Morphometric indicators of wound bone tissue condition after surgical treatment of spontaneous periodontitis accompanied by different functional state of organism reactivity

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In periodontal surgery, advanced technologies such as the use of platelet-enriched plasma, the technique of directed tissue regeneration, applying various osteoplastic materials are widely spread. Despite the undoubted achievements, there is a risk of postoperative complications.

The aim of the work was to study the intensity and duration of the wound healing phases after surgical treatment of spontaneous periodontitis accompanied by normo-, hyper- or hyporeactivity of the body by bone morphometry.

Materials and methods. Wistar rats were selected for the study – 90 nonlinear white adult male rats weighing 270 ± 58 grams, aged 11–12 months with spontaneous periodontitis. The animals were divided into three equal groups depending on the condition of their organism reactivity. All the animals underwent surgery on the periodontium: one half of the animals in each of the three groups underwent flap operations, the other – flap operations with osteoplasty (Kolapan-L, Hypro-sorb F). The specific weight of microhemocirculatory bed, connective tissue and bone granulation tissue, bone trabeculae, bone marrow cavities, polymorphonuclear leukocytes, lymphocytes, macrophages, plasma cells was studied by a morphometric method.

Results. Morphometric study of bone wound preparations from animals with spontaneous periodontitis accompanied by normoreactivity of the body has allowed to identify the following phases of healing during the wound process: degenerative-inflammatory changes (the 10th day), an increase in reparative processes (the 20th day) and active regeneration (the 30th day). In cases of hyper- and hyporeactivity, the intensity and duration of the wound healing phases differed. In case of hyperreaction, the granulocyte-macrophage reaction was more expressed and lasted longer until the 20th day, therefore later, only on the 30th day, the signs of regeneration could be observed. In case of hyporeaction, the granulocyte reaction appeared later (only on the 20th day) and lasted longer, signs of active regeneration were noticed later, on the 30th day. The identified patterns occurred regardless of the absence or presence of osteoplastic material in a wound.

Conclusions. In case of normoreactivity, the intensity and timing of the wound process phases were optimal. In case of impaired (hyper- and hypo-) reactions, altered intensity of the cellular phase (increased or decreased) and terms (accelerated or slowed down) resulted in delayed bone wound healing, that is, a complicated course was observed. It justifies the feasibility and necessity of developing methods of targeted drug correction for transforming the wound process phases with impaired body reactivity into those that are typical of normoreaction.

Key words: reactivity of organism, spontaneous periodontitis, periodontal surgery, bone wound, bone morphology.

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Morphometrichні показники стану кісткової тканини рані після хірургічного лікування при спонтанному пародонтиті на тлі різного функціонального стану реактивності організму

Ю. Ю. Яров

У пародонтальній хірургії впроваджують передові технології, як-от використання збагаченої тромбоцитами плазми, техніка спрямованої регенерації тканин, використання різних остеопластичних матеріалів. Незважаючи на безсумнівні досягнення, залишається ризик виникнення післяопераційних ускладнень.

Мета роботи – вивчити інтенсивність і тривалість фаз загострення після хірургічного лікування при спонтанному пародонтиті на тлі нормо-, гіпер- і гіпореактивності організму шляхом аналізу морфометрії кісткової тканини.


Результати. Морфометричне дослідження препаратів кісткової рани у тварин зі спонтанним пародонтитом при нормореактивності організму дало змогу визначити фази загострення під час ранового процесу: дегенеративно-запальних змін (10 діб), активної регенерації (20 діб) та активної регенерації (30 діб). При гіпер- та гіпореактивності інтенсивність та тривалість фаз загострення рани відрізнялися. У разі гіперреакції гранулоцитарно-макрофагальна реакція більш виражена, тривала понад 20 діб, і тому пізніше (на 30 діб) з'являлися ознаки активної регенерації. У разі гіпореакції гранулоцитарна реакція наставала пізніше (на 20 діб) і тривала довше, ознаки активної регенерації з'являлися пізніше – на 30 діб. Ці закономірності спостерігали незалежно від наявності чи відсутності остеопластичного матеріалу в рані.

Висновки. При нормореактивності інтенсивність і терміни фаз ранового процесу є оптимальними. При порушеннях (гіпер-, гіпо-) реакції визнають зміни інтенсивності клітинної фази (підвищеня або зниження) та термінів (прискорені або уповільнені).

Ключові слова: реактивність організму, спонтанний пародонтит, пародонтальна хірургія, кісткова рана, морфометрія кісткової тканини.

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According to modern ideas, the treatment of generalized periodontitis is based on the principles of an integrated approach, which includes the use of therapeutic, surgical, orthopedic, orthodontic, physiotherapy interventions, general and local medications [1–5]. For treatment of generalized periodontitis of II, III degree of severity, surgical methods are the main ones [6].

Periodontal surgery has an etiologic and symptomatic focus and aims at stopping the further development of the inflammatory-destructive process and restoring the periodontal structure and function. Data on the use of various osteoplastic materials and techniques of targeted tissue regeneration are highlighted. It has been proved that the use of platelet-enriched fibrin in the complex treatment for patients with generalized periodontitis of II–III degrees improved the postoperative course and stimulated regenerative processes [7].

Various osteoplastic materials have been widely used in periodontal surgery: synthetic calcium-phosphate, autogenous bone grafts, allogeneic bone, combined plastic materials, membranes for targeted bone regeneration, bioactive agents – bone growth factors, xenotransplants. The use of osteoplastic materials optimizes the conditions for the alveolar process bone tissue restoration, preventing epithelial vegetation of the gingival margin deep towards the apical part of the tooth root [8,9]. Positive results and high efficiency of periodontal surgical treatment consisting in stabilization of the process at the stage of severe tissue destruction, have been achieved not only due to the surgery, but also largely depended on heredity and consistency between physicians of all specialties involved in the treatment of patients, as well as on a course of medical correction, volume and tactics of surgery and postoperative rehabilitation measures [10–12].

However, there is always the risk of postoperative complications [13,14]. This called for further research in this direction with the aim of finding ways to optimize the interventions undertaken by increasing efficiency of pathogenetically targeted drug therapy. It has been proven that the state of body reactivity determines an outcome of post-myocardial infarction healing. In hyper- and hyporeactivity, healing after myocardial infarction is complicated by the damaged zone state (phases of cellular reactions are disturbed) and delayed. In case of normoreactivity, the course of myocardial infarction is uncomplicated and characterized by adequate phases of the wound process and normal healing time [15]. Therefore, it is promising to use the principle of optimal management in the drug therapy of patients with generalized periodontitis, namely, an effect on complicated forms in order to bring the disease course closer to uncomplicated one.

**Aim**

The aim of this study was to examine the intensity and duration of the wound healing phases in the alveolar bone after surgical treatment with or without osteoplasty in case of spontaneous periodontitis accompanied by normo-, hyper- or hyporeactivity of the body by morphometric assessment of the correlation between tissues, bone trabeculae, bone marrow cavities, polymorphonuclear leukocytes, lymphocytes, macrophages and plasma cells.

**Materials and methods**

Wistar rats – 90 nonlinear white adult male rats weighing 270 ± 58 grams, aged 11–12 months, with spontaneous periodontitis were selected as experimental animals for this morphological study. The animals were kept in standard vivarium conditions. The choice of the study object was attributable to traditional laboratory animals (rats) with bone tissue similar to human bone tissue. The animals were divided into three equal groups depending on the condition of organism reactivity. In the first group, drugs that disrupt the organism reactivity were not used (normoreactivity of the organism). In this case, “placebo” animals were injected with saline. In the second group, immunostimulant pyrogenal at a dose of 10 μg/kg/day was injected intramuscularly to the animals, in that way, the condition of organism hyper-reactivity was simulated. The drugs were administered for a month – for the first 7 days daily, then – every 4 days. The choice of a body reactivity model was determined by the fact that, according to the author, the characteristic changes in the reactivity state were confirmed by the dynamics of adrenocorticotropic hormone, adrenaline, cortisol contents and index of blood leukocyte shift [15]. The periodontal tissues condition was evaluated according to generally accepted clinical indicators and periodontal indices. After modeling the organism reactivity, all the animals with spontaneous periodontitis underwent careful instrumental removal of soft and hard supragingival and subgingival dental deposits, drug treatment by irrigating the oral cavity with “Parodontax” rinse. Then, all the animals were subjected to a surgery on the periodontium: one half of the animals in each of the three groups underwent flap surgery according to Cieszyn-Widman-Neumann, the other half – flap surgery with osteoplasty. Colapan-L and Hypro-sorb F were used as osteoplastic materials. Colapan-L is a drug for bone regeneration consisting of artificial hydroxyapatite, collagen and lincomycin. Hypro-sorb F is an absorbable bilayer collagen membrane made of highly purified collagen (99.9 %).

For the morphological study, the area of the alveolar bone adjacent to a surgical wound was used. Extraction of animal bone fragments was performed after sequential withdrawal of 5 animals of each group from the experiment by overdose of inhaled narcotic analgesic on the 10th, 20th and 30th day. Bone tissue was fixed for 24 hours in 10 % buffered formalin solution (pH 7.0). Then, it was decalcified in EDTA solution in a thermostat at 56 °C for 5 days. Decalcified bone was embedded in paraffin at a temperature not exceeding 60 °C. The sections were prepared with a rotary microtome Microm HM325 (Carl Zeiss, Germany)
Table 1. Morphometric parameters of bone tissue after surgical treatment without osteoplasty in cases of body normo-, hyper- and hyporeactivity, M ± SE

<table>
<thead>
<tr>
<th>Groups</th>
<th>Day</th>
<th>Specific weight (%)</th>
<th>MHCB</th>
<th>CTBGT</th>
<th>BT</th>
<th>BMC</th>
<th>PMNLs</th>
<th>L, M, P</th>
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<tbody>
<tr>
<td>Normoreaction</td>
<td>10</td>
<td>9.52 ± 1.03</td>
<td>12.59 ± 2.23</td>
<td>2.07 ± 0.64</td>
<td>0.50 ± 0.12</td>
<td>39.16 ± 3.02</td>
<td>35.49 ± 3.01</td>
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<td></td>
<td>20</td>
<td>12.96 ± 1.80</td>
<td>19.47 ± 3.15</td>
<td>16.01 ± 2.23</td>
<td>4.59 ± 1.42</td>
<td>17.03 ± 1.63</td>
<td>19.04 ± 1.01</td>
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<td></td>
<td>30</td>
<td>5.06 ± 0.54</td>
<td>30.46 ± 4.82</td>
<td>32.63 ± 2.26</td>
<td>10.69 ± 1.00</td>
<td>12.96 ± 1.01</td>
<td>17.54 ± 1.04</td>
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</tbody>
</table>

| Hyperreaction| 10  | 3.36 ± 0.65         | 3.58 ± 0.44  | 0.82 ± 0.63  | 0.36 ± 0.02 | 48.23 ± 3.34* | 43.65 ± 4.05* |
|              |     |                     |         |          |          |           |          |         |
|              | 20  | 7.12 ± 1.08*        | 15.22 ± 2.88 | 5.67 ± 0.66* | 1.98 ± 0.14* | 37.34 ± 3.08* | 32.67 ± 2.86* |
|              |     |                     |         |          |          |           |          |         |
|              | 30  | 11.86 ± 1.86*       | 24.32 ± 3.45* | 15.65 ± 2.08* | 4.63 ± 0.46* | 17.86 ± 1.64* | 25.66 ± 1.34* |

| Hyporeaction | 10  | 3.12 ± 1.43*        | 3.28 ± 0.38* | 0.74 ± 0.54* | 0.32 ± 0.08 | 25.64 ± 1.34* | 22.45 ± 1.08* |
|             | 20  | 6.09 ± 1.03*        | 12.34 ± 1.68* | 4.21 ± 0.32* | 0.98 ± 0.09* | 27.71 ± 1.42* | 28.23 ± 1.75* |
|             | 30  | 11.44 ± 1.34*       | 20.87 ± 2.61* | 14.65 ± 1.96* | 3.78 ± 0.67* | 19.34 ± 1.12* | 22.45 ± 1.67* |

*p < 0.05 in relation to the corresponding values in case of body normoreactivity.

The results of the study on reparative processes in the bone wound after surgical treatment without osteoplasty in animals with spontaneous periodontitis and normoreactivity are presented in Table 1. As can be seen from this table, an active degenerative-inflammatory reaction could be observed for the first 10 days in the bone wound, which was characterized by a large number of cells (in total, a proportion of PMNLs, lymphocytes, macrophages and plasma cells was almost 75 %) in the specimens.

Elements of the MHCB and CTBGT had 3.4 times less specific weight. BT (2.07 ± 3.14 %) and BTcs (0.50 ± 0.12 %) were revealed in limited numbers. On the 20th day, the correlation between morphometric parameters was changed: a percentage of cells was 2.01 times lower, MHCB and CTBGT were 1.36 and 1.55 times (p < 0.05) higher, respectively. In addition, there was an increase in the number of BT (7.37 times, p < 0.05) and BTcs (9.00 times, p < 0.05) in the specimens. This morphological picture indicated the beginning of active regenerative process development in the bone wound. On the 30th day of observation, the predominant morphometric parameters in the bone wound were CTBGT, BT and BTcs (their proportion in relation to the number was 73.98 %) indicating an active course of the healing process. Thus, morphometric examination of bone wound specimens after surgical treatment without osteoplasty from animals with spontaneous periodontitis and body normoreactivity allowed to identify the following periods of cellular reactions during the wound process: the period of degenerative-inflammatory changes (the 10th day), the period of reparative processes (the 20th day) and the period of active regeneration (the 30th day).

The results of the study on reparative processes in the bone wound after surgical treatment with osteoplasty (“Colapan” with osteoconductive properties was used as an osteostructural material for half of the animals, “Hypro-sorb F” including osteoinductor was used for the other half) in animals with spontaneous periodontitis accompanied by body normoreactivity are shown in Table 2. During that initial ten-day period, there was an active degenerative-inflammatory reaction, which was characterized by a large number of cells in the specimens (the total percentage of PMNLs, lymphocytes, macrophages and plasma cells was almost 61 %). A proportion of the MHCB and CTBGT elements were 2.23 times less (p < 0.05). BT (6.41 ± 1.56 %) and BTcs (2.70 ± 0.60 %) were less numerous. However, one should pay attention to their significantly higher number than after surgery without osteoplasty, 3.09 and 5.4 times (p < 0.05), respectively.

On the 20th day, the correlation between morphometric parameters was changed: the total proportion of cells was 1.96 times decreased, MHCB and CTBGT were increased by 1.17 and 1.76 times, respectively (p < 0.05). At the same time, their significant increase by 1.29 and 1.18 times, respectively, compared with those after surgical treatment without osteoplasty, drew the attention. This morphological picture indicated a more pronounced beginning of active regenerative process development in the bone wound with osteoplastic material. On the 30th day of observation, the predominant morphometric parameters in the bone wound were CTBGT, BT and BTcs (their percentage in relation to the number was 80.46 %, which was 6.48 % more than the value without osteoplasty) indicating an active course of the healing process. Thus, morphometric study of bone...
Table 2. Morphometric parameters of bone tissue after surgical treatment with osteoplasty in cases of body normo-, hyper- and hyporeactivity, M ± SE

<table>
<thead>
<tr>
<th>Groups</th>
<th>Day</th>
<th>Specific weight (%)</th>
<th>MHC</th>
<th>CTBGT</th>
<th>BT</th>
<th>BMC</th>
<th>PMNL</th>
<th>L, M, P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normoreaction</td>
<td>10</td>
<td>6.72 ± 1.01</td>
<td>21.75 ± 4.00</td>
<td>6.41 ± 1.56</td>
<td>2.70 ± 0.60</td>
<td>31.09 ± 4.74</td>
<td>29.86 ± 3.30</td>
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<td></td>
<td>20</td>
<td>7.18 ± 1.24</td>
<td>37.38 ± 5.60</td>
<td>20.78 ± 2.06</td>
<td>5.32 ± 0.73</td>
<td>14.31 ± 4.29</td>
<td>16.71 ± 2.35</td>
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<tr>
<td></td>
<td>30</td>
<td>3.23 ± 0.51</td>
<td>30.32 ± 3.24</td>
<td>35.62 ± 3.47</td>
<td>14.32 ± 3.27</td>
<td>2.38 ± 1.07</td>
<td>14.32 ± 1.36</td>
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<tr>
<td>Hyperreaction</td>
<td>10</td>
<td>4.72 ± 0.65*</td>
<td>5.12 ± 0.82*</td>
<td>1.44 ± 0.63*</td>
<td>0.96 ± 0.34*</td>
<td>49.97 ± 5.08*</td>
<td>44.46 ± 4.89*</td>
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<td>20</td>
<td>5.88 ± 1.11</td>
<td>16.12 ± 2.72*</td>
<td>5.98 ± 0.68*</td>
<td>2.01 ± 0.20*</td>
<td>39.03 ± 3.18*</td>
<td>33.31 ± 3.03*</td>
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<tr>
<td></td>
<td>30</td>
<td>12.08 ± 1.88</td>
<td>25.94 ± 3.82*</td>
<td>16.85 ± 2.10*</td>
<td>4.95 ± 0.47*</td>
<td>18.06 ± 1.70*</td>
<td>26.42 ± 1.38*</td>
<td></td>
</tr>
<tr>
<td>Hyporeaction</td>
<td>10</td>
<td>3.82 ± 1.45</td>
<td>6.92 ± 0.43*</td>
<td>1.20 ± 0.62*</td>
<td>0.68 ± 0.12*</td>
<td>27.74 ± 1.40</td>
<td>24.85 ± 1.10</td>
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<td></td>
<td>20</td>
<td>6.98 ± 1.08</td>
<td>18.62 ± 1.78*</td>
<td>5.54 ± 0.62*</td>
<td>2.04 ± 0.12*</td>
<td>30.01 ± 1.75*</td>
<td>28.11 ± 1.82</td>
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<tr>
<td></td>
<td>30</td>
<td>8.11 ± 1.00*</td>
<td>26.72 ± 2.93</td>
<td>24.02 ± 2.06*</td>
<td>6.23 ± 0.99*</td>
<td>11.93 ± 1.10*</td>
<td>12.22 ± 1.08*</td>
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</tr>
</tbody>
</table>

*: p < 0.05 in relation to the corresponding values in case of body normoreactivity.

The results of the study on reparative processes in the bone wound after surgical treatment with osteoplasty from animals with spontaneous periodontitis accompanied by body normoreactivity were observed later. The results of the study on reparative processes in the bone wound after surgical treatment with osteoplasty from animals with spontaneous periodontitis accompanied by body hyperactivity was delayed because the cellular inflammatory response was significantly more pronounced and lasted longer, the signs of active osteoregeneration were observed later. The results of the study on reparative processes in the bone wound after surgical treatment with osteoplasty from animals with spontaneous periodontitis accompanied by body hyperactivity was delayed because the cellular inflammatory response was significantly more pronounced and lasted longer, the signs of active osteoregeneration were observed later.

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The results of the study on reparative processes in the bone wound after surgical treatment with osteoplasty from animals with spontaneous periodontitis accompanied by body hyporeactivity was delayed because the cellular inflammatory response was significantly more pronounced and lasted longer, the signs of active osteoregeneration were observed later.
periodontitis and body hyperreactivity allowed to identify the same periods of osteoregeneration as in the case of normoreactivity. However, the intensity and duration of the wound healing phases differed from those, which were typical for body normoreactivity: granulocyte-macrophage reaction was more pronounced and lasted longer until the 20\textsuperscript{th} day, so the signs of regeneration were later, only on the 30\textsuperscript{th} day. It demonstrated that postoperative wound healing in animals with increased body reactivity was complicated, as evidenced by morphometric studies of the correlation between MHC\textsubscript{B}, CTB\textsubscript{G}, BT and BMC\textsubscript{s}, lymphocytes and PMNL\textsubscript{s}.

The results of the study on reparative processes in the bone wound after surgical treatment without osteoplast in animals with spontaneous periodontitis accompanied by body hyporeactivity are demonstrated in Table 1. During the first 10 days, there was a weak degenerative-inflammatory reaction, characterized by significantly lower number of macrophages and plasma cells in the specimens, in comparison with that of normoreactivity (the total number of PMNL\textsubscript{s}, lymphocytes, macrophages and plasma cells was 1.55 times less than the corresponding value typical for normoreactivity, \( p < 0.05 \)). All the other morphometric parameters were observed in the specimens in limited numbers. On day 20, despite a slight increase, there were relatively low proportions of PMNL\textsubscript{s}, lymphocytes, macrophages and plasma cells in comparison with their maximum values in case of normoreactivity. There was a significant increase in MHC\textsubscript{B}, CTB\textsubscript{G} in the specimens as compared to the 10\textsuperscript{th} day. It is necessary to consider that the contents of these morphometric parameters in this period were significantly 2.12 and 1.58 times \(( p < 0.05 )\) lower, respectively, than those of normoreactivity. This morphological picture displayed a less pronounced and prolonged inflammatory stage of bone wound healing in body hyporeactivity compared to that of normoreactivity. However, the inflammatory cellular response after using osteoplastic inducer material was more active in comparison with that after surgical treatment without using osteoplastic material. On the observational day 30, the correlation between morphometric parameters was changed: the percentage of cells was 2.45 times decreased, MHC\textsubscript{B} and CTB\textsubscript{G} = 1.16 and 1.48 times increased \(( p < 0.05 )\), respectively. In addition, there was an increase in the content of BT \((2.81\text{times}, \ p < 0.05)\) and BMC\textsubscript{s} \((3.05\text{times}, \ p < 0.05)\) in the specimens. This morphological picture showed a more active development of regenerative processes in the bone wound after surgical treatment using osteoplastic material with a regeneration inducer in comparison with that without osteoplast. Though it is worth noting that the speed of regenerative reactions was still lower than that of normoreactivity, which required an additional drug correction.

Thus, the study on morphometric parameters of bone tissue after surgical treatment in animals with spontaneous periodontitis with body hyporeactivity has allowed to identify the same periods of osteoregeneration as with normo- and hyperreactivity. However, the intensity and duration of the bone wound healing phases differed from those of body normoreactivity: granulocyte reaction occurred later (only on the 20\textsuperscript{th} day) and lasted longer, signs of active regeneration appeared later, on the 30\textsuperscript{th} day. This indicates that postoperative wound healing in animals with body hyperreactivity was complicated as evidenced by morphometric studies on the proportion of MHC\textsubscript{B}, CTB\textsubscript{G}, BT and BMC\textsubscript{s}, lymphocytes and PMNL\textsubscript{s}.

**Discussion**

Previous studies have shown the dependence of the wound healing process on the condition of organism reactivity. It has been proven that the wound healing process during myocardial infarction was determined by the organism reactivity status, namely, the state of the damaged area and the healing time. When an organism is normoreactive, the intensity and duration of wound healing phases provided conditions for normal, uncomplicated healing after myocardial infarction. When the body reactivity was impaired, post-infarction healing was delayed with a violation of phases, which was determined morphologically, that is, it was complicated. It has been proposed to apply the principle of optimal management, in particular, effects of drug therapy.
on complicated forms, in order to bring the disease course closer to uncomplicated one based on the state damage zones, regulatory systems, and phases of development. It requires study on the specifics of the wound process course in inflammatory-destructive periodontal disease with different body reactivity [15].

Today, the issue of the body reactivity influence on wound healing processes in generalized periodontitis remains unstudied. At the same time, we have chosen a specific task to study the features of osteoregeneration after flap surgery without osteoplasty and with the use of osteoplastic material from animals with spontaneous periodontitis with organism normo-, hyper- and hyporeactivity. The different nature (intensity, timing) of osteoregeneration in the alveolar bone, determined through the analysis of morphometric parameters of bone tissue in case of normal and impaired body reactivity, allowed to identify the dependence of wound healing on the initial response to damage. In case of normoreaction, the intensity and timing of the wound process phases were optimal due to providing adequate, uncomplicated wound healing. In case of impaired (hyper- and hypo-) reaction, altered intensity of a cellular phase (increased or decreased) and terms (accelerated or slowed down) resulted in delayed bone wound healing, and as the result, a complicated course was observed. The revealed patterns have proven the necessity to develop methods of the targeted medical correction which would be able to shorten the phases of wound process in case of impaired organism reactivity and make them similar to those that are typical of normoreaction.

Conclusions

1. In case of organism normoreactivity, the following stages of osteoregeneration after surgical treatment both without osteoplasty and with the use of osteoplastic material have been revealed: degenerative-inflammatory changes (the 10th day), activation of reparative processes (the 20th day) and active regeneration (the 30th day). The intensity and duration of the wound healing phases provided conditions for normal uncomplicated osteoregeneration of the alveolar bone, which was confirmed by morphometric studies on the correlation between microhemocirculatory bed, connective tissue and bone granulation tissue, bone trabeculae, polymorphonuclear leukocytes, lymphocytes, macrophages, plasma cells.

2. The intensity and duration of the wound healing phases in cases of hyper- and hyporeaction differed from those typical for organism normoreactivity. In case of hyperreaction, the granulocyte-macrophage reaction was more expressed and lasted longer until the 20th day, therefore later, only on the 30th day, there were signs of regeneration. In case of hyporeaction, the granulocyte reaction occurred later (only on the 20th day) and lasted longer, signs of active regeneration were seen later, on the 30th day.

3. Osteoregeneration of alveolar bone in animals with impaired (hyper- and hypo-) organism reactivity was delayed in comparison with that of normoreaction, so it was complicated. The identified patterns occurred regardless of the absence or presence of osteoplastic material in the wound. 4. It is important to choose a targeted drug correction that capable of transforming phases of osteoregeneration after surgical treatment for inflammatory-destructive process in the periodontium with impaired body reactivity into those that are typical for normoreaction, since it provides uncomplicated healing of bone wounds.

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