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CHARACTERISTICS OF THE TREATMENT PROCESS IN PATIENTS WITH FRACTURES OF THE SHOULDER BONE ON A BACKGROUND OF COVID-19

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The purpose of the study was to analyze the distribution of patients with shoulder fractures during the COVID-19 epidemic and to determine changes in their treatment approaches. To carry out the study, we retrospectively analyzed the treatment of 289 trauma patients who underwent inpatient treatment at the Kyiv City Clinical Emergency Medical Hospital from 2019 to 2021. During the epidemic of COVID-19, the number of cases of damage to the girdle of the upper limb significantly decreased, which included all localizations except damage to the distal part of the forearm, where an increase in the number was found during this period. Epidemic restrictions and screening mechanisms for patients with upper extremity fractures during COVID-19 have changed approaches to the treatment of patients with upper extremity fractures towards a wider use of conservative treatment methods, which applied to all locations, except for patients with fractures of the distal humerus, where the structure of treatment showed almost the same tendency in comparison with the treatment of similar patients in the pre-epidemic period.

Key words: fractures, humerus, forearm bones, pandemic, surgical treatment, conservative treatment, COVID-19.

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ХАРАКТЕРИСТИКА ЛІКУВАЛЬНОГО ПРОЦЕСУ У ПАЦІЄНТІВ З ПЕРЕЛОМАМИ ДОВГИХ КІСТОК ВЕРХНЬОЇ КІНЦІВКИ НА ТЛІ COVID-19

Метою нашого дослідження було проаналізувати розподіл пацієнтів з переломами плеча у період епідемії COVID-19 та визначити зміни у підходах до їх лікування. Для виконання нашого дослідження нами ретроспективно проаналізовано лікування 289 пацієнтів з травмою, що проходили стаціонарне лікування у Київській міській клінічній лікарні швидкої медичної допомоги з 2019 по 2021 рік. Під час епідемії COVID-19 значно зменшилась кількість випадків пошкодження поясу верхньої кінцівки, що включало всі локалізації крім пошкодження дистального відділу передпліччя, де виявлено зростання кількості у цей період. Епідемічні обмеження та механізми скринінгу пацієнтів з переломами верхньої кінцівки під час COVID-19 змінили підходи до лікування пацієнтів з переломами верхньої кінцівки у бік більш широкого використання консервативних методик лікування, що стосувалось усіх локалізацій, крім пацієнтів з переломами дистального відділу плечової кістки, де структура лікування показала майже однаково тенденцію у порівнянні з лікуванням подібних пацієнтів у доковідному періоді.

Ключові слова: переломи, плечова кістка, кістки передпліччя, пандемія, хірургічне лікування, консервативне лікування, COVID-19.

The study is a fragment of the research project "Fractures of long bones in patients with COVID-19 (diagnosis, clinical features and the course of the traumatic process)", state registration No. 0123U103221.

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 [2]. Therefore, the adequate work of the trauma service during the pandemic is impossible without the creation of a system of providing assistance to patients with multidisciplinary emergency pathology, which includes bone fractures [8]. Treatment of skeletal bone fractures in patients with COVID-19, given the novelty of this problem, is one of the most difficult tasks of modern traumatology and orthopedics [1]. Bone fractures against the background of COVID-19 are characterized not only by high mortality and disability, but also by unpredictable progression. That is why today the development of a clear clinical organization of medical care for patients with fractures against the background of COVID-19 is needed, which should begin with the diagnosis of the viral disease and traumatic injuries and end with rehabilitation measures in a specialized center [9].

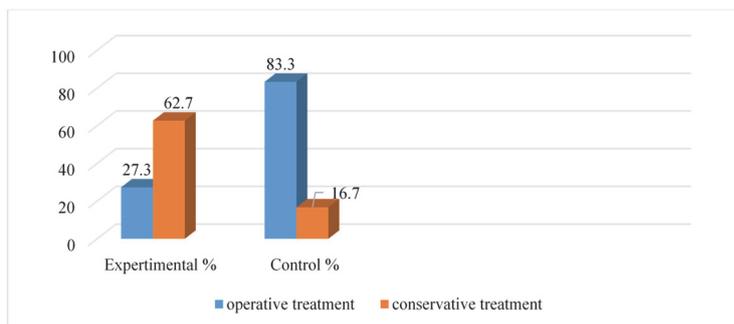
Determining the clinical and nosological characteristics of patients with fractures of the bones of the skeleton will allow to determine the features of injury options for fractures of the bones of the skeleton during the period of the epidemic of COVID-19 and will allow to determine their features in comparison with the "pre-war period. The clinical and nosological characteristics of fractures in patients with COVID-19 will make it possible to assess both the effect of the virus itself and the features of the course of fractures against the background of infection, which in turn will allow a detailed study and analysis of the available clinical and nosological aspects of this scientific problem [7].

Characteristics of the treatment of fractures of long bones of the upper limbs in patients against the background of COVID-19 is an important component of the general characteristics of the phenomenon.

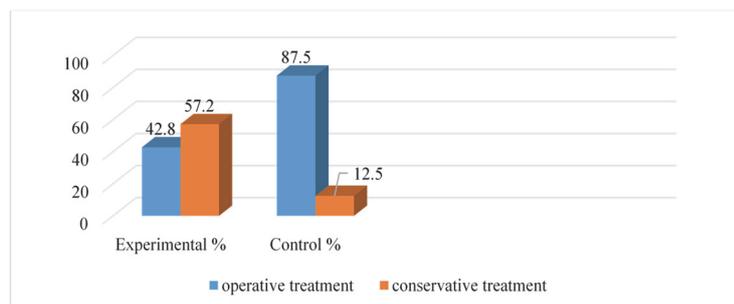
Determining the nosological structure of injuries will reveal the peculiarities of the distribution of skeletal trauma during the epidemic period. Clinical and nosological characteristics of injuries during the pandemic will allow to orient the diagnostic and treatment capabilities of health care institutions and reorient them in the post-pandemic period. To date, there are no reports in Ukraine about the peculiarities of the course of the traumatic process in victims with damage to the humerus against the background of COVID-19, which prompted us to carry out this study.

The purpose of the study was to analyze the distribution of patients with shoulder fractures during the COVID-19 epidemic and to determine changes in approaches to their treatment.

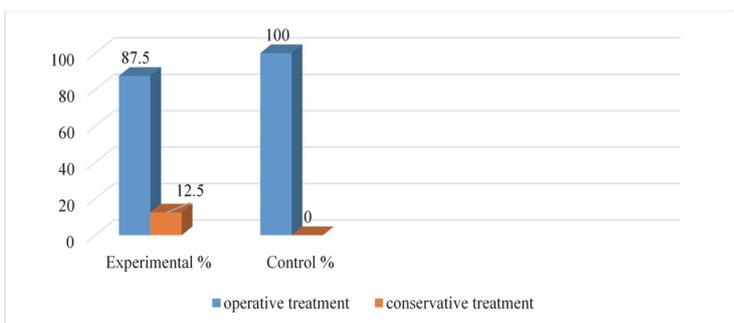
Materials and methods. To carry out the study, we retrospectively analyzed the treatment of 289 trauma patients who underwent inpatient treatment at the Kyiv City Clinical Emergency Medical Hospital from 2019 to 2021. Damage to the bones of the upper limb was detected in 136 patients, which was 47.1 % of the total mass. For the purpose of qualitative analysis of the actual research material, we divided the study array into groups according to the time period when the traumatic injury occurred. The first group included victims whose injuries occurred from 01.03.2020 to 01.03.2021, that is, during the COVID-19 pandemic. The first (main) group included 73 cases of fractures of the bones of the upper limb against the background of infection with COVID-19, which accounted for 53.7 % of the total mass. The second (control) group included 63 cases of upper extremity bone injuries that were diagnosed between March 1, 2019, and March 1, 2020, that is, in the “pre-war period”. In the relative value of the absolute indicator, it was 46.3 % of the total array. In our study, we used the generally accepted classification of AO/ASIF fractures to determine the clinical and nosological characteristics of injuries in patients with COVID-19. The research was carried out in accordance with the terms of the Declaration of Helsinki with the approval of the Ethics Committee of the DNU Center for Innovative Medical Technologies of the National Academy of Sciences of Ukraine (protocol No. 5 dated March 17, 2020). All subjects signed a voluntary informed consent to participate in this study. All patients participating in our study were tested for the presence of COVID-19 using laboratory, x-ray, sonographic, and other diagnostic methods.



A



B



C

Fig. 1. Distribution of treatment methods in victims with injuries of the humerus (A – proximal part, B – diaphyseal part, C – distal part).

Statistical processing was carried out using non-parametric methods. Taking into account the number of analyzed signs and the need to ensure the uniformity of the effective indicators, in order to make a correct comparison, we chose the method of calculating the coefficient of the polychoric relationship indicator proposed by K. Pearson.

Results of the study and their discussion. There were 11 victims with damage to the proximal part of the humerus in the main array, which made up 15.1 % of the array of the group. Among them, type A damage occurred in 63.6 % of cases, type B damage in 27.3 %, and type C damage in 9.1 % of cases. Operative treatment was carried out only in 3 patients, which was 27.3 % of the mass of the group. All patients who underwent operative treatment received type B fractures, and the remaining patients underwent conservative treatment.

There were 12 patients with fractures of the proximal part of the humerus in the control group, which was 19.0 % of the group. 75.0 % of

patients in this cohort had type A fractures, 16.7 % had type B fractures, and 8.3 % had type C fractures. Operative treatment was performed in 83.3 % of patients in the control group. Conservative treatment was carried out in 16.7 % of patients, of which one patient had a fracture of the humeral head (type A) and one patient refused surgical treatment (type A). Fig. 1 A shows the distribution of treatment of injuries of the proximal part of the humerus in the main and control groups of the observation array.

The analysis of the treatment of patients with fractures of the proximal part of the humerus showed that the given positions are within the probability field ($\chi^2 17.71 \geq \chi^2_{st} 6.0$) ($p \leq 0.05$).

Among the patients in the main array, damage to the diaphysis of the humerus was detected in 9.6 % of the group's array. Type A fractures in this area were observed in 85.7 % of cases, and type B in the remaining 14.3 % of cases. Type C lesions were not detected among the patients of the main group. Operative treatment was performed in 6 patients, which was 85.7 % of this cohort. 14.3 % of patients were offered a conservative method of treating a fracture of the diaphyseal part of the humerus. In the control array of patients with similar damage, there were 8, which was 12.7 %. The distribution of fracture types was similar to the distribution of the main group: type A fractures in 62.5 % of cases, and type B fractures in 37.5 % of cases. Type C fractures were not detected in the control array. In the control group, fractures of the diaphyseal part of the humerus were treated surgically in 7 cases, which accounted for 87.5 % of the cohort group. In 1 case, 12.5 % of the patients were fitted with a plaster cast at the early hospital stage, and subsequently the patient refused to replace it and switch to surgical treatment. Fig. 1B shows the distribution of treatment of injuries of the diaphyseal part of the humerus in the main and control groups of the observation array.

The results of the study indicate a change in the technology of providing medical care to victims with fractures of the diaphysis of the humerus during the COVID-19 epidemic. As indicated by the analysis of the data in Fig. 1B, during the epidemic period, surgical treatment of patients with fractures of the humerus diaphysis decreased by more than half. In the period before COVID-19, this damage was operated on in 87.5 % of cases, but during the epidemic, only in 42 % of cases. At the same time, the number of patients with a conservative method of treatment increased more than 4.5 times. The conducted polychoric analysis indicated that the given positions are within the probability field ($\chi^2 23.85 \geq \chi^2_{st} 6.0$) ($p \leq 0.05$).

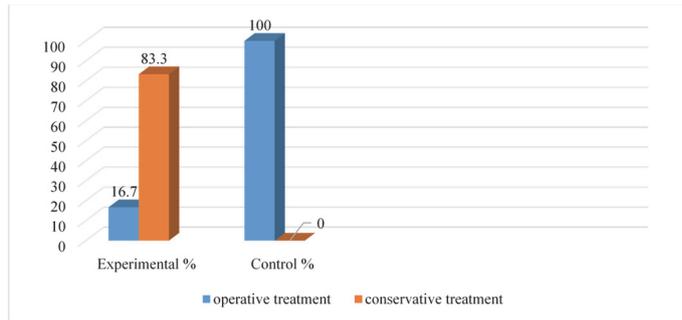
Damage to the distal part of the humerus was found in 8 victims of the main group, which accounted for 10.9 % of the cohort group. Type A fracture was found in 62.5 % of victims, type B in 12.5 %, and type C in 25.0 % of victims. In the main array, operative treatment was carried out in 7 victims, which was 87.5 %. Conservative treatment was offered to 12.5 % of patients. In the control array, damage to the distal part of the humerus was observed in 4 patients, which was 6.3 % of the cohort. Operative treatment was performed in all 100.0 % of patients. Fig. 1C shows the distribution of treatment methods among patients in the observation array.

The results of the study indicate a change in the technology of providing medical care to victims with fractures of the diaphysis of the humerus during the COVID-19 epidemic. As indicated by the analysis of the data in Fig. 4, during the epidemic period, surgical treatment of patients with fractures of the humerus diaphysis decreased by more than half. In the period before COVID-19, this damage was operated on in 87.5 % of cases, but during the epidemic, only in 42.8 % of cases. At the same time, the number of patients with a conservative method of treatment increased more than 4.5 times. The conducted polychoric analysis indicated that the given positions are within the probability field ($\chi^2 23.85 \geq \chi^2_{st} 6.0$) ($p \leq 0.05$).

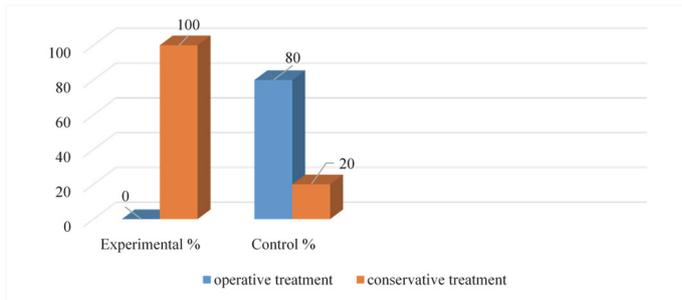
Damage to the distal part of the humerus was found in 8 victims of the main group, which accounted for 10.9 % of the cohort group. Type A fracture was found in 62.5 % of victims, type B in 12.5 %, and type C in 25.0 % of victims. In the main array, operative treatment was carried out in 7 victims, which was 87.5 %. Conservative treatment was offered to 12.5 % of patients. In the control array, damage to the distal part of the humerus was observed in 4 patients, which was 6.3 % of the cohort. Operative treatment was performed in all 100.0 % of patients. Fig. 1C shows the distribution of treatment methods among patients in the observation array.

There were 6 victims with damage to the proximal part of the bones of the forearm in the main massif, which was 8.2 % of this cohort. 66.6 % of patients were diagnosed with type A damage, and 33.4 % with type B damage according to the AO/ASIF classification. Among the patients of the main array with damage to the proximal part of the forearm, surgical treatment was performed in 1 case, which was 16.7 %. In the remaining 83.3 % of patients, conservative treatment methods were performed. The distribution in patients with damage to the proximal part of the forearm in the control array was somewhat different. Patients with AO/ASIF classification 21 lesions in the control array were identified in 3 cases, representing 4.8 % of the cohort. Type A damage was diagnosed in 1 patient (33.3 %) and type B damage in 2 patients

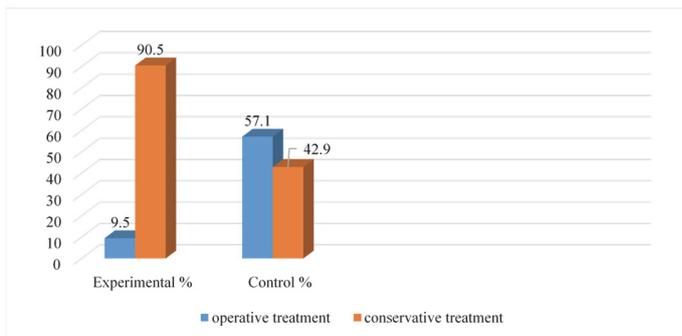
(66.7 %). All 3 patients (100.0 %) of the control group underwent surgical treatment. Fig. 2A shows the distribution of treatment methods among observational patients with proximal forearm injuries.



A



B



C

Fig. 2 Distribution of treatment methods in victims with injuries to the bones of the forearm (A – proximal part, B – diaphyseal part, C – distal part).

5.5 % of this cohort. In all of them, damage of type A was detected. All patients with damage to the bones of the diaphysis of the forearm during the epidemic period received conservative treatment in 100.0 % of cases. The tactics of treatment of patients of the control array with damage 22 according to AO/ASIF were somewhat different. Such patients were found in 5 cases of the control array, which was 7.9 % of the cohort. Among them, type A damage was detected in 80.0 %, type B in 20.0 %, and type C was not registered. Operative treatment was performed in 4 cases, which was 80.0 % of the cohort. In the remaining 20.0 % cases, conservative treatment was performed because the patient had a closed diaphysis fracture of the ulna without fragment displacement.

Fig. 2B shows the distribution of treatment methods among patients of the observation array with injuries of the diaphysis of the forearm.

As indicated by the data analysis in Fig. 2B, during the COVID-19 epidemic, all patients with diaphyseal fractures of the forearm were offered conservative treatment. During the pre-clinical period, only 20.0 % of patients with similar injuries of the forearm were treated in this way, and the remaining 80.0 % of patients chose surgical treatment. The analysis of statistical data indicated that these positions are outside the limits of the probability field ($\chi^2 4.9 \leq \chi^2_{st} 6.0$) ($p \leq 0.1$), which indicates the influence of other features on the phenomenon under study.

Patients with injuries of the distal part of the forearm were found in the main array in 21 cases, which accounted for 28.8 % of this cohort. Type A fractures occurred in 16 patients, representing 76.2 % of the cohort, type B fractures in 4 patients, representing 19.0 %, and type C injuries in 1 patient, representing 4.8 % of the cohort. During the COVID-19 epidemic, the distribution of treatment methods for patients with these injuries was as follows: operative treatment was performed in 2 cases, which was 9.5 % of this cohort. The remaining 19 patients received conservative treatment. The relative value of the absolute indicator was 90.5 %. In the control array, lesion 23 according to the AO/ASIF classification was

detected in 14 cases, which was 22.2 % of the cohort. Type A fractures were observed in 78.6 % of cases, type B in 14.3 %, and type C in 7.1 % of cases. In the control array, the distribution of treatment methods for this category of patients was somewhat different. Thus, operative treatment was performed in 8 patients of the control group with fractures of the distal part of the forearm, which was 57.1 % of the cohort. All remaining 42.9 % of patients received conservative treatment. Fig. 2C shows the distribution of treatment methods among patients of the observation array with injuries of the distal part of the forearm.

Analysis of the data presented in Fig. 2C indicates significant changes in treatment tactics for patients with distal forearm injuries during the COVID-19 epidemic. Thus, the number of patients undergoing surgical treatment in the epidemic period decreased by six times compared to the pre-epidemic period. The level of conservative treatment has doubled during the COVID-19 epidemic. Thus, we can say about an increase in the level of conservative treatment in patients with injuries of the distal part of the forearm during the epidemic of COVID-19.

The conducted polychoric analysis indicated that the given positions are within the probability field ($\chi^2 18.0 \geq \chi^2_{st} 6.0$) ($p \leq 0.05$).

The COVID-19 pandemic has had enormous consequences not only in the field of health care, but also in social, economic and social psychology. As in the rest of the world, the government of Ukraine has taken a number of measures to control the pandemic. He ordered people to stay at home and restricted people's movement except for work, urgent needs and health conditions. Many hospitals have been declared pandemic. A large part of most hospitals has been reserved exclusively for the treatment of coronavirus patients. Planned operations were postponed throughout the country, other patients were treated only in emergency cases [3]. The most important finding of this study is that after the implementation of most public quarantine measures, there was a significant reduction in the number of upper extremity fractures occurring after orthopedic trauma and in the number of severe multifragmentary fractures requiring surgical treatment. Turgut A. et al. (2020), indicate that the incidence of fractures decreased by about a third during the pandemic period compared to the non-pandemic period. A decrease in the average age of patients with a fracture in all age groups was also established. It was found that the number of finger fractures and metatarsal fractures in adults significantly decreased during the pandemic [10]. Our data also indicate a reduction in upper extremity fractures during the COVID-19 period, but this was only 14.3 % among patients in our study. This may be due to the fact that the Turkish colleagues took into account the reduction in the number of all fractures, while in our study we determined only the fractures of the bones of the upper limb. There has also been a significant reduction in outdoor injuries, such as traffic accidents and sports injuries, which account for a significant portion of the etiology of fractures. In their study, a group of authors from Italy highlight the impact of the stay-at-home strategy on injuries for a large part of our society, with the exception of civil servants, health workers and security services. The authors indicate that in Italy, low-energy injuries, the largest etiological cause during the COVID-19 period, occurred in a wide range of cases, including falls while walking, falling down stairs, falling from the sidewalk, punching a wall, or falling in the bathroom [6].

In 2020, the majority of low-energy injuries reported as etiological causes were indoor injuries, such as falls in the bathroom, down stairs, or inside the house [8]. In percentage terms, we observed a statistically significant increase in supracondylar fractures of the humerus, proximal and distal parts of the forearm and clavicle. Garcia-Portabella M et al. (2020) obtained similar data in a study on surgical treatment of humerus fractures. The authors indicate an increase in operative interventions for humerus fractures among elderly patients and emphasize the prevalence of type B fractures (15.5 %). [5]. Jain V.K., et al. (2020) indicate that in India, the increase in fractures during the covid period is due to failure to comply with stay-at-home orders and increased pandemic stress, which may have increased the tendency towards violence in some parts of society. In addition, the quarantine of society has led to the appearance of many psychological problems, such as panic disorder, anxiety, and depression. Psychological problems such as anxiety and depression have been shown to be statistically significantly higher in upper extremity fracture patients compared to healthy controls and other fracture groups [4].

Among the reasons for the increase in type A simple fractures of the bones of the upper limb during the COVID-19 period, not the least, in our opinion, was the negative impact of public quarantine on the psychology of people and the difficulties of their stay at home, which in turn caused an increase in the number of household accidents. We also believe that the number of shoulder fractures has increased because these fractures in the elderly are usually caused by falls at home. Limiting physical activity in the elderly leads to a progressive loss of muscle mass and function. This condition is associated with osteoporosis and an increased risk of shoulder fracture. In a study conducted in Italy, a sharp decrease in the number of fractures of both the upper limb and the bones of the lower limb was found during the course

of the COVID-19 epidemic, however, the authors found an increase in fractures associated with osteoporosis in elderly patients compared to the pre-war period by 2.5 % [6].

Nuñez J.H. et al. (2020) indicate that a proportional decrease in the number of fracture operations was observed during the pandemic. The authors consider the reason for this to be the postponement of all scheduled operations. In all age groups, the frequency of operations for fractures that occurred during the pandemic was half as low as in other years. Another reason for this could be that patients did not want to go to the hospital with minor injuries, because they could be infected with COVID 19. In our opinion, there are other reasons for this as well. In our study, we found an increase in type A simple fractures during the period of COVID-19. Most of these fractures can usually be treated on an outpatient basis, which led to a decrease in surgical interventions during the epidemic period [8]. Similar data were published by Probert AC, et al. (2020) who found that the number of operations for fractures of the proximal and distal segments of the humerus decreased. The authors consider the reasons for this to be a decrease in the number of screenings for operations and the concern of the patient and the attending physician that the risk of transmission of the COVID infection will increase with a long stay in the hospital [9]. Menendez M.E. et al. (2020) in their study emphasize the impact of the COVID-19 epidemic on the clinical and nosological structure of fractures. The author believes that most of what we do in orthopedic surgery is based more on empirical evidence. A significant caseload following the outbreak of COVID-19 may prompt a stricter adherence to evidence-based practice guidelines regarding who to prioritize for surgery. This will create an opportunity to reduce the unwarranted variation in orthopedic procedures that are of questionable value to some patients. Accelerating progress after the COVID-19 outbreak will require creative thinking, and innovation is critical to future-proofing [7].

Conclusions

1. During the COVID-19 epidemic, the number of cases of upper limb girdle injuries significantly decreased, including all locations except for distal forearm injuries, where an increase in the number was observed during this period, which is due to an increase in the level of household injuries.

2. During the COVID-19 epidemic, conservative treatment methods prevailed in all localizations of fractures of both the humerus and forearm bones, except for fractures of the distal humerus, where surgical treatment (osteosynthesis or elbow joint endoprosthesis) prevailed, which is explained by the large number of complications, such as heterotopic ossification, contractures in the elbow joint, after conservative treatment of fractures of this localization.

3. Epidemic restrictions and screening mechanisms for patients with upper limb fractures during COVID-19 changed approaches to the treatment of patients with upper limb fractures towards a wider use of conservative treatment methods, which concerned all localizations, except for patients with distal humerus fractures, where the treatment structure showed almost the same trend compared to the treatment of similar patients in the pre-COVID period.

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