DOI: 10.17816/KMJ2022-309

Differentiated approach to the surgical tactics choice in the treatment of patients with bite wounds

S.G. Izmaylov[1], A.E. Leontev[1], A.G. Izmaylov[2]*, E.E. Lukoyanychev[1], A.I. Rotkov[1], A.A. Kuranov[1], N.A. Koloshein[1], A.V. Mezinov[1], A.S. Simonov[1], E.V. Samarin[1]

[1]City Clinical Hospital No. 7 named after E.L. Berezova, Nizhny Novgorod, Russia;
[2]Kazan State Medical University, Kazan

Abstract

Background. Wounds inflicted by the teeth of animals and humans take a special place and have a number of characteristic features. There is still no generally accepted surgical tactics for the bite wounds treatment, and the issues of choosing the timing of wound closure, depending on their localization, remain unresolved.
Aim. To analyze the clinical experience of bite wounds surgical treatment by applying primary and secondary sutures.
Material and methods. From 2008 to 2018 409 patients with bite wounds of various localizations (289 female and 120 male) aged 16 to 84 years were under our supervision. The average age of the victims was 52.5±10.17 years. All patients were prescribed combined therapy, which was based on an urgent surgical care, since we attach a decisive role in the prevention and local treatment of wound infection to full primary or secondary surgical treatment. The analysis of the obtained data was performed using the statistical calculations in R 3.6.3 (R Foundation for Statistical Computing). To compare the average treatment time for primary and secondary sutures nonparametric Mann–Whitney test was used.
Results. Analysis of the obtained clinical data showed that the largest number of bite wounds were dog bites (95%), which occured most often in spring (38%) and summer (38.1%), and, as a rule, at home (68%), these results were comparable with statistical data from other sources. The average duration of patients' treatment with a primary suture was 13.2 days, and with a secondary suture — 19.3 days. The authors proposed a differentiated approach to the choice of surgical tactics in the treatment of patients with bite wounds, depending on the timing of their admission to the hospital and the local status of the wound defect.
Conclusion. The primary or primary delayed blind suturing should be used in the early stages (not later than in 12 hours after getting a bite), and secondary sutures are shown in late stages (more than 12 hours).
Keywords: bite wounds; primary suture; secondary suture.

For citation: Izmaylov SG, Leontev AE, Izmaylov AG, Lukoyanychev EE, Rotkov AI, Kuranov AA, Koloshein NA, Mezinov AV, Simonov AS, Samarin EV. Differentiated approach to the surgical tactics choice in the treatment of patients with bite wounds. *Kazan Medical Journal.* 2022;103(2):309–316. DOI: 10.17816/KMJ2022-309.

Background

Wounds inflicted by animal and human teeth, which differ in several characteristic aspects, are of special importance among all types of accidental wounds. Bite and bite-avulsive wounds are heavily contaminated with highly virulent abundant microflora contained in the oral cavity, which leads to complications with various vulgar infections (pyogenic, putrid) in the shortest possible time, and the healing processes are torpid due to significant tissue damage [1].

Lethal outcomes from body injuries caused by dogs were reported, and they are not isolated [2–4]. The first was mentioned in forensic medicine in the death of a 10-year-old boy due to injuries from a dog attack found in a 1912 textbook by E. Hoffmann (cited in [5]). Becoming infected with hazardous diseases, such as rabies, anaerobic infection, and tetanus, are possible in patients with an open injury [6, 7]. Additionally, bites from cats, mice, rats, martens, and squirrels are fraught with the genesis of "rat-bite fever" or "rat-bite disease" (sodoku).

Cases of developing benign lymphoreticulosis ("cat-scratch disease," regional non-bacterial lymphadenitis, cat scratch fever, and Mollare–Rai-

*For correspondence: izmailov_alex@mail.ru
Received 09.08.2021; accepted 21.10.2021; published 12.04.2022.

ly disease) have been described, of which the symptoms after 12–20 days (incubation period) are reduced due to increased regional lymph nodes associated with fever and ailment [8–10]. The disease caused by a filter-passing virus of the psittacosis group, ornithosis, carried by cats with birds as its reservoir, was first described by A. Debre and K. Foshay (1932), and then by V. Mollare et al. (1950) (cited in [8]). G.V. Saltsev [9] refers to the disease of a peculiar glandular form of ornithosis, which more often occurs in childhood.

A literature analysis showed that bite wound treatments have no generally accepted surgical approach, issues of wound closure timing based on their location remain unresolved, and the traditional concept of medical care has to be revised and improved [11, 12].

Patients with bite wounds accounted for 1.8% of all patients treated in outpatient (90%) and inpatient (10%) conditions, which is consistent with literature data [13–16].

Aim

The study aimed to analyze the clinical experience of surgical treatment of bite wounds by applying primary and secondary sutures.

Materials and methods of research

From 2008 to 2018, we monitored 409 patients with bite wounds of various localizations (289 females and 120 males aged 16–84 years). The average age of patients was 52.5 ± 10.17 years. In the first 12 h after the injury, 147 people were admitted, while the remaining 262 patients were admitted later (12 h to 5 days).

All patients received the combination therapy, which was based on emergency surgical treatment since we attach a decisive role in the prevention and local treatment of wound infection to full-fledged primary or secondary surgical wound treatment [17–21]. Viable tissue becomes the most powerful barrier to infection, as evidenced by many years of surgical experience [22–25].

Patients underwent clinical, standard laboratory, and bacteriological examinations, as well as X-ray and ultrasound examinations if medically required.

All patients received a set of local and general conservative treatment measures, including mandatory preventive anti-rabies and antitetanus vaccinations, and the antigas gangrene serum was administered following the instructions in case of heavily contaminated wounds and an extensive area of tissue damage.

Antibiotics with a different spectrum of broad synergistic action were prescribed in combination with sulfonamides, nitrofuran agents, or quinoxaline derivatives. Antibiotics, to which the inoculated microflora was sensitive, were used after verifying the pathogen. Encouraging results were obtained from the use of β-lactam antibiotics, namely carbapenems, and third (cefoperazone, ceftazidime, etc.) and fourth (cefpirome) generation cephalosporins, as well as fluoroquinolones and their combinations (unazine, tazocin, etc.). Pyrimidine bases (xymedon and methyluracil), proteolytic enzymes, and physiotherapy (ultrasound, laser, etc.) were used. Detoxification and symptomatic therapy were performed when indicated. Limb immobilization with a plaster splint was used in cases of hand, foot, or joint wounds.

The obtained data were analyzed using the environment for statistical calculations R 3.6.3 (R Foundation for Statistical Computing). The nonparametric Mann–Whitney test was used to compare the mean treatment times for primary and secondary sutures. Data were presented as mean ± standard deviation. Differences were considered statistically significant at p-values of <0.05.

Results

Most often, patients were admitted during the warm season (Fig. 1). In the vast majority of cases, they were hospitalized with extensive injuries, as well as with wounds localization on the hands, head, and neck, and with an increased post-vaccination reaction in history during passive and active immunization. Often (65 people) at a later term, patients with complicated local wound infection were referred to the clinic after surgical care, with a primary blind suture (PBS) application in traumatology centers.

Wound shapes and sizes were very diverse, often characterized by contused, avulsive, and crushed wounds. The edges were uneven, with multiple skin flaps and the presence of bruises in the paravulnar zone, deeply penetrating rounded puncture lesions, and skin abrasions (teeth marks). External traumatic changes were absent or insignificant in the wound circumference with a small area of tissue damage; however, severe subcutaneous injuries of vital anatomical structures were detected later during surgery in some patients.

The wounds were predominantly localized on the shins and hands (Fig. 1). Bacteriological studies of the wound contents showed that the species composition of the flora was always polymicrobial with a frequent combination of pyogenic bacteria with clostridia.

Surgical intervention indications in our cases were determined not by the time elapsed since the bite, but by the local wound status. Surgical intervention was also performed at a later date when

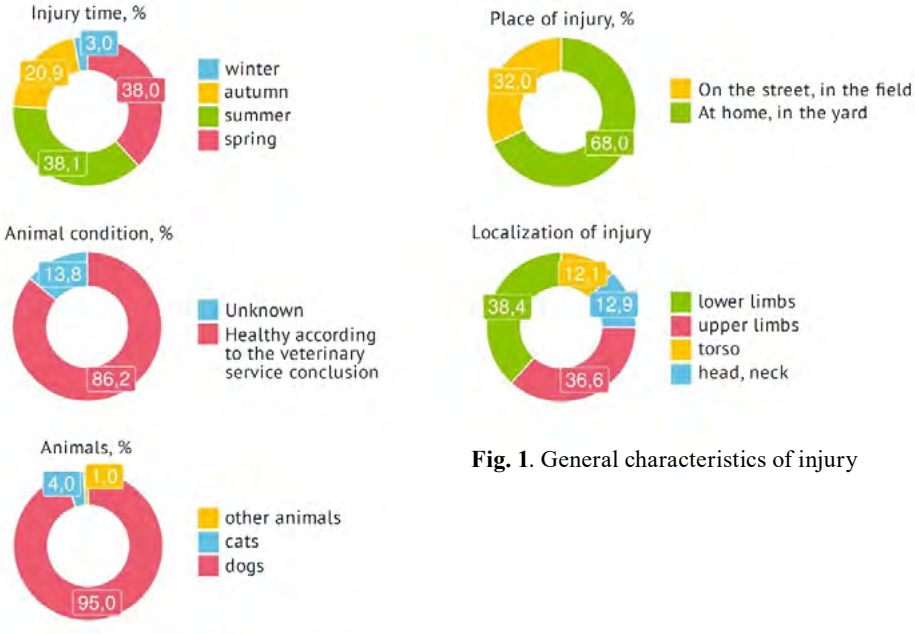

Fig. 1. General characteristics of injury

local and general changes indicating the purulent-inflammatory process progression and wound content retention became secondary surgical treatment indications. Concurrently, surgical indications were established according to the principle "*ubi pus–ibi evacua*."

The old rule regarding the desirability of surgical intervention in the early stages is not disputed by anyone and remains resolute. In the absence of relevant indications (graze wounds, single shallow teeth marks, and bruises without skin damage), which was recorded in 6.1% of patients, treatment was performed through conservative generally accepted measures.

The surgery was performed after establishing a systolic arterial pressure at the level of 100 mm Hg in 4 patients with signs of traumatic shock.

The surgery was preceded by surgical field preparation, including hair shaving, thorough skin washing with a detergent solution, and iodonate treatment. The wound was examined and washed with 3% hydrogen peroxide or other antiseptic solution.

Predominantly, under intravenous anesthesia, the wound was dissected along its length, additionally revised under visual control with blind passage and bridge elimination, and foreign body, obviously accessible necrotic, and doubtful tissue viability removal. In uninfected wounds in no more than 12 h from injury (147 patients), wound edges were excised, as well as the bottom if anatomically acceptable. The excision was made at different sizes (2–15 mm) based on tissue destruction degree, contamination, blood circulation characteristics in the site, and localization. Thus, within the minimum limits, wounds of the face, head, perineum, and hands are subject to excision [26–29].

In the context of the modern assessment approach to the surgical treatment of bite wounds, the problem of closing the wound surface at the final stage of the surgical intervention is extremely relevant. To date, the use of PBS has no consensus among the surgeons. Some believe that such wounds should not be tightly sutured due to their severe contamination [28–30], or that surgical treatment of bite wounds with suturing is possible no earlier than 5 days after the injury [31]. Others adhere to the opposite point of view that PBS can be safely applied to a completely excised wound on day 1 after injury [11, 13, 14, 32, 33]. The authors motivate this approach with convincing arguments, namely a high incidence of wounds on open body parts (head, hands, etc.), and leaving them unsutured leads to disfiguring scar formation in many patients.

Agreeably, the fears of bite wound infection are exaggerated. Thus, our cases show that the healing time was reduced in achieving high cosmetic effect after PBS during intensive rational conservative therapy in 28.5% of 147 patients, even in doubtful cases using fractional or permanent wound cavity lavage through installed drains. PBS was not applied to the foot wound.

In 17% of 147 cases, delayed blind sutures with a preliminary application of retention sutures were used when the use of PBS was risky [34]. Wounds were examined daily. Wound healing by primary intention in this group of patients was achieved in 80%. Sutures were removed on days 8–10. In cases of suppuration, wound edges were separated,

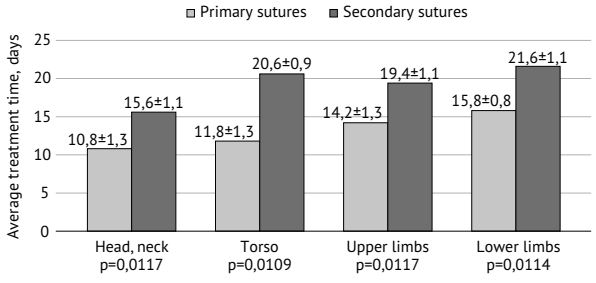

Fig. 2. Localization and terms of bite wound treatments; along the abscissa axis is p when comparing the terms of treatment using primary and secondary sutures at different localizations

and the treatment was performed openly under a bandage.

In patients who are hospitalized late, >12 h after injury (262 people), the wound was subjected to secondary surgical treatment and was adequately drained. After cleansing from purulent-necrotic elements, the wound was closed with a secondary blind suture after the preparation of the edges or making relaxation incisions. A simple interrupted suture was mostly used (57.3%), as well as Donati suture (11.8%), U-shaped sutures (11.8%), adhesive plaster wound edge approximation (7.6%), and 8-shaped sutures (5.3%), and the adaptive repositioning apparatus of G.A. Izmailov and S.G. Izmailov was used for the wound edge intention (6.1%) [35, 36]. In all cases, wound edges could be simultaneously approximated with apparatus removal after suturing using the apparatus method of suturing. No indications were seen for leaving the apparatus for a longer period to reduce the tensile force of wound edges.

The authors proposed a differentiated consideration in choosing the surgical treatment approach in patients with bite wounds, depending on the timing of their hospital admission and the local wound defect status.

Advanced incisions were made, which bordered the area of purulent inflammation, in 7 cases of infection generalization with the development of sepsis, the so-called barrier. One patient, Z., aged 57 years, underwent guillotine amputation in the upper third of the leg due to the genesis of a severe form of septicotoxemia associated with ascending anaerobic non-clostridial intermuscular phlegmon of the lower limb. Recovery occurred.

The average treatment time was 13.2 days for patients with primary sutures and 19.3 days for secondary sutures ($p < 0.0001$) (Fig. 2).

Conclusions

1. Bite wounds account for 2.2% of all injury types, and their treatment should be considered justified in purulent surgical departments, where specialized assistance can be immediately provided in full.

2. The treatment method of choice for patients in the early stages (no later than 12 h) includes a surgical treatment to impose a primary or primary delayed blind suture. Primary blind sutures can reduce the healing time with a good cosmetic effect; however, this requires further research.

3. In cases of late (>12 h) treatment of patients, the use of secondary sutures is justified, as it reduces the treatment duration.

Author contributions. S.G.I. was the work supervisor; A.E.L, A.G.I., and E.E.L. edited the article and prepared it for publication; N.A.K. A.I.R., A.V.M., A.S.S., and E.V.S collected and analyzed the results.

Funding. The study had no external funding.

Conflict of interest. The authors declare no conflict of interest.

REFERENCES

1. Vorobyov AA, Myakonkiy RV. The morphological features of the bite wounds. *Astrakhanskiy meditsinskiy zhurnal*. 2012;(4):72–74. (In Russ.)

2. Litovchenko VM, Masterov VF. Death from body injuries caused by dogs. *Sudebnaya meditsinskaya ekspertiza*. 1966;(1):38–40. (In Russ.)

3. Barinov EKh, Burago YuI, Kaukal' VG. Establishment of death from bites by the teeth of an animal under unknown circumstances of injury. *Sudmedekspert.* 1997;(1):49–50. (In Russ.)

4. Pismarev VV. Death from damage caused by the teeth of dogs. *Sudmedekspert*. 1964;(4):44–45. (In Russ.)

5. Vlasuk IV, Avdeev AI, Baranova AV. Damage caused by dogs in aggression against the person. *Dalnevostochnyy meditsinskiy zhurnal.* 2014;(1):135–139. (In Russ.)

6. Plekhanov VI, Odinotchenko NG, Makarov ML, Balashov AV, Baranovich SYu, Barabash VI, Plekhanova LA. Treatment of patients with the bitten wounds. *Uspekhi sovremennogo estestvoznaniya.* 2006;(12):71–72. (In Russ.)

7. Movsesyants AA, Olefir YuV. Current challenges of preventive vaccination against rabies. *Biopreparation. Prevention, diagnosis, treatment.* 2019;19(1):10–16. (In Russ.) DOI: 10.30895/2221-996X-2019-19-1-10-16.

8. Samoylenko IG, Maksimova SM. Benign inoculation reticulosis (cat scratch disease). *Zdorove rebenka.* 2010;(4):115–117. (In Russ.)

9. Sal'tsev GV. A case of benign lymphoreticulosis. *Sovetskaya meditsina*. 1957;(7):130–131. (In Russ.)

10. Romashkina AS, Snarskaya ES, Alekberzade AV. Cat scratch disease. *Rossiyskiy zhurnal kozhnykh i venericheskikh bolezney.* 2013;(2):23–26. (In Russ.)

11. Parshikova SA, Parshikov VV, Glyavina IA. To the question of surgical tactics in children with facial bites. *Vestnik eksperimentalnoy i klinicheskoy khirurgii*. 2013;6(4):483–488. (In Russ.)

12. Kostyakov DV, Zinoviev EV, Asadulaev MS, Lopatin IM, Luk'yanov SA, Artsimovich IV, Sukhoparova EP. Modern approaches to providing medical aid to affect dogs bites. *Russian biomedical research*. 2018;(4):8–12. (In Russ.)

13. Anishin NS, Anishina ON. About the treatment of wounds inflicted by animals. *Vestnik khirurgii*. 1979;(11):111–115. (In Russ.)

14. Lenyushkin AI. Bitten wounds in children. *Sovetskaya meditsina*. 1962;(11):80–84. (In Russ.)

15. Messina VM. *Pervichnaya kozhnaya plastika pri travme myagkikh tkaney litsa*. (Primary skin grafting in case of face's soft tissues trauma.) M.: Meditsina; 1970. 397 p. (In Russ.)

16. Selimov MA, Semenova EV, Boltutskiy AG. Some results of the use of anti-rabies gamma globulin in healthcare practice. In: *Trudy Moskovskogo instituta vaktsin i syvorotok im II Mechnikova*. (Proceedings of the Moscow Institute of Vaccines and Serums named after I.I. Mechnikov.) M.: Meditsina; 1960. Vol. 15. 236 p. (In Russ.)

17. Dwyer JP, Douglas TS, van As AB. Dog bite injuries in children — a review of data from a South African paediatrictrauma unit. *S Afr Med J*. 2007;97(8):597–600. PMID: 17952217.

18. Petrushin AL. Bitten wounds of the hand. *Ekologiya cheloveka*. 2010;(8):61–64. (In Russ.)

19. Kostyakov DV, Zinovyev EV. Modern choice of pathogenetically-based methods of treatment of bite wounds. *Bulletin of the Russian Military Medical Academy*. 2016;(2):235–240. (In Russ.)

20. Gostishchev VK. *Operativnaya gnoinaya khirurgiya*. (Operative purulent surgery.) M.: Meditsina; 1996. 416 p. (In Russ.)

21. Danilov IV, Rovnov IS, Shraiber MI. Wounds and their treatment. In: *Spravochnik khirurga*. (Surgeon's Handbook.) M.: Medgiz; 1961. p. 133–151. (In Russ.)

22. Izmaylov SG, Izmaylov GA. *Gnoyno-vospalitel'nye i nekroticheskie zabolevaniya kozhi i podkozhnoy kletchatki*. (Purulent-inflammatory and necrotic diseases of the skin and subcutaneous tissue.) Nizhny Novgorod: ABAK; 1999. 144 p. (In Russ.)

23. Sergeev AN, Morozov AM, Askerov EM, Sergeev NA, Armasov AR, Isaev YuA. Methods of local antimicrobial prevention of infection of the surgical intervention area. *Kazan Medical Journal*. 2020;101(2):243–248. (In Russ.) DOI: 10.17816/KMJ2020-243.

24. Kostyuchenok BM, Dumchev VA, Karlov VA. Modern treatment of a purulent wound. *Sovetskaya meditsina*. 1977;(3):123–127. (In Russ.)

25. Kurbangaleev SM. *Gnoynaya infektsiya v khirurgii*. (Purulent infection in surgery.) M.: Meditsina; 1985. 272 p. (In Russ.)

26. Sidelnikov YuN, Panevin TS. Analysis of medical referrals of people bitten by potential sources of rabies to khabarovsk hospitals. *Dalnevostochnyy meditsinskiy zhurnal*. 2015;(2):48–51. (In Russ.)

27. *Obshchaya khirurgiya*. (General surgery.) Petrov SV, editor. Ed. 3. SPb.: Piter; 2010. 768 p. (In Russ.)

28. *Instruktsiya po meditsinskomu primeneniyu*. (Instructions for medical use.) *RU №LS-001202*. http://www.consultant.ru/document/cons_doc_LAW_99350 (access date: 16.07.2022). (In Russ.)

29. *Khirurgicheskie infektsii kozhi i myagkikh tkaney*. Rossiyskie natsional'nye rekomendatsii. (Surgical infections of the skin and soft tissues. Russian national recommendations.) Gel'fand BR, Kubyshkin VA, Kozlov RS, Khachatryan NN, editors. M.; 2015. 111 p. (In Russ.)

30. Rusanov SG. Wounds, injuries. In: *Bol'shaya meditsinskaya entsiklopediya*. (Big medical encyclopedia.) Vol. 29. M.: Sovetskaya entsiklopediya; 1962. p. 954–1007. (In Russ.)

31. Kuzin MI. *Rany. Obshchaya khirurgiya*. (Wounds. General surgery.) M.: Meditsina; 1985. 400 p. (In Russ.)

32. Mikhal'chenko VV. Treatment of bite wounds. *Zdravookhranenie Kazakhstana*. 1968;(2):46–47. (In Russ.)

33. Rui-Feng C. Emergency treatment on facial laceration of dog bite wounds with immediate primary closure: a prospective randomized trial study. *BMC Emerg Med*. 2013;13(Suppl 1):S2. DOI: 10.1186/1471-227X-13-S1-S2.

34. Reznikova AE. Surgical tactics of treatment and rehabilitation of children with bite wounds of the face and neck. In: *Sbornik, posvyashchennyy 10-letiyu Moskovskogo tsentra detskoy chelyustno-litsevoy khirurgii: rezul'taty, itogi, vyvody*. (Collection dedicated to the 10th anniversary of the Moscow Center for Pediatric Maxillofacial Surgery: results, findings, conclusions.) Moscow; 2000. p. 137–142. (In Russ.)

35. Kochnev OS, Izmaylov SG. *Sposoby ushivaniya ran*. (Methods of suturing wounds.) Kazan: Izdatel'stvo Kazanskogo universiteta; 1992. 160 p. (In Russ.)

36. *Soedinenie tkaney v khirurgii*. Rukovodstvo dlya vrachey. (Tissue connection in surgery. Guide for doctors.) Ovchinnikov VA, Abelevich AI, editors. N. Novgorod: Izdatel'stvo Nizhegorordskoy gosudarstvennoy meditsinskoy akademii; 2005. 152 p. (In Russ.)

Author details

Sergey G. Izmailov, M.D., Doct.Sci. (Med.), Prof., City Clinical Hospital No. 7 named after E.L. Berezov, Nizhniy Novgorod, Russia; izi28082009@yandex.ru; ORCID: https://orcid.org/0000-0001-7998-9277

Andrey E. Leontiev, M.D., Cand.Sci. (Med.), Assoc.Prof., City Clinical Hospital No. 7 named after E.L. Berezov, Nizhniy Novgorod, Russia; leontjeff@mail.ru; ORCID: https://orcid.org/0000-0001-6510-3391

Alexander G. Izmailov, M.D., Cand.Sci. (Med.), Assoc.Prof., Depart. of General Surgery, Kazan State Medical University, Kazan, Russia; izmailov_alex@mail.ru; ORCID: https://orcid.org/0000-0001-9559-550X

Egor E. Lukoyanychev, M.D., Cand.Sci. (Med.), Assoc.Prof., City Clinical Hospital No. 7 named after E.L. Berezov, Nizhniy Novgorod, Russia; egor-lukoyanychev@yandex.ru; ORCID: https://orcid.org/0000-0001-6392-2692

Andrey I. Rotkov, M.D., Cand.Sci. (Med.), Assoc.Prof., City Clinical Hospital No. 7 named after E.L. Berezov, Nizhniy Novgorod, Russia; 3959400@mail.ru; ORCID: https://orcid.org/0000-0002-6678-8422

Anatoly A. Kuranov, M.D., Cand.Sci. (Med.), City Clinical Hospital No. 7 named after E.L. Berezov, Nizhniy Novgorod, Russia; aa.kuranov@gmail.com; ORCID: https://orcid.org/0000-0001-6899-5890

Nikita A. Koloshein, M.D., Depart. of Purulent Surgery, City Clinical Hospital No. 7 named after E.L. Berezov, Nizhniy Novgorod, Russia; n.koloshein@mail.ru; ORCID: https://orcid.org/0000-0002-4563-5478

Andrey V. Mezinov, M.D., Head, Depart. of Purulent Surgery, City Clinical Hospital No. 7 named after E.L. Berezov, Nizhniy Novgorod, Russia; mezinov.andre@yandex.ru

Anton S. Simonov, M.D., Depart. of Purulent Surgery, City Clinical Hospital No. 7 named after E.L. Berezov, Nizhniy Novgorod, Russia; anton_simonov91@mail.ru; ORCID: https://orcid.org/0000-0002-3377-5860
Evgeny V. Samarin, M.D., Depart. of Traumatology and Orthopedics, City Clinical Hospital No. 7 named after E.L. Berezov, Nizhniy Novgorod, Russia; samar-evgenij@yandex.ru