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## CLASSIFICATION OF GUNSHOT FOREIGN BODIES MIGRATION

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The purpose of the study was to provide the classification features of the gunshot foreign bodies migration. We analyzed 90 cases of gunshot shrapnel blind wounds of different localization for a certain period, where there was a foreign body migration in different ways. The wounded which were admitted to the Military Medical Clinical Centre of the Northern Region of the Command of the Medical Forces of the Armed Forces of Ukraine, were examined by X-ray and, as indicated, using videoendoscopic methods. We distinguish the following classification features: the localization of the entrance hole; the place of migration initiation; the direction of migration; the number of foreign bodies; the structure of foreign bodies; the migration distance; the process of migration occurrence; the time of migration; the cause of migration; the frequency of migration; the foreign body fixation during migration; the volume of referral of migration surgical treatment. The identification of following three landmarks (the entrance hole, the place of migration starts and the place of detection), two stages (the wound channel and the migration corridor) and the direction of gunshot foreign bodies migration form a complete conception. The authors state that gunshot foreign bodies migration represents a separate type of a gunshot wound manifestation. The proposed original classification of gunshot foreign bodies migration allows to sort the data of clinical observations, which is of great importance for adequate and rapid diagnosis, determination of direct foreign body migration and its direction, and for effective treatment of gunshot wounds with phenomena of gunshot foreign body migration.

**Key words:** gunshot wound, foreign bodies, migration, classification

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## КЛАСИФІКАЦІЯ МІГРАЦІЇ СТОРОННІХ ТІЛ ВОГНЕПАЛЬНОГО ПОХОДЖЕННЯ

Метою дослідження було надати класифікаційні ознаки міграції сторонніх тіл вогнепального походження. Ми проаналізували 90 випадків вогнепальних осколкових сліпих поранень різної локалізації за визначений період, де була міграція стороннього тіла різними шляхами. Поранені проходили обстеження та лікування в умовах Військово-медичного клінічного центру Північного регіону і були обстежені променевими та за показами відеоендоскопічними методами. Ми виділяємо наступні класифікаційні ознаки: міграція сторонніх тіл: місце вхідного отвору, місце початку міграції, напрямку міграції, кількість сторонніх тіл, структура сторонніх тіл, дистанція міграції, процес виникнення міграції, час, причина та частота міграції, фіксація стороннього тіла при міграції, обсяг направлення оперативного лікування. Відокремлення трьох подій (місце вхідного отвору, місце початку міграції, місце виявлення), двох етапів (рановий канал та шлях міграції) та напрямку міграції стороннього тіла вогнепального походження формують цілісну концепцію. Автори констатують, що міграція сторонніх тіл вогнепального походження є окремим видом перебігу вогнепального поранення. Запропонована оригінальна класифікація міграції стороннього тіла вогнепального походження дозволяє систематизувати дані клінічних спостережень, що має велике значення для адекватної та швидкої діагностики, визначення безпосереднього процесу та напрямку міграції та ефективного лікування поранених внаслідок вогнепальних уражень з явищами міграції сторонніх тіл вогнепального походження.

**Ключові слова:** вогнепальне поранення, сторонні тіла, міграція, класифікація.

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The migration of foreign bodies of gunshot origin is a rare phenomenon [1, 3, 6] and requires appropriate attention and response. The main methods of gunshot foreign bodies migration diagnosis are X-ray and videoendoscopic methods [2, 5, 6]. The importance of this topic and the direction of research became amplified due significant increase in gunshot wounds of various localization occurring after the large-scale aggression against our country [5, 6].

The absence of a foreign body in the wound channel with anamnestic and clinical signs of its presence indicates its migration which is usually limited by the cavity edges, by both length and cross-section of natural or pathological pathways [3]. Inconsistency in the wound channel direction by the foreign body localization and its size decrease also indicate with a high probability that it has been migrated.

The foreign body migration occurs usually within the cavity (pleural or abdominal, joint etc.) in natural (arteries, veins, respiratory tract, gastrointestinal tract etc.) or pathological (in case of suppuration) ways [2, 3].

In the case of penetrating gunshot wounds of cavities (pleural, abdominal, large joints etc.) where the foreign bodies migration is possible the preference should be given to minimally invasive endoscopic methods of their removal using modern magnetic instruments [5, 6, 12].

However, there are also known clinical cases of foreign body migration during surgery which requires the surgeon to be prepared and have special competencies in additional intraoperative research methods [3, 8, 13].

The lack of gunshot foreign bodies migration classification encouraged the authors to analyze their own experience in this pathology diagnosis and treatment [4, 12] and other specialists results [7, 10] to clarify the problem.

**The purpose** of the study was to provide the classification features of the gunshot foreign bodies migration.

**Materials and methods.** We analyzed 90 cases of gunshot shrapnel blind wounds of different localization for a certain period, where there was a foreign body migration in different ways. All the wounded were treated at the Military Medical Clinical Center of the Northern Region during 2014–2023. All the wounded were men, their average age was  $43.2 \pm 4.1$  years.

The data of anamnesis, objective clinical and general clinical and laboratory studies, as well as the results of instrumental diagnostics were analyzed. The injured were examined by X-ray and, as indicated, using videoendoscopic methods.

Depending on the wound location all the injured were subjected to multispiral computed tomography (MSCT) of the head, chest and abdominal cavities using “Toshiba Activion 16” (Japan) device with a tomograph step of 0.5 mm with and without tomohexol contrast. We used also the head, organs of the thoracic and abdominal cavities and limbs radiographic studies using the X-ray diagnostic “KRD-50 INDIASCOPE-01” complex (Ukraine), fibrobronchoscopy, fibrogastroduodenoscopy, fibrocolonoscopy using the “OLYMPUS CV-170” (Japan) videoendoscopic stand, the neck, chest, abdomen, joints and soft tissues ultrasound examination using the “GE LoGiQ P8” (USA) device.

Mini-invasive surgical interventions with the use of magnetic technologies predominated [12], the conservative tactics foreign bodies migration along the gastrointestinal tract inspection represented a smaller part of our clinical observations.

During the wounded examination and treatment, we carried on the following. The gunshot foreign body migration conceptually has three landmarks: the entrance hole, the place of migration starts and the place of fixation (detection); two stages: the wound channel and the migration corridor; and the direction of migration, which could be changed.

We used the following definitions to operate with the results obtained from the diagnostic procedures. The wound channel we suppose to be located from the place of the entrance hole to the place of migration start. We believe the wound channel ends blindly in case of gunshot foreign bodies migration and the foreign body is not identified at its end. We considered the corridor of migration as the space between the place where the migration starts (this is the damaged organ) and the place of its fixation (detection). The direction of migration goes from the place of the entrance hole through the wound channel to the place of migration initiation further along the migration corridor towards the foreign body's place of fixation (detection).

**Results of the study and their discussion.** 1. Endoscopic methods for the gunshot foreign bodies migration detection. The videogastroduodenoscopy (VGDS) method prevails among all used endoscopic investigations studies, we used it in 19 cases. We used videobronchoscopy (VBS) in 18 cases and videoecolonoscopy (VCS) in 3 cases (Table 1).

Table 1

**The number of endoscopic examinations in the case of gunshot foreign bodies migration**

No	Method of investigation	Absolute and relative (in %) quantity
1	Videobronchoscopy	18 (45)
2	Videogastroduodenoscopy	19 (47.5)
3	Vidoecolonoscopy	3 (7.5)
Totally:		40 (100)

The endoscopic methods of investigation use were equal to 44.4 %, among all wounded with foreign body migration. If compared to the total number of studies – 11.8 %.

The using of VGDS frequency was equal to 47.5 % (19 cases) followed by VBS – 45 % (18 cases) and VKS – 7.5 % (3 cases). Intraoperative diagnostic endoscopic methods were used in 11 (27.5 %) cases, which helped to determine the localization of hollow organ damage and the existence of foreign bodies.

We received the exciting data using VGDS method (Fig. 1).

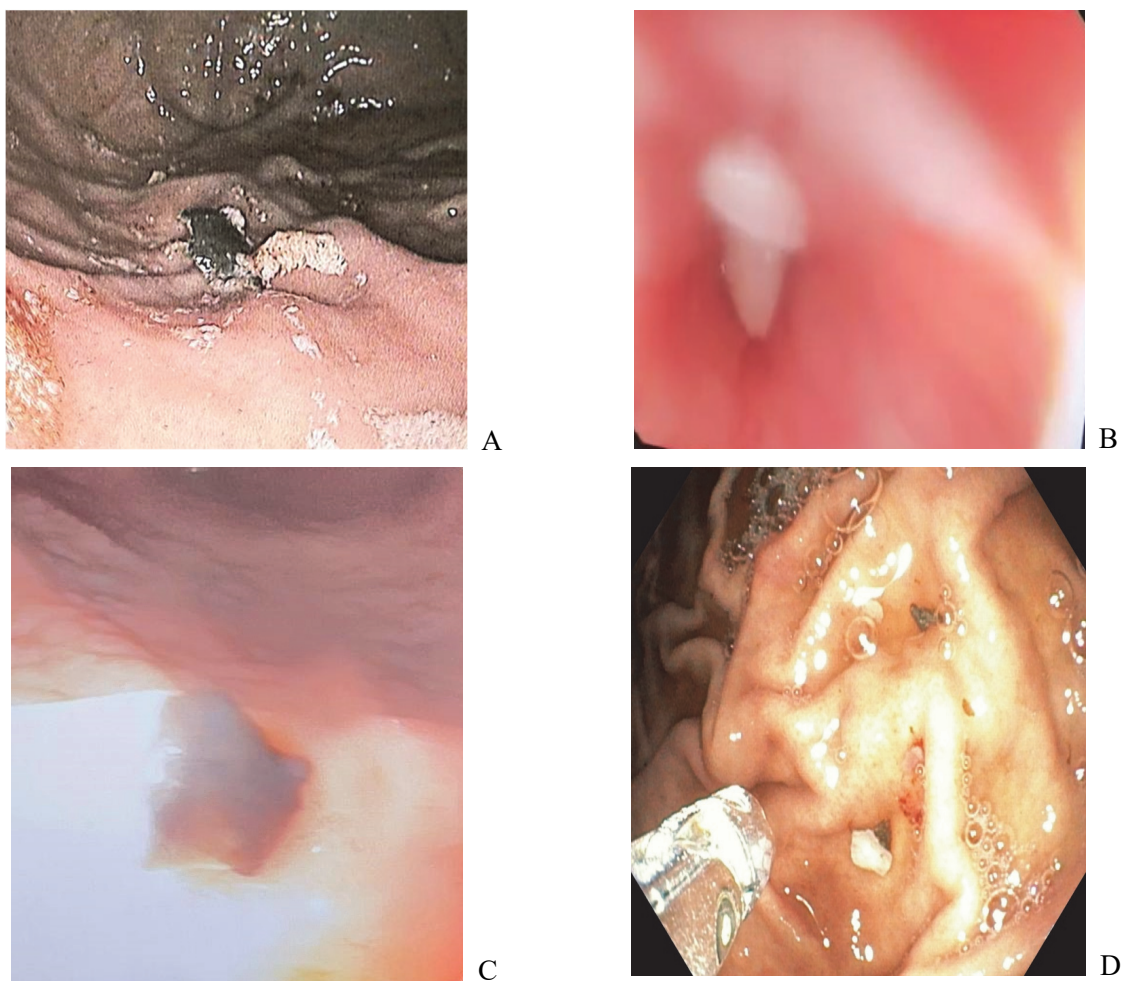


Fig. 1. Endoscopic signs of foreign bodies presence in the lumen of hollow organs: A – foreign body (metal fragment) in the lumen of the stomach; B – a foreign body (part of a tooth) in the lumen of the lower third of the esophagus; C – foreign body (metal fragment) in the lumen of the stomach; D – a foreign body (a metal fragment and part of a tooth) in the lumen of the stomach.

MSCT manifestations of foreign bodies (metal fragments) migration through the vascular bed after a gunshot fragment wound of the right thigh with femoral vein damage are shown in Fig. 2.

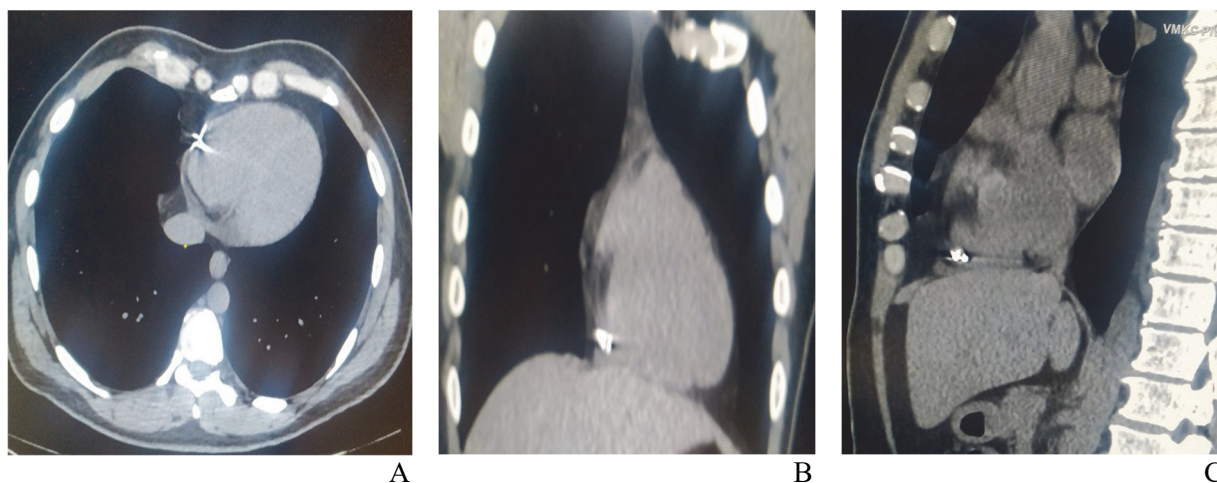


Fig. 2. MSCT of the chest and abdomen of patient K., 42 years, the first day after the injury. A metal fragment was found in the lumen of the cardiac right ventricle: A – axial projection; B – coronal projection; C – sagittal projection.

Next, we would like to present the MSCT signs of a gunshot fragment blind penetrating wound of the chest with pericardium damage and with a foreign body (a metal fragment inside the cavity of the pericardial sac) migration (Fig. 3).

## 2. Classification of the gunshot foreign bodies migration.

Having certain personal experience and taking into account fundamental knowledge we distinguish the following classification features: the localization of the entrance hole; the place of migration initiation;



the direction of migration; the number of foreign bodies; the structure of foreign bodies; the migration distance; the process of migration occurrence; the time of migration; the cause of migration; the frequency of migration; the foreign body fixation during migration; the volume of referral of migration surgical treatment.

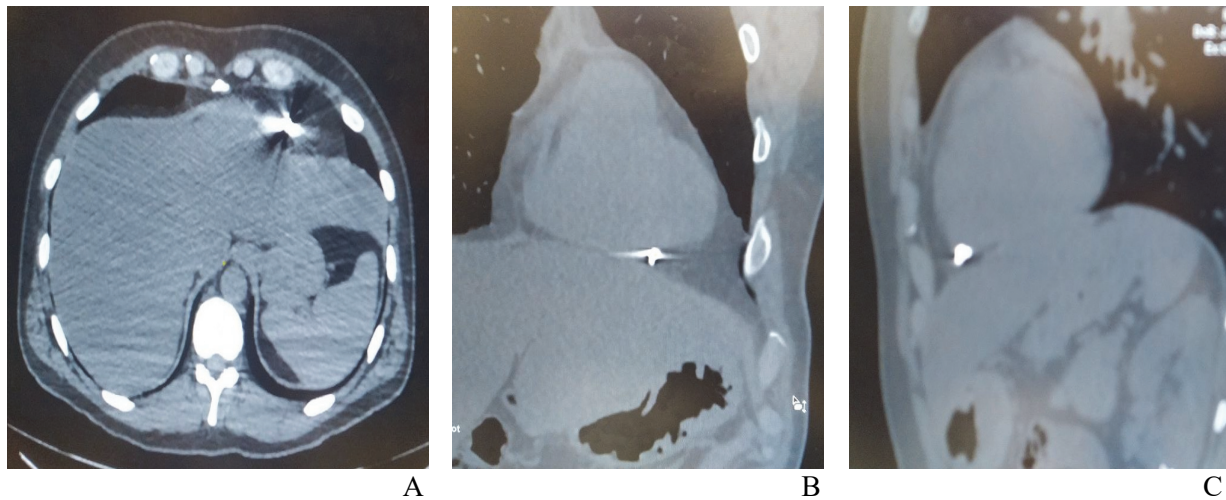


Fig. 3. MSCT of the chest and abdomen of patient G., 47 years, the first day after the injury. A metal fragment inside the pericardial sac: A – axial projection; B – coronal projection; C – sagittal projection.

According to the entrance hole location (in accordance with data by Khoroshun EM et al., 2022) one could distinguish the following items:

1. Head;
2. Neck;
3. Breasts;
4. Stomach;
5. Pelvis;
6. Limbs.

According to the place of migration initiation, the classification items correspond to organs whose damage initiates the passage of gunshot foreign bodies.

According to the direction of gunshot foreign bodies migration, we propose to distinguish the following items:

I. In one direction:

1. Respiratory tract;
2. Gastrointestinal tract;
3. Vascular channel (main veins and arteries, heart);
4. Urinary tract;
5. In cavities (pleural, abdominal, pericardium, joints etc.);
6. In soft tissues during suppuration, when the source is a foreign body that moves along the flow

of pus;

II. In several directions (a combination of different directions).

By the number of gunshot foreign bodies that migrate one should identify:

1. Single foreign body;
2. Multiple foreign bodies (2 or more).

According to the structure of gunshot foreign bodies that migrate there might be the following items:

1. Metal fragment;
2. Bone fragment;
3. Fragments of another structure;
4. Fragments and bone pieces simultaneously.

By the distance from the wound channel termination to the place of foreign body fixation (the migration distance), the following items should be distinguished:

1. Short (up to 100 mm);
2. Medium (from 101 mm to 1000 mm);
3. Long (above 1001 mm).

According to the process of occurrence of gunshot foreign bodies migration, they might be the following:

1. Instantaneous (when a foreign body during an injury enters a blood vessel, respiratory tract, gastrointestinal tract, or cavity and is immediately fixed);

2. Staged (when the foreign body gradually changes its localization).

Over time, the migration of gunshot foreign bodies might be as follows:

1. Immediate (occurs immediately during the injury);

2. Short-term (hours or days before the development of the complications);

3. Prolonged (with purulent complications development).

The cause of gunshot foreign bodies migration, they might be the following:

1. Spontaneous (occurs without the evident reason);

2. Provoked (occurs during surgery, during movements or in case of wound suppuration).

According to the frequency of gunshot foreign body migration one could distinguish the following items:

1. Primary;

2. Repeated.

According to gunshot foreign bodies fixation during migration, the following classification should be used:

1. Static (immovable);

2. Dynamic (moving).

By volume of referral of gunshot foreign bodies migration surgical treatment, one could distinguish the following:

1. Entrance hole of a gunshot wound;

2. Place of migration initiation;

3. Place of foreign body detection;

4. A mix of points ##1–3

5. Non-operative treatment.

Therefore, the proposed original classification of gunshot foreign body migration allows sorting of the data of clinical observations, which is of great importance for adequate and rapid diagnosis, determination of direct foreign body migration and its direction, and for effective treatment of gunshot wounds with phenomena of gunshot foreign body migration. We want to stress that the proposed classification is the result of our own extensive surgical experience and exceptional military medical practice experience during the ATO/OUF (Antiterrorist operation and Operation of the United Forces) and now during the military aggression against our country. The original classification was built taking into account the body of gunshot wounds clinical characteristics and using the fundamental positions of pathophysiological mechanisms expression inside the body of the wounded after the gunshot injury [1, 3, 5, 6].

We would like to emphasise the following when discussing the results obtained and the proposed conceptual classification of gunshot foreign bodies migration.

The foreign bodies penetrated into the tissues during a gunshot wound and remain in the wound channel. However, in the future, as a result of numeral factors, i.e., the patients' active movements, the wound channel rehabilitation faults and/or inadequacy, the purulent complications development characterized by tissues "melting", blind wounds of anatomical cavities (sheaths of tendons, paranasal sinuses) etc., the foreign bodies migrate sometimes to a significant distance from the place of their initial penetration. One could read reports that the bullet which was inside the cardiac right ventricle cavity 40 days later was found in the femoral artery, as well as the foreign bodies identified inside the cardiac cavity after the jugular vein injuries [5, 15].

The study of foreign bodies migration into the large joint cavity or bag is of significant practical importance because of its anatomical complexity, deep localization in the tissues, especially inside the hip joint, favorable conditions for infection development and a high rate of wounded disability [5].

We want to stress that there is a lack of scientific works devoted the gunshot foreign bodies migration. Such descriptions occasionally are found in scientific literature but they have the character of short reports, case reports and give limited information [9, 15]. We found mostly reports concerning the foreign bodies migration in pediatrics who observed the foreign bodies swallowing into the respiratory tract or digestive system in children [11, 14]. Consequently, the analysis of a significant amount of material and individual provisions systematization regarding the gunshot foreign bodies migration are of huge interest to surgeons.

It's vitally important to understand that migration can be inside the cavities or with the different juices (secretions) movement in hollow structures. The migration in the case of multiple foreign bodies can

be implemented simultaneously by different migration routes (for example, along the respiratory pathways or through the gastrointestinal tract in case of the facial skull injury, or in both these cavities).

Many colleagues point to be personally difficult the cases of digestive organs gunshot damage [6]. The migration peculiarities through the gastrointestinal tract are due to peristalsis presence, the foreign body migration slows down in case of peristalsis either absence or decrease. The foreign body migration along the gastrointestinal tract can be combined with the abdomen penetrating wound – the volume of surgical intervention depends in these cases upon the place of foreign body migration initiation and its final location [6]. Non-operative treatment of the gunshot foreign body migration inside the gastrointestinal tract is possible in cases of the hollow organ perforations absence [6, 12].

For that reason, each of the used key classification features is important from the point of view of gunshot foreign body migration process understanding and for the prospective operative or conservative treatment extent determination. Operative treatment in these cases can be aimed both to wounds primary surgical treatment and to the defect at the point of migration initiation suturing together with the foreign body extraction when indicated.

We emphasize the gunshot foreign bodies migration for the reason that that this type of migration is a separate type of gunshot wound manifestation since it differs from other courses of a gunshot wound.

We suppose the following three items are important to prevent foreign bodies remigration: (a) radiation control methods using after wounded persons transportation, before and during surgery; (b) to fix the appropriate position of the body on the operating table, in which the foreign body cannot move; (c) intraoperative proximal control during the foreign body migration through the veins.

### Conclusions

1. The identification of the following three landmarks (the entrance hole, the place of migration starts and the place of detection), two stages (the wound channel and the migration corridor) and the direction of gunshot foreign bodies migration form a complete conception.

2. Each of the identified classification features is important in understanding the process of gunshot foreign body migration and determining the volume of operative or conservative treatment.

3. Migration of gunshot foreign bodies represents a separate type of gunshot wound manifestation.

4. Foreign body migration can occur in places where foreign bodies penetrate into vessels, hearts, cavities, or where secretions move in hollow organs and structures.

5. The original classification was built taking into account the body gunshot wounds clinical characteristics and using the fundamental positions of pathophysiological mechanisms expression inside the body of the gunshot wounded.

6. The proposed original classification of gunshot foreign bodies migration allows to sort the data of clinical observations, which is of great importance for adequate and rapid diagnosis, determination of direct foreign body migration and its direction, and for effective treatment of gunshot wounds with phenomena of gunshot foreign body migration.

*Prospects for further research include the study of additional improvement of the original concept of classification of gunshot foreign bodies migration and its implementation in the practical activities of surgeons to improve the efficacy of diagnostics and treatment of soft tissue gunshot injuries which are accompanied by foreign bodies migration.*

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## COMPLEX TREATMENT OF PERIODONTITIS IN SYSTEMIC LUPUS ERYTHEMATOSUS

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The research is devoted to the implementation of an integrated approach to treatment to improve the quality of life of patients with periodontitis in systemic lupus erythematosus with the determination of quantitative changes in transcutaneous tension before and after treatment. The study involved 50 patients with systemic lupus erythematosus (10 men and 40 women) aged 20 to 55 years (mean age  $38.8 \pm 7.6$  years) who were treated in the rheumatology department. During treatment, patients were divided into two groups by blind randomisation. The first group received only systemic drug and local treatment of periodontitis. The second group received systemic treatment of systemic lupus erythematosus, local therapy and laser therapy on the gum area. A quantitative comparison of patients in group I before and after treatment revealed that in mild systemic lupus erythematosus, the regional perfusion index increased by 30 % in the lower jaw, and in severe lupus erythematosus, only by 28 %. In a quantitative comparison of patients in group II before and after treatment, the regional perfusion index increased to 46 % in mild systemic lupus erythematosus and to 29 % in severe lupus erythematosus.

**Key words:** periodontitis, treatment measures, systemic lupus erythematosus, transcutaneous tension, adult patients.

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## КОМПЛЕКСНЕ ЛІКУВАННЯ ПАРОДОНТИТУ ПРИ СИСТЕМНОМУ ЧЕРВОНОМУ ВОВЧАКУ

Дослідження присвячено втіленню в практику комплексного підходу в лікуванні для покращення якості життя хворих на пародонтит при системному червоному вовчак з визначенням кількісних змін транскутанного напруження до та після проведеного лікування. У дослідженні приймали участь 50 хворих на системний червоний вовчак (10 чоловіків та 40 жінок) від 20 до 55 років (середній вік  $38,8 \pm 7,6$  років), які проходили лікування в ревматологічному відділенні. Під час проведення лікування хворі були поділені сліпою рандомізацією на дві групи. Перша група діставала тільки системне медикаментозне та локальне лікування пародонтиту. А друга група – системне лікування системного червоного вовчаку, локальну терапію та лазеротерапію на ділянку ясен. При кількісному порівнянні пацієнтів I групи до та після лікування встановлено, що при легкій формі системного червоного вовчаку індекс регіонарної перфузії зростає на 30 % більше у нижній щелепі, а при важкій формі тільки у 28 %. При кількісному порівнянні хворих II групи до та після лікування при легкій формі системного червоного вовчаку індекс регіонарної перфузії зростає до 46 %, а при важкій – до 29 %.

**Ключові слова:** пародонтит, лікувальні заходи, системний червоний вовчак, транскутанне напруження, дорослі пацієнти.

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Chronic inflammatory periodontal diseases remain one of the most common dental pathologies, the effectiveness of treatment of which is still low [6, 10]. Despite the generally recognised role of microbial factors and occlusal disorders in their development, somatic disorders are one of the most important aggravating factors of periodontal disease [7]. The problem of diagnosing dentogenic pathology is of particular relevance in patients with chronic somatic diseases of autoimmune genesis [3, 9].