

AGE-RELATED DYNAMICS OF PERIODONTAL TISSUES STATE
IN PATIENTS WITH DENTITION DEFECTS¹Uzhgorod National University (Uzhgorod, Ukraine)²Kharkiv National Medical University (Kharkiv, Ukraine)

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The results of the analysis of age-related and the gender features of the state of periodontal tissues in individuals with dentition defects at the stage of preparation for dental implantation are presented. The results of dental examination of 95 patients with minor dentition defects (main group) and 40 people with preserved dentition (control group) aged 20–59 years were analyzed. According to age, the patients were distributed between 10-year periods: from 20 to 29 (1st age period), from 30 to 39 (2nd age period), from 40 to 49 (3rd age period), and from 50 to 59 years (4th age period). The features of the state of periodontal tissues were studied using the determining indicator indices: papillary-marginal-alveolar (PMA) and interdental papillae bleeding (IPB). The findings of the study demonstrate a negative impact of dentition defects on the state of periodontal tissues, which increases with the patient age. According analysis of the indicator indices of inflammation (PMA) and bleeding (PBI), the described indicators in individuals with small dentition defects were significantly worse than in individuals with preserved dentition across all comparable age periods in both men and women. We also found a lower rate of periodontal tissue deterioration with age in women compared to men. The study contributes to a more in-depth understanding of the consequences of dentition defects for oral health.

Key words: periodontal tissue, dentition defects, PMA inflammation index, bleeding index PBI, age and gender features.

Connection of the publication with planned research work.

The article was written within the framework of the planned research “Optimization of methods for diagnosing and treating main dental diseases” (state registration number 0119U002899).

Introduction.

Today, the close relationship between oral health, and general health [1] and even the improvement in sports results [2], has been confidently demonstrated. According to the WHO's definition, oral health is a state that ensures the optimal level of functional, psychological and social capabilities of people throughout their lives and enables them to socialize and work without pain or discomfort (WHO, 2026). In many ways, this level of dentition functioning depends on the preservation of the complete dentition. First, tooth loss and the formation of dentition defects lead to decreased chewing efficiency and, as a result, changes in diet with a decrease in the proportion of hard and fibrous foods [3]. Over time, the consumption of soft, technologically processed foods leads to the development of systemic risks, even to depressive symptoms and cognitive disorders [4–6]. Second, at the local level, the consumption of soft foods does not promote tooth cleaning and does not stimulate salivation, which should serve a protective and cleansing function. In turn, poor nutrition weakens immunity, which, undoubtedly, affects the speed of healing and resistance to the development of pathological processes. Therefore, the stable functioning of the oral cavity is directly related to the preservation of dentition integrity and, by enabling maintenance of a proper diet, helps protect systemic health in the long term [7, 8].

The consequences of tooth loss may initially be insignificant, but become more noticeable with age. In addition, tooth loss is closely related not only to several dental and metabolic diseases, but may also have a bio-

logical basis that forms gender-specific behavioral characteristics.

Therefore, it is advisable to clarify the possible influence of the presence of dentition defects (DDs) periodontal tissue state in with respect to age and gender.

The aim of the study.

To analyze age-related and the gender features of the state of periodontal tissues in individuals with dentition defects at the stage of preparation for dental implantation.

Object and research methods.

The results of dental examination of 95 patients with minor DDs (main group) and 40 people with preserved dentition (control group) were analyzed. Both groups were age- and sex- matched. According to age, the patients were distributed between 10-year periods: from 20 to 29 (1st age period), from 30 to 39 (2nd age period), from 40 to 49 (3rd age period), and from 50 to 59 years (4th age period). The examination of patients was based on general clinical (complaints, history, examination, palpation, percussion, probing) and radiological methods (sighting and orthopantomography, 3D computed tomography) for a thorough study of the condition of hard tissues of teeth and periodontal tissues, analysis of the size and localization of dentition defects, and the type of bite. In order to most objectively assess the impact of the presence of minor DDs on the condition of the periodontal tissue, the following inclusion criteria were used: identical oral hygiene care regimen, similar food preferences, consent to participate in the study, and readiness to comply with the study protocol. The persons with decompensated somatic diseases, pregnancy, lactation, advanced forms of periodontal tissue diseases (periodontitis), pathology of hard dental tissues (caries, filled, removed, CFR ≥ 4 , only due to component F), orthodontic structures, those taking medication with antimicrobial, anti-inflammatory, hormonal, metabolic effects were excluded from the study.

The groups were comparable in age, gender, and dental status at the beginning of the study ($p>0.05$ for all parameters compared).

The features of the state of periodontal tissues were studied using the determining indicator indices: papillary-marginal-alveolar (PMA) and interdental papillae bleeding (IPB).

The presence and intensity of the inflammatory process in the gums (PMA index according to the modified method of C. Parma, 1960) was assessed by the spread within the gingival papilla (P) – 1 point, inflammation of the marginal edge of the gums (M) – 2 points, alveolar gingival inflammation (A) – 3 points. The PMA index was calculated as a percentage using a formula, where the sum of points was determined by adding the highest indicators for each tooth. The assessment criteria were as follows: up to 20% – mild gingivitis; 25–50% – moderate gingivitis; above 51% – severe gingivitis [9].

Of the many markers used to describe the state of periodontal tissues, gingival bleeding is an objective sign of inflammation that is easily assessed. Therefore, as a sensitive indicator, the papilla bleeding index (PBI; Saxer, Mühlemann, 1975) was chosen to assess the severity of gingivitis.

The index was determined using a periodontal probe with a button. With light effort, the probe was passed along the gingival sulcus from the base of the papilla to the apex, along the mesial and distal surfaces of the tooth. After 20–30 s, when the entire quadrant is probed, the intensity of bleeding is determined and recorded from grade 1 to 4: grade 1 – single pinpoint bleeding, grade 2 – linear/punctate light bleeding along the edge of the papilla apex, grade 3 – moderate bleeding from the interdental space of the gingival papilla, grade 4 – profuse bleeding that occurs immediately after probing in the interdental space [9].

The investigation was performed with the voluntary consent of all patients, in accordance with the provisions of the Declaration of Helsinki of the World Medical Association (2013), the international ethical principles for conducting biomedical research involving human subjects (CIOMS, 2016), and the current legislation of Ukraine in the field of bioethics and personal data protection.

Statistical processing of the obtained findings was performed using the software package "Statistica 12.0". The data conformity to a normal distribution was assessed using the Shapiro–Wilk test. The summarized data were presented as the mean value and the standard error of the mean (Mean $\pm$ SEM). Statistical comparison of the studied indicators across different age groups was carried out using a one-way analysis of variance (ANOVA) followed by application of the Newman–Keuls criterion for multiple comparisons, separately for men and women. Comparisons of indicators between the

control and main groups, as well as between male and female individuals within the corresponding age category, were carried out using the Student's t-test for independent samples. Differences were considered statistically significant at $p<0.05$.

Research results and their discussion.

Indicators of indices reflecting the degree of gingival inflammation by age are presented in Table 1 and 2. Thus, in male individuals in the control group, a tendency to an increase of the PMA index with age was observed (from 9.88 $\pm$ 0.76% to 17.22 $\pm$ 1.49%, although without a statistically significant difference between the previous and subsequent groups ($p>0.05$) (table 1). A significant difference was noted only between the indicators of the 3rd and 4th age periods and those of the 1st period ($p<0.05$).

Table 1 – PMA index (%) in individuals of different sexes and ages, (M $\pm$ SEM)

Group	20-29 years old (1st age period)	30-39 years old (2nd age period)	40-49 years old (3rd age period)	50-59 years old (4th age period)
males				
Control group (n=5)	9.88 $\pm$ 0.76	11.70 $\pm$ 1.42 $p_1=0.32$	14.70 $\pm$ 1.23 $p_1=0.039^*$ $p_2=0.11$	17.22 $\pm$ 1.49 $p_1=0.004^*$ $p_2=0.018^*$ $p_3=0.17$
Main group (n=11–13)	13.45 $\pm$ 1.17	17.03 $\pm$ 1.21 $p_1=0.03^*$	23.52 $\pm$ 1.22 $p_1=0.0001^*$ $p_2=0.0002^*$	27.89 $\pm$ 0.74 $p_1=0.0002^*$ $p_2=0.0001^*$ $p_3=0.007^*$
	$p_i=0.04^*$	$p_i=0.02^*$	$p_i=0.0006^*$	$p_i=0.00002^*$
females				
Control group (n=5)	2.98 $\pm$ 0.46	3.20 $\pm$ 0.43 $p_1=0.78$	5.04 $\pm$ 0.59 $p_1=0.038^*$ $p_2=0.028^*$	6.92 $\pm$ 0.63 $p_1=0.0006^*$ $p_2=0.018^*$ $p_3=0.025^*$
Main group (n=9–14)	5.48 $\pm$ 0.47	6.59 $\pm$ 0.53 $p_1=0.23$	7.89 $\pm$ 0.66 $p_1=0.03^*$ $p_2=0.16$	9.57 $\pm$ 0.76 $p_1=0.0005^*$ $p_2=0.006^*$ $p_3=0.07$
	$p_i=0.005^*$	$p_i=0.002^*$	$p_i=0.03^*$	$p_i=0.002^*$

Notes: n – number of persons in each age period; p_1^* – statistical significance of changes compared to indicators for the category 20–29 years old ($p_{crit}<0.05$); p_2^* – statistical significance of changes compared to indicators for the category 30–39 years old ($p_{crit}<0.05$); p_3^* – statistical significance of changes compared to indicators for the category 40–49 years old ($p_{crit}<0.05$); p_i^* – statistical significance of the difference in indicators between groups ($p_{crit}<0.05$).

The dynamics of the PMA index in men with minor DDs (main group) were similar to the control group – an increase with age (from 13.45 $\pm$ 1.17% to 27.89 $\pm$ 0.74%), but it was more noticeable and statistically significant when comparing the index of each subsequent age period with the index of the previous one, respectively ($p<0.05$).

The PMA index in women of the control and main groups generally demonstrated similar trends of increase with age, which were also recorded in men: an increase from 2.98 $\pm$ 0.46% to 6.92 $\pm$ 0.63% in women of the control group ($p<0.05$) versus an increase from 5.48 $\pm$ 0.47% to 9.57 $\pm$ 0.76% in the main group ($p<0.05$).

At the same time, the PMA indices in all similar age periods in individuals with small DDs were significantly worse than the values of the specified index in individuals with preserved dentition in both men and women ($p<0.05$).

It should also be noted that there was a discrepancy in the interpretation of the average values obtained. Thus, if in males in the control group the PMA index values were within the range of mild gingivitis even in

the last age group, then in men of the main group, starting from the third age period (40–49 years), the average PMA index values corresponded to the moderate gingivitis ($23.52 \pm 1.22\%$) and worsened in the fourth age period to $27.89 \pm 0.74\%$ ($p < 0.05$). At the same time, in men, the statistical significance of the difference between the groups was observed across all age periods ($p < 0.05$). In women, despite the differences between the condition of the gums in the representatives of the control and main groups in each of the age categories ($p < 0.05$), the average PMA index values did not go beyond the limits of mild inflammation, even in the last age period ($9.57 \pm 0.76\%$).

As for the PBI index, which reflects the intensity of bleeding, it also tended to increase with age from the first age period (20–29 years) to the fourth (50–59 years) (table 2). Thus, in the control group, the increase in the indicated age period in men from 1.24 ± 0.17 points to 1.62 ± 0.05 points ($p > 0.05$) was observed, while in the main group, from 1.55 ± 0.11 points to 2.54 ± 0.03 points, and also with a statistically significant difference between the indicators of the next and previous age periods ($p < 0.05$). In women of the control group, the PBI index increased from 0.15 ± 0.01 points (with a statistical difference between the 1st and 2nd age periods and the 3rd and 4th) and from 0.22 ± 0.02 points to 0.25 ± 0.01 points in the main group (with a statistical difference only between the 2nd and 4th age periods).

Again, the PBI index, as well as the PMA index, across all comparable age periods in individuals with minor DDs were significantly worse than the corresponding indices in individuals with preserved dentition in both men and women ($p < 0.05$).

Thus, the findings of the study demonstrate a negative impact of DDs on the state of periodontal tissues, which increases with the patient age. According to analysis of the indicator indices of inflammation (PMA) and bleeding (PBI), the described indicators in individuals with small DDs were significantly worse than in individuals with preserved dentition across all comparable age periods in both men and women. This study overlaps with the work of scientists from UzhNU, who also analyzed the state of periodontal tissues according to the PMA index and Russel's index in individuals with DDs, but depending on their topography, and established the presence of a moderate degree of gingivitis [10]. Most

Table 2 – PBI index (points) in patients of different sex and age, (M $\pm$ SEM)

Group	20-29 years old (1st age period)	30-39 years old (2nd age period)	40-49 years old (3rd age period)	50-59 years old (4th age period)
males				
Control group (n=5)	1.24 ± 0.17	1.36 ± 0.19 $p_1 = 0.56$	1.52 ± 0.12 $p_1 = 0.38$ $p_2 = 0.45$	1.62 ± 0.05 $p_1 = 0.29$ $p_2 = 0.43$ $p_3 = 0.63$
Main group (n=11–13)	1.55 ± 0.11	2.14 ± 0.07 $p_1 = 0.0001^*$	2.42 ± 0.05 $p_1 = 0.0001^*$ $p_2 = 0.006^*$	2.54 ± 0.03 $p_1 = 0.0002^*$ $p_2 = 0.0005^*$ $p_3 = 0.22$
	$p_i = 0.13$	$p_i = 0.0002^*$	$p_i = 0.00001^*$	$p_i = 0.00001^*$
females				
Control group (n=5)	0.15 ± 0.01	0.15 ± 0.01 $p_1 = 0.87$	0.18 ± 0.01 $p_1 = 0.04^*$ $p_2 = 0.03^*$	0.20 ± 0.01 $p_1 = 0.009^*$ $p_2 = 0.007^*$ $p_3 = 0.27$
Main group (n=9–14)	0.22 ± 0.02	0.20 ± 0.01 $p_1 = 0.16$	0.23 ± 0.01 $p_1 = 0.5$ $p_2 = 0.1$	0.25 ± 0.01 $p_1 = 0.14$ $p_2 = 0.008^*$ $p_3 = 0.21$
	$p_i = 0.005^*$	$p_i = 0.002^*$	$p_i = 0.03^*$	$p_i = 0.002^*$

Notes: n – number of people in each age period; p_1^* – statistical significance of changes compared to indicators for the category 20–29 years old ($p_{crit} < 0.05$); p_2^* – statistical significance of changes compared to indicators for the category 30–39 years old ($p_{crit} < 0.05$); p_3^* – statistical significance of changes compared to indicators for the category 40–49 years old ($p_{crit} < 0.05$); p_i^* – statistical significance of the difference in indicators between groups ($p_{crit} < 0.05$).

likely, in the presence of DDs, there is a decrease in the protective function of the oral cavity in relation to periodontal tissues. In addition, the absence of preserved dentition does not support full chewing and salivation, which in turn reduces cleaning and protective functions and creates systemic risks to dental health [3].

We also found a lower rate of periodontal tissue deterioration with age in women compared to men, which can be explained by a more responsible attitude toward the state of their dental health. This is consistent with previously published data on the gender dependence of DDs, namely: in women, complete preservation of the dentition was observed 1.9 times more often than in men ($p < 0.05$), and minor and major DDs were diagnosed, on the contrary, less often (1.4 and 1.3 times, respectively, $p < 0.05$) [11].

Conclusions.

1. The study contributes to a more in-depth understanding of the consequences of DDs for oral health.
2. The presence of DDs causes a higher degree of inflammation and bleeding of the gums compared to individuals with preserved dentition.
3. The negative impact of DDs on the condition of periodontal tissues has a steady tendency to worsen with the age of patients.

Prospects for further research.

Promising is further research to the gender-related characteristics of periodontal tissue status and oral hygiene in patients with dentition defects.

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ВІКОВА ДИНАМІКА СТАНУ ТКАНИН ПАРОДОНТА У ПАЦІЄНТІВ З ДЕФЕКТАМИ ЗУБНИХ РЯДІВ

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Резюме. Збереження цілісності зубних рядів є запорукою стабільного функціонування ротової порожнини та захисту системного здоров'я в довгостроковій перспективі. Втрата зубів тісно пов'язана не тільки з низкою стоматологічних та метаболічних захворювань, а й може мати біологічне підґрунтя, яке формує гендерні поведінкові особливості. Тому доцільним є з'ясування можливого впливу наявності дефектів зубних рядів на стан тканин пародонта у віковому та гендерному аспектах.

Представлено результати аналізу вікових та гендерних особливостей стану тканин пародонта у осіб з дефектами зубних рядів на етапі підготовки до дентальної імплантації. Проаналізовано результати стоматологічного обстеження 95 пацієнтів з малими дефектами зубних рядів (основна група) та 40 осіб зі збереженими зубними рядами (контрольна група) віком 20–59 років. За віком пацієнти розподілені через кожні 10 років на 4 періоди: з 20 до 29 (1-й віковий період), з 30 до 39 (2-й віковий період), з 40 до 49 (3-й віковий період) та з 50 до 59 років (4-й віковий період). Особливості стану тканин пародонта вивчалися за допомогою таких індикаторних індексів як папілярно-маргінально-альвеолярний (РМА) та кровоточивості міжзубних сосочків (РБІ). Результати дослідження демонструють негативний вплив дефектів зубних рядів на стан тканин пародонта, який зростає з віком пацієнта. Згідно з аналізом індикаторних індексів запалення (РМА) та кровоточивості (РБІ), обрані показники у осіб з дефектами зубних рядів були значно гіршими ($p < 0,05$), ніж у осіб зі збереженими зубними рядами, в динаміці всіх вікових періодів як у чоловіків, так і у жінок. Також в осіб чоловічої статі в контрольній групі показники індексу РМА вкладалися в діапазон легкого запалення ясен навіть в останній віковій групі, в той час як в чоловіків основної групи починаючи вже з третього вікового періоду (40–49 років) середні показники індексу РМА відповідали середньому ступеню запалення ясен ($23,52 \pm 1,22\%$) та погіршувалися в четвертому віковому періоді до $27,89 \pm 0,74\%$ ($p < 0,05$). Також нами виявлено більш повільні темпи погіршення стану тканин пародонта з віком у жінок порівняно з чоловіками. Дослідження сприяє глибшому розумінню наслідків наявності дефектів зубних рядів для здоров'я порожнини рота.

Ключові слова: тканини пародонта, дефекти зубних рядів, індекс запалення ясен РМА, індекс кровоточивості міжзубних сосочків РБІ, вікові та гендерні особливості.

AGE-RELATED DYNAMICS OF PERIODONTAL TISSUES STATE IN PATIENTS WITH DENTITION DEFECTS

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Abstract. Maintaining the complete dentition is the key to stable functioning of the oral cavity and protection of systemic health in the long term. Tooth loss is closely related not only to several dental and metabolic diseases, but may also have a biological basis that forms gender-specific behavioral characteristics. Therefore, it is advisable to clarify the possible influence of the presence of dentition defects periodontal tissue state in with respect to age and gender.

The analysis of age-related and the gender features of the state of periodontal tissues in individuals with dentition defects at the stage of preparation for dental implantation are presented. The results of dental examination of 95 patients with minor dentition defects (main group) and 40 people with preserved dentition (control group) aged 20–59 years were analyzed. According to age, the patients were distributed between 10-year periods: from 20 to 29 (1st age period), from 30 to 39 (2nd age period), from 40 to 49 (3rd age period), and from 50 to 59 years (4th age period). The features of the state of periodontal tissues were studied using the determining indicator indices: papillary-marginal-alveolar (PMA) and interdental papillae bleeding (IPB). The findings of the study demonstrate a negative impact of dentition defects on the state of periodontal tissues, which increases with the patient age. According analysis of the indicator indices of inflammation (PMA) and bleeding (PBI), the described indicators in individuals with small dentition defects were significantly worse than in individuals with preserved dentition across all comparable age periods in both men and women. In males in the control group the PMA index values were within the range of mild gingivitis even in the last age group, then in men of the main group, starting from the third age period (40–49 years), the average PMA index values corresponded to the moderate gingivitis ($23.52 \pm 1.22\%$) and worsened in the fourth age period to $27.89 \pm 0.74\%$ ($p < 0.05$). We also found a lower rate of periodontal tissue deterioration with age in women compared to men. The study contributes to a more in-depth understanding of the consequences of dentition defects for oral health.

Key words: periodontal tissue, dentition defects, PMA inflammation index, bleeding index PBI, age and gender features.

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The authors declare no conflict of interest.

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