

УДК: 617.5-001.1/.3-06: 616.9

DOI <http://dx.doi.org/10.5281/zenodo.15066160>

FRACTURES IN PATIENTS WITH COVID-19. PROBLEMS AND A MODERN VIEW OF TREATMENT

Tanasiienko P.V.¹, Guriev S.O.², Skobenko E.O.³

¹ Vinnytsia National Medical University named after N.I. Pirogov, Vinnytsia, Ukraine,

² DZ "Ukrainian scientific and practical center of emergency medical aid and disaster medicine of the Ministry of Health of Ukraine", Kiev, Ukraine,

³ DNU "Center of Innovative Medical Technologies of the National Academy of Sciences of Ukraine", Kiev, Ukraine.

ПЕРЕЛОМИ У ХВОРИХ НА COVID-19. ПРОБЛЕМИ ТА СУЧАСНИЙ ПОГЛЯД НА ЛІКУВАННЯ

Танасієнко П.В.¹, Гур'єв С.О.², Скобенко Е.О.³

¹Вінницький національний медичний університет ім. М.І.Пирогова, Вінниця, Україна,

²ДЗ «Український науково-практичний центр екстреної медичної допомоги та медицини катастроф МОЗ України», м. Київ, Україна,

³ДНУ «Центр інноваційних медичних технологій НАН України», Київ, Україна.

Summary/Резюме

Today, it is clear that the COVID-19 pandemic has become a challenge for the health care system in all countries. Vast financial and human resources are involved in providing care to infected patients. Many multidisciplinary hospitals have been repurposed into infectious diseases hospitals. In the conditions when the pandemic is in full swing, it is also necessary to solve the issue of specialized trauma care. The purpose of our work was to generalize global and own experience in the problem of treating fractures in patients with the coronavirus disease COVID-19 and to develop modern recommendations in the technology of providing medical care to patients of this category. To carry out the research tasks, we formed a retrospective study array, which consisted of 289 cases of skeletal bone fractures, which were treated at the "Kiev City Clinical Hospital of Emergency Medical Care" from March 2020 to February 2021 and met the criteria for inclusion in the study. The total array of the study was 289 cases of fractures of the bones of the skeleton. The COVID-19 pandemic undoubtedly has many important consequences for health, the economy and society, and it also requires several initiatives to determine which measures are most appropriate to prepare to reduce occupational risks. These initiatives include understanding various aspects of disease control and transmission in the context of an ongoing pandemic. Strict adherence to the World Health Organization's evidence-based recommendations for PPE and environmental hygiene increases safety and improves infection mitigation in acute orthopedic practice. Nevertheless, we believe that these recommended measures can optimize the medical services provided to patients with confirmed COVID-19 and should reduce the risk of occupational transmission to other patients and healthcare workers.

Keywords: pandemic, COVID-19, traumatology, fractures, long bones, algorithm, treatment,

Сьогодні очевидно, що пандемія COVID-19 стала викликом для системи охорони здоров'я в усіх країнах. Величезні фінансові та людські ресурси залучаються для

надання допомоги інфікованим пацієнтам. Багато багатопрофільних лікарень перепрофільовано в інфекційні. В умовах розпалу пандемії необхідно також вирішувати питання спеціалізованої травматологічної допомоги. Метою нашої роботи було узагальнення світового та власного досвіду з проблеми лікування переломів у хворих на коронавірусну хворобу COVID-19 та розробка сучасних рекомендацій з технології надання медичної допомоги пацієнтам цієї категорії. Для виконання завдань дослідження було сформовано масив ретроспективного дослідження, який склав 289 випадків переломів кісток скелета, які перебували на лікуванні в «Київській міській клінічній лікарні швидкої медичної допомоги» з березня 2020 року по лютий 2021 року та відповідали критеріям включення до дослідження. Загальний масив дослідження склав 289 випадків переломів кісток скелета. Пандемія COVID-19, безсумнівно, має багато важливих наслідків для здоров'я, економіки та суспільства, а також вимагає кількох ініціатив, щоб визначити, які заходи є найбільш доцільними для підготовки для зниження професійних ризиків. Ці ініціативи включають розуміння різних аспектів контролю та передачі захворювань у контексті пандемії, що триває. Суворе дотримання заснованих на доказах рекомендацій Всесвітньої організації охорони здоров'я щодо ЗІЗ та гігієни навколишнього середовища підвищує безпеку та покращує пом'якшення інфекцій у невідкладній ортопедичній практиці. Тим не менш, ми вважаємо, що ці рекомендовані заходи можуть оптимізувати медичні послуги, які надаються пацієнтам із підтвердженням COVID-19, і мають зменшити ризик професійної передачі іншим пацієнтам і медичним працівникам.

Ключові слова: пандемія, COVID-19, травматологія, переломи, довгі кістки, алгоритм, лікування,

Introduction

The emergence of a new coronavirus a year ago became one of the key events for the entire civilization in the 21st century, had and will continue to have a strong impact on the development of our society. At the same time, it came as a surprise to virologists. The possibility of the emergence of such a virus has always been discussed, and after the appearance in 2002 of the coronavirus, the causative agent of SARS, which became a kind of “educational alarm”, in the leading countries of the world, especially in the USA, China and Germany, active work was carried out to study the potential virtually all mammalian viruses as sources of new human pathogens [6, 22]. However, many questions remain unsolved today: why does the mortality rate differ in different countries and among different population groups; how effectively the immune system fights a viral infection and how long immunity is preserved in a person, does virus infection affect the occurrence and course of fractures in patients of different age groups

[2, 18]. Virus infection occurs through mucous membranes through contact with an aerosol, containing the virus (particles of sputum), or by direct hand contact with a contaminated object and subsequent transfer of the virus to susceptible areas (for example, hand contact with the nose and face). The possibility of transmission of the virus in the aerosol, which is formed primarily during intubation/extubation of patients, as well as when using during surgical interventions electrocoagulation, drilling of the bone marrow canal, is shown. In the air in the form of an aerosol, SARS-CoV-2 can be detected for 3 hours, and on surfaces — up to 24 hours on cardboard and up to 3 days. on plastic and metal [8]

Today, it is clear that the COVID-19 pandemic has become a challenge for the health care system in all countries. Vast financial and human resources are involved in providing care to infected patients. Many multidisciplinary hospitals have been repurposed into infectious diseases hospitals. In the conditions when the pandemic is in full

swing, it is also necessary to solve the issue of specialized trauma care. According to Gur'ev S.O et al. (2024), traumatology is one of the branches of medicine that cannot suspend its activities, despite the danger of the epidemic. The level of injury slightly decreases during periods of self-isolation and restrictions on social activities, but remains significant [10]. These problems cannot be solved in isolation from providing care to patients of other specialties. After all, during the pandemic, not only skeletal injuries occur, but also craniocerebral injuries, acute surgical diseases, conditions related to the provision of emergency neurological and cardiac care, and much more. Therefore, the adequate work of one of these services, for example, the trauma service, is impossible without the creation of a system of providing assistance to patients with multidisciplinary emergency pathology in the conditions of a pandemic.

The purpose of our work was to generalize global and own experience in the problem of treating fractures in patients with the coronavirus disease COVID-19 and to develop modern recommendations in the technology of providing medical care to patients of this category.

Materials and methods

To fulfill the tasks of the study, we formed a retrospective array of the study, which consisted of 289 cases of fractures of the bones of the skeleton, which were treated in the KNP "Kiev City Clinical Hospital of Emergency Medical Care" from March 2020 to February 2021 and met the criteria for inclusion in the study. The total array of the study was 289 cases of fractures of the bones of the skeleton, which were divided into two groups: the main and the control. 157 cases of skeletal fractures against the background of COVID-19 were included in the main group and met the selection criteria for the study. In relative terms, this accounted for 54.3 % of the total array. The control group included 132 cases of skeletal fractures in which there was no COVID-19 infection and also met the selection criteria for the control group. In relative terms,

this accounted for 45.7 % of the total array. In the main group, there were 88 men, which constituted 56.0 % of the mass of the group, and 69 women, respectively, which constituted 44.0 % of the mass of the group. The average age in the group was 52.1 ± 8.8 years. In the control group, there were 82 men, which constituted 62.1 % of the mass of the group, and 50 women, which constituted 37.9 % of the mass of the group. Scientific information was collected and analytically processed using systematic and comparative analysis. PubMed NCBI, Google Scholar and others were the most frequently used search engines. In addition, the data of literary sources were compared with the own experience of treating patients with bone fractures against the background of the disease of COVID-19.

Results

Looking back, it should be admitted that after the publication of information about the spread of a new viral infection in China, its true danger and possible consequences of widespread distribution, up to the development of a pandemic, not only in Ukraine, but also in many other countries, were underestimated. This circumstance led to the fact that at the beginning of the pandemic, measures for the prevention and treatment of COVID-19 did not involve serious structural changes in the system of providing medical care, but were limited to local measures within medical institutions. At the same time, when we had the first serious patients with a clinical picture of a new infection and when the real danger of COVID-19 was realized, measures were initiated to radically reorganize the provision of care, to ensure a sufficient number of disinfectants and personal protective equipment for personnel. The described picture is not unique to Ukraine. To one degree or another, the same mistakes were made in other countries. Everywhere, with the accumulation of experience came an understanding of how to fight infection and how to care for patients with other diseases and injuries [10].

Based on the world and our own ex-

perience, we have developed recommendations that can be combined in the following four important areas:

1. Prevention of unnecessary contacts, transfers of patients, operations;
2. Limiting the number of consultations and visitors;
3. Reduction of waiting time, volumes of treatment;
4. Use of personal protective equipment (PPE).

Organization of patient flows, indications for hospitalization under pandemic conditions. In most cases, patients with acute trauma requiring surgical treatment were hospitalized for examination and preparation for surgical treatment. In the conditions of the pandemic, this approach was caused by local outbreaks of infection directly in the hospital with the involvement of both patients and medical personnel, which led to the impossibility of providing specialized care. Therefore, in our opinion, limiting optional hospitalizations until the patients' COVID-status is clarified was the first priority. Hospitalization of scheduled patients for orthopedic operations during the pandemic was completely suspended both due to the risk of infection and to free up potentially necessary intensive care unit resources. Thus, in the conditions of the developing pandemic, hospitalization in a trauma hospital is indicated only for patients who really required surgical fixation of the fracture, in which the delay of surgical treatment for a period of 30 days or more will lead to a worsening of the result. We did not hospitalize all patients with fractures who could be treated conservatively and on an outpatient basis. In the conditions of a pandemic, such cases should also include fractures in which surgical treatment shortens the patient's recovery time, but does not improve the final long-term result of treatment, for example, fractures of the clavicle, humerus, distal part of the radius with an acceptable position of the fragments [17].

Referral to the clinic of a patient with a fracture who needs urgent surgical treat-

ment requires a clear plan of action. Arrangements should be made to separate patient flows into COVID-19-negative and COVID-19-confirmed or non-excluded. If surgery cannot be delayed until the test results are available, the patient should be considered infected and all appropriate precautions should be taken. Currently, there are documented cases of nosocomial spread of the virus, so such a strict protocol is extremely important

Detailed information on the selection of patients of all surgical profiles, screening, places and the amount of care provided to them, anti-epidemic requirements for staff and patients, maintenance and exchange of medical documentation, recommendations for rest of medical staff are contained in the recommendations of the American Academy of Orthopedic Surgeons. There is also a table in which all surgical pathology is divided into 5 sections according to the degree of their priority. Priority A includes interventions that must be performed urgently (within 24 hours). These include open fractures; femoral neck fractures in young people; pelvic fractures accompanied by bleeding; fractures with damage to large vessels; compartment syndrome; dislocations; necrotizing fasciitis; closed fractures with compromise of soft tissues; complex fractures (external fixation only).

Priority B includes urgent (up to 48 hours) operations that must be performed for fractures of the neck of the femur in the elderly, fractures of the neck of the talus, fractures of the diaphyses of the femur and tibia, and the distal part of the femur. All other operations for fractures are prioritized and can be performed within two weeks. All scheduled operations are classified as priority D and E and may be delayed for three months or more.

This document also presents an exemplary staffing schedule for the trauma department with the allocation of three separate teams that do not overlap with each other. Also, which is very important, the necessary parameters for computers, networks,

data storage format and exchange of information about patients are defined. In cases where surgery can be delayed for several days, primary outpatient care and preoperative outpatient examination, which should also include testing for SARS-CoV-2 as close as possible to the scheduled date of hospitalization for surgical treatment, are optimal. With a positive test result, preference is given to conservative treatment, or surgical treatment is postponed until the virus is eliminated from the body. If urgent surgical treatment of the fracture is necessary, it should be performed, but the treatment plan should take into account measures to prevent the spread of the virus. A very high risk of developing life-threatening complications in patients infected with SARS-CoV-2 should be taken into account [11]. Park C, et al. (2020) analyzed the clinical course of COVID-19 in 10 patients with fractures. Seven of them became infected during their stay in the hospital, three were infected before they were injured. Three out of 10 were operated on, the rest were treated conservatively. Four patients died within 2 weeks. after hospitalization. The authors recommend limiting indications for surgical treatment of infected patients, taking into account the type of fracture and the patient's risk factors. If outpatient treatment is not possible and emergency hospitalization is required for urgent/urgent surgical treatment (for example, femur fracture), the patient should be tested for COVID-19 as soon as possible. If there is a viral disease clinic, hospitalization should be carried out in a specially designated box (ward/department) until the patient's status is clarified. If the test result is negative, the patient is transferred to the general ward for further surgical treatment [20].

Surgical treatment

A number of precautions should be taken when surgically treating a patient with known or suspected COVID-19. In the operating room, the presence of non-essential medical personnel should be limited by reducing the number of assistants as much as possible. Given the high risk of forma-

tion during intubation and extubation of an aerosol containing the virus, regional anesthesia methods should be preferred. The patient's face should be covered with a surgical mask or respirator. If intubation and extubation are necessary, they should be carried out in separate rooms if possible; when performing intubation/extubation directly in the operating room, the rest of the medical staff must leave the room during the manipulation and for the period necessary to change the air in the room. In the operating room, when treating COVID-19-positive patients, it is recommended to maintain negative pressure to prevent the spread of the virus outside the room — this slightly increases the risk of surgical infection in a particular patient, so it is desirable to know the patient's status before the operation [14].

The dangerous stages of the operation are the so-called aerosol-generating procedures. In addition to intubation/extubation, these include the use of an electrocoagulator, an oscillating saw, bone drilling, and reaming of the bone marrow canal. These stages require appropriate precautions: removal of smoke during coagulation using an aspirator, use of protective shields or insulating glasses during aggressive processing of bone tissue (sawing and drilling) [1].

Outpatient treatment of patients and consultation

If necessary, personal consultations of patients are replaced by telemedical consultations (must be accompanied by appropriate documentation). Personal visits of patients to the clinic are canceled whenever possible. This especially applies to patients from regions far from the trauma center, reducing the spread of the virus between regions. To limit personal visits to the clinic, necessary examinations are limited to the following cases:

- acute injury;
- direct control after surgery to remove sutures (if absorbable sutures are not used or no one else can remove them);
- Control of the position of fragments

- during conservative fracture treatment;
- High potential risk of complications;
 - Cases when the change in the load mode on the limb by body weight depends on the radiograph data or requires removal of the (gypsum) bandage [3].

In the latter case, it is also recommended, if possible, to perform x-rays at the place of residence and evaluate them through telemedical consultation. If immobilization with plaster casts is necessary, it is recommended to use lancet rather than circular plaster casts as widely as possible to reduce the duration of contact between the patient and the medical staff in the subsequent stages of treatment [19].

The main directions of action in the developing COVID-19 pandemic should be:

- Minimization or postponement of planned orthopedic care;
- separation of flows of patients and medical staff;
- testing of patients for COVID-19 before hospitalization/performance of emergency trauma operations;
- in the case of urgent surgical interventions on a patient with unconfirmed COVID-19, he should be treated the same as an infected person, with all possible precautions and personnel protection being observed;
- division of personnel into 2-3 trauma teams with alternating periods of active work in the hospital (usually 1 week) with periods of isolation (remote work for 1-2 weeks).
- strict and regulated use of personal protective equipment.

Discussion

The main conclusion of this study was that the outbreak of COVID-19 trauma care conditions for patients worldwide. So according to Barahona M, et al. (2020) in Chile during the COVID-19 epidemic, the number of surgeries decreased by 22.3 % compared to 2019. The most affected months were May, June and July, which according to the

mobility of the country were the period of greatest restriction [1]. A single-center study in India reported a 43.92 % reduction in orthopedic surgeries over a full year. In our study, we also observed a similar trend demonstrating the impact of COVID-19 on orthopedic surgery throughout the year [14].

Country mobility was strongly correlated with number of procedures; also the number of cases of COVID-19 had a more significant effect on the number of procedures performed in the public health network. Mobility restrictions dictated by the government of Ukraine were determined by such factors as accumulated cases of COVID-19, hospital capacity and socio-economic conditions. During the second wave in Japan, Nakai et al. (2022) showed that orthopedic procedures performed in preoperatively negative patients did not result in an increased complication rate, even in those who were immunoglobulin G (IgG) positive [18]. These findings are supported by an observational study in the United Kingdom (UK), which found no significant complications during lower extremity surgery during the peak of COVID-19 [7]. Preoperative testing for COVID-19 is important to reduce risk even in asymptomatic patients. In addition, Kader N., et al. (2020) estimated a low mortality risk for elective surgery in asymptomatic patients when all were tested for COVID-19, even with the risk of a false-negative test [12]. Therefore, each hospital institution must weigh the benefits of performing elective surgery based on staffing, hospital availability, PPE provision, and government policy [14].

Hip fracture is a critical pathology in orthopedics that requires multidisciplinary care to improve outcomes and survival. Reports from the United Kingdom show an increase in 30-day mortality after hip fracture in the first wave of the outbreak, with the risk of mortality being higher in COVID-19-positive patients. This study shows a reduction in hip fracture surgery [11]. A lower incidence rate may play a role, but this is unlikely, as other countries report a decline in the quality of care for this condition, and

during the first during the wave of the pandemic, no reduction in morbidity was noted [13]. Efforts must be made to support the operation of trauma units so as not to increase the morbidity, mortality, and long-term health care costs of this vulnerable patient population [22].

The main principles of separation of personnel, physical restructuring and the developed work process should focus on reducing exposure and contamination, ensuring compliance with PPE and subsequent decontamination. Ideally, there should be two types of hospital segregation. Segregation of orthopedic staff by location reduces the potential risk of cross-contamination. For example, orthopedic surgeons should not screen the population because of the risk of exposure [3]. Geographic separation within the complex of operating rooms limits the traffic of the operating rooms, reduces the impact and minimizes the area of contamination. Due to the rapid increase in the number of patients with COVID-19, the orthopedic staff should be divided between those treating suspected/confirmed patients with COVID-19 and those treating non-infectious patients if this is not possible. However, this may not be possible in smaller hospital systems and practices. In addition to screening and isolating high-risk patients with confirmed COVID-19, rigorous and frequent screening of individual operating room personnel is imperative. Members of isolated or unprotected personnel must immediately report any signs of illness and must be immediately relieved of duty. In addition, all contact between patients and staff should be recorded so that contact tracing and infection control measures can be implemented quickly if any member of the isolated staff tests positive [4].

Conclusions: The COVID-19 pandemic undoubtedly has many important consequences for health, the economy and society, and it also calls for several initiatives to determine which interventions are most appropriate for preparing to reduce occupational risks. These initiatives include understanding various aspects of disease control

and transmission in the context of an ongoing pandemic. Strict adherence to evidence-based CDC and World Health Organization guidelines for PPE and environmental hygiene increases safety and improves infection mitigation in acute orthopedic practice. Nevertheless, we believe that these recommended measures can optimize the medical services provided to patients with confirmed COVID-19 and should reduce the risk of occupational transmission to other patients and healthcare workers.

References

1. Barahona M, de Los Santos D, Diaz N, Barrientos C, Infante CA Trends in Orthopedic Surgery in Chile: Analysis Between 2004 and 2020. *Cureus*. 2021 May 17; 13 (5): e15080. doi: 10.7759/cureus.15080. PMID: 34017670; PMCID: PMC8129445.
2. Benazzo F, Rossi SMP, Maniscalco P, et al. The orthopaedic and traumatology scenario during Covid-19 outbreak in Italy: chronicles of a silent war. *Int Orthop*. 2020; 44 (8): 1453–1459. doi: 10.1007/s00264-020-04637-3.
3. Chang Liang Z., Ye Chong M.S., Sim M.A, Lim J.L., Castaceda P., Green D.W. et al. Surgical Considerations in Patients with COVID-19: What Orthopedic Surgeons Should Know. *J Bone Joint Surg Am*. 2020 Apr 24. doi: 10.2106/JBJS.20.00513.
4. Chatterji G, Patel Y, Jain V, Geevarughese NM, Haq RU. Impact of COVID-19 on Orthopaedic Care and Practice: A Rapid Review. *Indian J Orthop*. 2021 Mar 20; 55 (4): 839-852. doi: 10.1007/s43465-021-00354-0. PMID: 33776130; PMCID: PMC7980796.
5. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, Qiu Y, Wang J, Liu Y, Wei Y, Xia J, Yu T, Zhang X, Zhang L. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet*. 2020 Feb 15; 395 (10223): 507-513. doi: 10.1016/S0140-6736 (20)30211-7. Epub 2020 Jan 30. PMID: 32007143; PMCID: PMC7135076.
6. Coimbra R., Edwards S., Kurihara H., Bass G.A, Balogh Z.J., Tilsed J. et al. European Society of Trauma and Emergency Surgery (ESTES) recommendations for trauma and emergency surgery preparation during times of COVID-19 infection. *Eur J Trauma Emerg Surg*. 2020 Apr 17: 1–6. doi: 10.1007/s00068-020-01364-7
7. De C, Kainth N, Harbham PK, Brooks M, Agarwal S. J. Review of orthopaedic trauma surgery during the peak of COVID-19 pandemic — an observational cohort study in

- the UK. J Clin Orthop Trauma. 2021; 20: 101422.
8. Ding B.T.K., Soh T., Tan B.Y., Oh J.Y., Mohd Fadhl M.F.B., Rasappan K., Lee K.T. Operating in a Pandemic: Lessons and Strategies from an Orthopaedic Unit at the Epicenter of COVID-19 in Singapore. J Bone Joint Surg Am. 2020 May 6. doi: 10.2106/JBJS.20.00568
 9. Gruskay JA, Dvorzhinskiy A, Konnaris MA, LeBrun DG, Ghahramani GC, Premkumar A, DeFrancesco CJ, Mendias CL, Ricci WM. Universal Testing for COVID-19 in Essential Orthopaedic Surgery Reveals a High Percentage of Asymptomatic Infections. J Bone Joint Surg Am. 2020 Aug 19; 102 (16): 1379-1388. doi: 10.2106/JBJS.20.01053. PMID: 32516279.
 10. Gur'ev S.O., Tanasienko P.V., Skobenko E.O. REACTION OF THE CYTOKINE PROFILE IN PATIENTS WITH CLASS FRACTURES TO COVID-19 APHIES Actual Problems of the Modern Medicine: Bulletin of Ukrainian Medical Stomatological Academy Vol. 24 No. 1 (2024): 13-17. DOI 10.31718/2077-1096.24.1.13 (In Ukrainian)
 11. Hall AJ, Clement ND, Farrow L, MacLulich AMJ, Dall GF, Scott CEH, Jenkins PJ, White TO, Duckworth AD; IMPACT-Scot Study Group. IMPACT-Scot report on COVID-19 and hip fractures. Bone Joint J. 2020 Sep; 102-B (9): 1219-1228. doi: 10.1302/0301-620X.102B9.BJJ-2020-1100.R1. Epub 2020 Jul 7. PMID: 32634029.
 12. Kader N, Clement ND, Patel VR, Caplan N, Banaszkiwicz P, Kader D. The theoretical mortality risk of an asymptomatic patient with a negative SARS-CoV-2 test developing COVID-19 following elective orthopaedic surgery. Bone Joint J. 2020; 102-B: 1256-1260.
 13. Kayani B., Onochie E., Patil V. The effects of COVID-19 on perioperative morbidity and mortality in patients with hip fractures. Bone Joint J. 2020; 7: 1-10. doi: 10.1302/0301-620X.102B9.BJJ-2020-1127.R1
 14. Kumar Jain V., Lal H., Kumar Patralekh M., Vaishya R. Fracture management during COVID-19 pandemic: a systematic review. J Clin Orthop Trauma 2020; 11: S431-S441. doi: 10.1016/j.jcot.2020.06.035
 15. LeBrun D.G., Konnaris M.A., Ghahramani G.C. Hip fracture outcomes during the COVID-19 pandemic: early results from New York. J Orthop Trauma. May 2020 doi: 10.1097/BOT.0000000000001849.
 16. Liu YC, Kuo RL, Shih SR. COVID-19: The first documented coronavirus pandemic in history. Biomed J. 2020 Aug; 43 (4): 328-333. doi: 10.1016/j.bj.2020.04.007. Epub 2020 May 5. PMID: 32387617; PMCID: PMC7199674.
 17. Luengo-Alonso G, Páez-Tabernero FG, Tovar-Bazaga M, Arguello-Cuenca JM, Calvo E. Critical adjustments in a department of orthopaedics through the COVID-19 pandemic. Int Orthop. 2020 Aug; 44 (8): 1557-1564. doi: 10.1007/s00264-020-04647-1. Epub 2020 May 30. PMID: 32474718; PMCID: PMC7260474.
 18. Nakai T, Iwasaki H, Nishikawa T, Higuchi R, Sakata K, Matsuoka H, Iwata H, Sogo E, Nanno K, Nakamura S, Kuroda S, Hayashi J, Nakata S. Challenges and responses of elective orthopaedic surgery during the second wave of COVID-19. J Orthop Sci. 2022 May; 27 (3): 713-716. doi: 10.1016/j.jos.2021.02.017. Epub 2021 Apr 17. PMID: 33902971; PMCID: PMC8052470.
 19. Narang A, Chan G, Aframian A, Ali Z, Carr A, Goodier H, Morgan C, Park C, Sugand K, Walton T, Wilson M, Belgaumkar A, Gallagher K, Ghosh K, Gibbons C, Keightley A, Nawaz Z, Wakeling C, Sarraf K, Rogers BA, Kieffer WKM. Thirty-day mortality following surgical management of hip fractures during the COVID-19 pandemic: findings from a prospective multi-centre UK study. Int Orthop. 2021 Jan; 45 (1): 23-31. doi: 10.1007/s00264-020-04739-y. Epub 2020 Aug 29. Erratum in: Int Orthop. 2020 Sep 24; : PMID: 32862265; PMCID: PMC7456361.
 20. Park C, Sugand K, Nathwani D, Bhattacharya R, Sarraf KM. Impact of the COVID-19 pandemic on orthopedic trauma workload in a London level 1 trauma center: the "golden month". Acta Orthop. 2020 Oct; 91 (5): 556-561. doi: 10.1080/17453674.2020.1783621. Epub 2020 Jun 23. PMID: 32573331; PMCID: PMC8023929.
 21. Vaishya R, Vaish A, Kumar A. Impact of COVID-19 on the practice of orthopaedics and trauma an epidemiological study of the full pandemic year of a tertiary care centre of New Delhi. Int Orthop. 2021 Jun; 45 (6): 1391-1397. doi: 10.1007/s00264-021-05021-5. Epub 2021 Apr 9. PMID: 33835246; PMCID: PMC8032552.
 22. Wax RS, Christian MD. Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients. Can J Anaesth. 2020 May; 67 (5): 568-576. doi: 10.1007/s12630-020-01591-x. Epub 2020 Feb 12. PMID: 32052373; PMCID: PMC7091420.

*Вперше надійшла до редакції 05.01.2025 р.
Рекомендована до друку на засіданні
редакційної колегії після рецензування*