]. Pregnant women had a higher level of bacteria of the Prevotella, Fusobacterium, Streptococcus, Veillonella and Terrahaemophilus genera in subgingival biofilms, and microorganisms of the Prevotella, Streptococcus, Veillonella, Neisseria and Terrahaemophilus genera in saliva [26]. In a similar study, it was reported that in pregnant patients, the number of Porphyromonas gingivalis and Tanerella forsythia was increased in the first trimester, and the number of A. actinomycetemcomitans and P. intermedia was increased in the second and third trimesters [8].

Women who consumed oral contraceptives (OCs) had higher levels of P. gingivalis, P. intermedia, and A. actinomycetemcomitans in their biofilms and 16 times higher levels of Bacteroides in their saliva [8]. Simultaneously, in men, the consumption of anabolic steroid hormones had a significant effect on the oral microflora, in particular, in such persons, a higher number of A. actinomycetemcomitans, P. intermedia, P. gingivalis and Candida species were found [8]. Hormonal therapy during menopause reduced the number of positive subgingival plaque samples with periodontal pathogens like P. gingivalis, P. intermedia and T. forsythia [6].

Scientists often reported that the gender factor did not affect the likelihood of developing generalized periodontitis, and lifestyle played a major role in the likelihood of developing and intensity of

the disease [28]. The study found that women were more likely to have a lifestyle with low alcohol consumption, less frequent smoking and low physical activity, and this group of patients had a lower risk of generalized periodontitis. For men, frequent smoking, alcohol abuse, infrequent dental visits, short sleep, and low physical activity were more common. The risk of developing generalized periodontitis in this group was significantly higher compared to women [20]. The prevalence of generalized periodontitis among patients in another study differed, namely, in men it was 59.5 % and in women it was 34.2 %, whereas men were more likely to be smokers, had diabetes and hypertension, higher income, lower education, higher BMI, and more often abused alcohol [34].

Tobacco and alcohol were known to alter the subgingival microbiome, activate immune and inflammatory reactions, and lead to loss of gingival epithelial attachment [12]. The number of smokers among men ranged from 28 % to 62 % in different countries, while among women this figure was found to be between 4 % and 22 %. At the same time, 81 % of all smokers were men [21]. Men were twice as often likely to smoke, including e-cigarettes, and to use chewing tobacco [21].

According to the results of the meta-analysis, alcohol consumption was identified as a risk factor for the progression of generalized periodontitis, in particular, the risk of the disease increased by 0.4 % with an increase in the dose of alcohol for every 1 g of alcohol consumed per day. Men from middle-income countries who drank alcohol had a higher risk of developing generalized periodontitis compared to men who did not drink alcohol (OR=1.30; 95 % CI: 1.13–1.46; $p<0.05$). Among women, the effect of alcohol on the risk of generalized periodontitis was not significant (OR=1.18; 95 % CI: 0.99–1.37; $p>0.05$). The study found no significant ($p>0.05$) differences in the risk of developing generalized periodontitis between patients who both abused alcohol and smoked and those who only consumed alcohol [23].

In contrast to the above results, another clinical study found that concurrent smoking and depression significantly (OR=1.67; 95 % CI: 1.37–2.02; $p=0.03$) increased the risk of developing generalized periodontitis in men, while concurrent smoking and alcohol abuse significantly (OR=2.28; 95 % CI: 1.68–3.11; $p=0.03$) increased the similar risk in women. Concurrent alcohol consumption and depression had an insignificant effect ($p<0.05$) on the presence of generalized periodontitis in men and women [17]. The influence of emotional stress on the risk of generalized periodontitis and depression in menopausal women is confirmed. The depressed mood of such patients contributed to the poor oral hygiene, increased plaque and inflammatory destruction of periodontal tissues [6].

A survey of 600 adults found that women have more positive attitudes toward dental health, better individual care habits, and higher dental literacy than men [29]. In particular, women visited the dentist more often, fulfilled their appointments more accurately, maintained proper personal oral hygiene, and used floss more often ($p<0.001$) [29]. The results of the American Dental Association study also showed that approximately 8 % higher percentage of women brushed their teeth twice a day than men, and 26 % higher percentage of women flossed daily [21]. According to the results of a similar study, men visited the dentist less often, assessed the health of their teeth and gums worse, and used floss less ($p<0.05$). When examined, men were more likely to be offered an urgent visit to the dentist for treatment of dental diseases [33].

Gender differences also concerned the workplace. Among young men who were mainly engaged in physical work, there were 1.5 % of patients with generalized periodontitis, which was almost 3 times more than in patients who were engaged in mental activity (0.6 %). Place of residence and education, use of a particular toothpaste did not significantly ($p<0.05$) affect the presence of generalized periodontitis [38].

The results of the study of the correlation between the muscle quality index (MQI) and the risk of generalized periodontitis in people of both sexes aged 30 to 60 years were reported. According to the results obtained, the risk of developing generalized periodontitis decreases with increasing MQI, while the number of men with MQI of the 3rd degree was higher than women (27.9 % and 27.1 %, respectively), and men with MQI of the 4th degree were also more numerous (24.5 %), in contrast to women (21.6 %) [32].

A high number of biological and behavioural factors contributed to the differences in clinical outcomes of generalized periodontitis. According to the results of the survey of people aged 15 years and older and the subsequent regression analysis, it was determined that women had significantly (OR=1.36; 95 % CI: 1.12–1.67; $p<0.002$) higher gingival bleeding and significantly (OR=1.26; 95 % CI: 1.09–1.45; $p<0.002$) higher risks of tooth loss than men [16]. The authors of another study recorded an insignificant (OR=0.95; 95 % CI: 0.86–1.05; $p>0.05$) effect of sex and gender on the number of lost teeth in patients with generalized periodontitis [2]. Besides, according to the analysis of orthopantomograms of patients aged 40 to 50 years, there was no significant ($p>0.05$) difference between the average number of areas with bone loss around the teeth in men – 17.03 ± 5.06, and women – 17.33 ± 6.56 [18]. Also, the authors found no statistically significant differences between the severity of other clinical signs of generalized periodontitis in men and women aged 65 years and older, namely tooth mobility ($p>0.05$), gingival pocket depth ($p>0.05$) and the level of clinical attachment loss ($p>0.05$), with a total of 500 patients enrolled in the study and an average age of 74.4 ± 7.4 years [31].

Based on the clinical examination of adult patients, the authors recorded more severe symptoms of generalized periodontitis in men, in particular, the loss of epithelial attachment from 1 mm to 2 mm was

found in 1.2 % of men, from 3 mm to 4 mm was found in 15.2 %, and above 5 mm in 83.6 %. Among women, the percentage of patients with similar symptoms was 2.0 %, 19.7 % and 78.3 %, respectively. The probing depth from 4 mm to 5 mm was observed in men in 5.8 % of cases, from 5 mm to 6 mm in 24.4 % of cases, and more than 6 mm in 69.8 % of cases. In female patients, similar measurements were recorded in 6.8 %, 27.5 % and 65.7 % of cases. The study reported a higher risk of progression of generalized periodontitis 6 months after nonsurgical treatment in men, i.e. 29 %, which was almost twice as high as in women, i.e. 15 %. The authors also emphasized that the male gender tended to have significantly (OR=2.00; 95 % CI 0.95–4.18; p=0.068) greater tooth loss [2].

According to the results of a retrospective analysis of outpatient records of 4993 patients aged 18 to 55 years who had periodontal disease, it was found that the prevalence of generalized periodontitis is not significantly related to gender, but certain clinical symptoms of this disease are more common in a certain gender. Generalized periodontitis was diagnosed in 2715 patients (54.4 %) in the group of men, and in 2278 patients (45.6 %) in the group of women. The following signs were associated with the male sex: class I recessions (p=0.001), higher bleeding index during probing (p=0.001), greater depth of periodontal pockets (p=0.001), while the mobility of teeth of the second degree was significantly (p=0.036) correlated with the female sex [3].

Recently, there has been a growing interest in the influence of sex- and gender-related factors on the development and course of generalized periodontitis. Differences in hormonal levels, genetic predisposition, features of the oral microbiome between men and women, as well as gender-specific behavioural patterns can significantly affect susceptibility to the disease and its clinical manifestations. For example, women during pregnancy, menopause, or hormonal changes may experience an exacerbation of symptoms of periodontitis due to fluctuations in oestrogen and progesterone levels. In men, on the other hand, hormonal imbalance, in particular, a decrease in testosterone levels, can contribute to increased inflammatory reactions in periodontal tissues.

Gender differences in behaviour, including in hygiene habits and access to dental services, also determine the frequency and severity of the disease. Men are more likely to ignore regular oral hygiene and to visit the dentist more rarely, which leads to later diagnosis and more severe forms of periodontitis. Women, on the contrary, are more prone to maintaining regular dental health, which explains the lower morbidity rate among them.

The review was limited by considerable heterogeneity of study designs, populations and diagnostic criteria across the included publications, which complicated direct comparison of findings. In addition, only full-text articles published in open-access sources were eligible, which may have resulted in the exclusion of relevant studies and potential publication bias.

Conclusion

Sex- and gender-related factors play an important role in the development and clinical course of generalized periodontitis. The analysed evidence demonstrates that sex hormones, genetic predisposition, immune reactivity and the oral microbiome influence susceptibility to inflammation and the severity of periodontal tissue destruction in men and women. Women experience specific periods of hormonal change, such as pregnancy and menopause, which modify immune responses and bacterial composition, increasing vulnerability to periodontal breakdown. Men, in contrast, more frequently exhibit lifestyle-related risk factors, including smoking, alcohol consumption, lower oral hygiene motivation and delayed dental visits, which contributes to more advanced stages of disease at diagnosis and less favourable treatment outcomes.

Gender differences also affect clinical manifestations, inflammatory mediator profiles, and treatment response, underscoring the need for personalized diagnostic and preventive strategies. Incorporating sex- and gender-related characteristics into periodontal assessment may improve risk prediction, optimize treatment planning and enhance patient-centred care. Future research should focus on developing standardized methodological approaches that allow the reliable comparison of biological and behavioural mechanisms across populations and support the development of gender-oriented preventive programmes aimed at reducing the burden of generalized periodontitis.

References

1. Ali Alftaikhah SA, Issrani R, Alnasser M, Almutairi HA, Khattak O, Iqbal A, et al. Salivary biomarkers in periodontitis: a scoping review. Cureus. 2023;15(12):e50207. doi: 10.7759/cureus.50207.

2. Angelov N, Soldatos N, Ioannidou E, Carter TC, Shimpi N, Applegate J. A retrospective analysis of the role of age and sex in outcomes of non-surgical periodontal therapy at a single academic dental center. Sci Rep. 2024;14(1):e9504. doi: 10.1038/s41598-024-60094-7.

3. Ashwini A, Priyanka T, Nasser I, Sangavi G, Nagaland T, Agila E, et al. The clinical incorporation of the 2017 Classification of periodontal disease conditions part II: the association between clinical parameters and gender. Cureus. 2024;16(7):e63737. doi: 10.7759/cureus.63737.

4. Bosnić Z, Babič F, Wittlinger T, Anderková V, Šahinović I, Majnarić LT. Influence of age, gender, frailty, and body mass index on serum IL-17A levels in mature type 2 diabetic patients. Med Sci Monit. 2023;29:e940128. doi: 10.12659/MSM.940128.

5. Bostanci N, Krog MC, Hugerth LW, Bashir Z, Fransson E, Boulund F. Dysbiosis of the human oral microbiome during the menstrual cycle and vulnerability to the external exposures of smoking and dietary sugar. Front Cell Infect Microbiol. 2021;11:e625229. doi: 10.3389/fcimb.2021.625229.
6. Ciesielska A, Kusiak A, Ossowska A, Grzybowska ME. Changes in the oral cavity in menopausal women – a narrative review. Int J Environ Res Public Health. 2021;19(1):e253. doi: 10.3390/ijerph19010253.
7. Cornejo Ulloa PE, Krom BP, Schoonmade LJ, van der Veen MH. Sex steroid hormones: an overlooked yet fundamental factor in oral homeostasis in humans. Front Endocrinol (Lausanne). 2024;15:e1400640. doi: 10.3389/fendo.2024.1400640.
8. Cornejo Ulloa P, Krom BP, van der Veen MH. Sex steroid hormones as a balancing factor in oral host microbiome interactions. Front Cell Infect Microbiol. 2021;11:e714229. doi: 10.3389/fcimb.2021.714229.
9. Cornejo Ulloa P, van der Veen MH, Brandt BW, Buijs MJ, Krom BP. The effect of sex steroid hormones on the ecology of in vitro oral biofilms. Biofilm. 2023;6:e100139. doi: 10.1016/j.bioflm.2023.100139.
10. Del Pinto R, Ferri C, Giannoni M, Cominelli F, Pizarro TT, Pietropaoli D. Meta-analysis of oral microbiome reveals sex-based diversity in biofilms during periodontitis. JCI Insight. 2024;9(17):e171311. doi: 10.1172/jci.insight.171311.
11. Di Naro E, Loverro M, Converti I, Loverro MT, Ferrara E, Rapone B. The effect of menopause hypoestrogenism on osteogenic differentiation of periodontal ligament cells (PDLC) and stem cells (PDLCs): a systematic review. Healthcare (Basel). 2021;9(5):e572. doi: 10.3390/healthcare9050572.
12. Di Spirito F, Amato A, Romano A, Dipalma G, Xhajanka E, Baroni A, et al. Analysis of risk factors of oral cancer and periodontitis from a sex- and gender-related perspective: gender dentistry. Applied Sciences. 2022;12(18):e9135. doi: 10.3390/app12189135.
13. Freitag-Wolf S, Munz M, Junge O, Graetz C, Jockel-Schneider Y, Staufenbiel I, et al. Sex-specific genetic factors affect the risk of early-onset periodontitis in Europeans. J Clin Periodontol. 2021;48(11):1404-1413. doi: 10.1111/jcpe.13538.
14. Ghafouri-Fard S, Gholami L, Badrlou E, Sadeghpour S, Nazer N, Shadnoush M, et al. Sex-based dysregulation of inflammation-related genes in periodontitis. Int J Mol Cell Med. 2023;12(3):300-309. doi: 10.22088/IJMCM.BUMS.12.3.300.
15. Ghafouri-Fard S, Gholami L, Nazer N, Hussen BM, Sayad A, Hajiesmaeili M. Downregulation of oxytocin-related genes in periodontitis. Front Mol Neurosci. 2022;15:e950919. doi: 10.3389/fnmol.2022.950919.
16. Ghanem AS, Móré M, Nagy AC. Assessing the impact of sociodemographic and lifestyle factors on oral health: a cross-sectional study in the Hungarian population. Front Public Health. 2023;11:e1276758. doi: 10.3389/fpubh.2023.1276758.
17. Huang YQ, Xu JN, Huang Y, Xu YD, Wang HL, Shi WT, et al. Independent and combined effects of smoking, drinking and depression on periodontal disease. BMC Oral Health. 2024;24(1):e535. doi: 10.1186/s12903-024-04287-6.
18. Jain A, Bhavsar N, Baweja A, Bhagat A, Ohri A, Grover V. Gender-associated oral and periodontal health based on retrospective panoramic radiographic analysis of alveolar bone loss. 2020;1:1-37. doi: 10.5772/intechopen.93695.
19. Li J, Wang Y, Tang M, Zhang C, Fei Y, Li M, et al. New insights into nanotherapeutics for periodontitis: a triple concerto of antimicrobial activity, immunomodulation and periodontium regeneration. J Nanobiotechnology. 2024;22(1):e19. doi: 10.1186/s12951-023-02261-y.
20. Lin J, Pei T, Yang H. Association between modifiable lifestyle pattern and periodontitis: a cross-sectional study based on NHANES. BMC Oral Health. 2024;24(1):e591. doi: 10.1186/s12903-024-04207-8.
21. Lipsky MS, Su S, Crespo CJ, Hung M. Men and oral health: a review of sex and gender differences. Am J Mens Health. 2021;15(3):e15579883211016361. doi: 10.1177/15579883211016361.
22. Michelson C, Al-Abedalla K, Wagner J, Swede H, Bernstein E, Ioannidou E. Lack of attention to sex and gender in periodontitis-related randomized clinical trials: a meta-research study. J Clin Periodontol. 2022;49(12):1320-1333. doi: 10.1111/jcpe.13707.
23. Oliveira LM, da Silva Pilecco K, de Oliveira CA, Antoniazzi RP, Demarco FF, Zanatta FB. Alcohol intake influences the occurrence and progression of periodontitis differently according to sex and country sociodemographic development: a two-stage systematic review. Alcohol. 2022;57(5):566-575. doi: 10.1093/alcalc/agac023.
24. Park KY, Kim MH, Choi SH, Pang EK. Association of periodontitis with menopause and hormone replacement therapy: a hospital cohort study using a common data model. J Periodontal Implant Sci. 2023;53(3):184-193. doi: 10.5051/jpis.2202480124.
25. Rafiei M, Salarisedigh S, Khalili P, Jamali Z, Sardari F. Hormonal fluctuations and periodontal status in postmenopausal women. Int J Dent. 2022;2022:e9990451. doi: 10.1155/2022/9990451.
26. Saadaoui M, Singh P, Al Khodor S. Oral microbiome and pregnancy: a bidirectional relationship. J Reprod Immunol. 2021;145:e103293. doi: 10.1016/j.jri.2021.103293.
27. Sayad A, Ghafouri-Fard S, Shams B, Arsang-Jang S, Gholami L, Taheri M. Sex-specific up-regulation of p50-associated COX-2 extragenic RNA (PACER) lncRNA in periodontitis. Heliyon. 2020;6(5):e03897. doi: 10.1016/j.heliyon.2020.e03897.
28. Seredin P, Litvinova T, Ippolitov Y, Goloshchapov D, Peshkov Y, Kashkarov V. A study of the association between primary oral pathologies (dental caries and periodontal diseases) using synchrotron molecular FTIR spectroscopy in view of the patient's personalized clinical picture (demographics and anamnesis). Int J Mol Sci. 2024;25(12):e6395. doi:10.3390/ijms25126395.
29. Sfeatcu R, Balgiu BA, Mihai C, Petre A, Pantea M, Tribus L. Gender differences in oral health: self-reported attitudes, values, behaviours and literacy among romanian adults. J Pers Med. 2022;12(10):e1603. doi: 10.3390/jpm12101603.
30. Singh N, Verma SK, Sharma NK, Gupta V, Jha AK, Priyank H. Comparative evaluation of periodontal health status of pre and postmenopausal females. J Educ Health Promot. 2023;12:e211. doi: 10.4103/jehp.jehp_15_23.
31. Skośkiewicz-Malinowska K, Kaczmarek U, Malicka B. Gender-wise comparison of oral health quality of life and its relationship with oral health parameters among elderly from Wroclaw, south-west Poland. PLoS One. 2021;16(11):e0259286. doi: 10.1371/journal.pone.0259286.
32. Song J, Wu Y, Ma H, Zhang J. Association between muscle quality index and periodontal disease among American adults aged ≥ 30 years: a cross-sectional study and mediation analysis. BMC Oral Health. 2023;23(1):e918. doi: 10.1186/s12903-023-03520-y.
33. Su S, Lipsky MS, Licari FW, Hung M. Comparing oral health behaviours of men and women in the United States. J Dent. 2022;122:e104157. doi: 10.1016/j.jdent.2022.104157.
34. Su X, Jin K, Zhou X, Zhang Z, Zhang C, Li Y, et al. The association between sex hormones and periodontitis among American adults: a cross-sectional study. Front Endocrinol (Lausanne). 2023;14:e1125819. doi: 10.3389/fendo.2023.1125819.
35. Tavakoli TT, Gholami F, Huang H, Gonçalves PF, Villasante-Tezanos A, Aukhil I, et al. Gender differences in immunological response of African-American juveniles with Grade C molar incisor pattern periodontitis. J Periodontol. 2022;93(3):392-402. doi: 10.1002/JPER.21-0143.

36. Thomas C, Timofeeva I, Bouchoucha E, Canceill T, Champion C, Groussolles M, et al. Oral and periodontal assessment at the first trimester of pregnancy: the PERISCOPE longitudinal study. Acta Obstet Gynecol Scand. 2023;102(6):669-680. doi: 10.1111/aogs.14529.
37. Vág J, Nagy TL, Mikecs B. Sex-related differences in endothelium-dependent vasodilation of human gingiva. BMC Oral Health. 2022;22(1):e177. doi: 10.1186/s12903-022-02186-2.
38. Wen X, Li H, Li S, Chang B, Chen S, Li H, et al. Associated factors of periodontitis and predicted study among young man in China: a population-based cross-sectional study. BMC Public Health. 2024;24(1):e1235. doi: 10.1186/s12889-024-18732-2.
39. Yang YP, Hsin HT, Wang BL, Wang YC, Yu PC, Huang SH, et al. Gender differences in oral health among prisoners: a cross-sectional study from Taiwan. BMC Oral Health. 2023;23(1):e900. doi: 10.1186/s12903-023-03598-4.
40. Zhao YQ, Zhou YH, Zhao J, Feng Y, Gao ZR, YeQ, et al. Sex variations in the oral microbiomes of youths with severe periodontitis. J Immunol Res. 2021;2021:e8124593. doi: 10.1155/2021/8124593.

Стаття надійшла 6.11.2024 р.

DOI 10.26724/2079-8334-2025-4-94-270-275
UDC 616.716.4-001.5-08:616-089.87(048.8)

D.V. Steblovskyi, D.S. Avetikov, O.S. Svyryda, V.O. Lychman, K.P. Lokes, O.A. Toropov
Poltava State Medical University, Poltava

CURRENT CONDITION, INDICATIONS AND CONTRAINDICATIONS OF CONSERVATIVE METHODS OF TREATMENT OF FRACTURES OF THE LOWER JAW

e-mail: d.steblovskyi@pdmu.edu.ua

This review explores the conservative approaches to treating mandibular fractures, focusing on methods like intermaxillary ligatures, splints, and orthopedic devices. It details the fabrication and application of common splints, such as the Tigerstedt splint, and describes various types of intermaxillary fixation. The role of medication, including analgesics, antibiotics, and supplements, is discussed. The article also outlines indications for conservative treatment, including linear fractures without significant displacement, high-risk patients, and pediatric cases. Furthermore, it addresses potential disadvantages such as muscle atrophy, joint contractures, and occlusal dysfunction. The text also covers strategies for preventing complications in surgical treatment, emphasizing multidisciplinary approaches and evidence-based practices to improve patient outcomes.

Key words: mandibular fractures, fracture, lower jaw, mandibular, conservative treatment, intermaxillary fixation, splints, complications, prevention, surgical treatment.

Д.В. Стебловський, Д.С. Аветіков, О.С. Свирида, В.О. Личман, К.П. Локес, О.А. Торопов

СУЧАСНИЙ СТАН, ПОКАЗАННЯ ТА ПРОТИПОКАЗАННЯ ДО КОНСЕРВАТИВНИХ МЕТОДІВ ЛІКУВАННЯ ПЕРЕЛОМІВ НИЖНЬОЇ ЩЕЛЕПИ

У цьому огляді досліджуються консервативні підходи до лікування переломів нижньої щелепи, ми зосереджувалися на таких методах, як міжщелепні лігатури, шини та ортопедичні пристрої. У статті докладно описано виготовлення та застосування звичайних шин, таких як шина Тігерштедта, і описано різні типи міжщелепної фіксації. Обговорюється роль ліків, включаючи анальгетики, антибіотики та добавки. У статті також викладено показання до консервативного лікування, зокрема лінійних переломів без значного зміщення, пацієнтів групи високого ризику та педіатричні випадки. Крім того, воно усуває потенційні недоліки, такі як атрофія м'язів, контрактури суглобів і оклюзійна дисфункція. Стаття також охоплює стратегії запобігання ускладненням під час хірургічного лікування, наголошуючи на мультидисциплінарних підходах і науково-обґрунтованих практиках для покращення результатів лікування пацієнтів.

Ключові слова: переломи нижньої щелепи, перелом, нижня щелепа, консервативне лікування, міжщелепна фіксація, шини, ускладнення, профілактика, оперативне лікування.

The work is a fragment of the research project "Algorithm of complex treatment of inflammatory processes and prevention of the formation of pathological scars of the scalp and neck after planned and urgent surgical interventions", state registration No. 0124U000093.

Fractures of the mandible are one of the most frequent injuries of the maxillofacial area, which is a significant medical and social problem. These injuries may result from domestic, street, occupational, athletic, or transport-related trauma. Currently, there is a significant increase in the incidence of mandibular traumatic injuries caused by gunshot and blast-related trauma [8, 10]. It is noteworthy that mandibular fractures can also be of iatrogenic origin, occurring as a complication during the surgical extraction of impacted mandibular third molars or supernumerary teeth. The frequency of this complication ranges from 0.0033% to 0.0036% for intraoperative fractures and from 0.0042% to 0.0046% for postoperative fractures [8].

The nature of the fracture is also influenced by factors such as the anatomical features of the mandible and masticatory muscles, bone mineral density, and other physiological variables [18]. Based on the number of fragments and the configuration of the fracture lines, they can be classified into two categories: simple and complex. Simple fractures are linear and characterized by the presence of two bone fragments. Complex