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Maxillofacial Surgery In Ukraine During A War: Challenges And Perspectives. A National Survey

--Manuscript Draft--

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Abstract:	Introduction. The invasion of Ukraine by Russian troops on February 24th, 2022, and the beginning of the full-scale war had huge humanitarian consequences. The major challenges facing the Ukrainian health care system included the disruption of medical infrastructure and logistics, the termination of the supply of expendable materials, significant migration and a dramatic increase in high-velocity blast and gunshot injuries among combatants and civilians. The aim of the present study was to analyze the challenges and solutions in patient care faced by the Ukrainian system of maxillofacial surgery during the war in different regions of the country. Materials and Methods. A cross-sectional study was designed and implemented as an

	online survey to collect national data concerning maxillofacial surgeons' experiences and professional activities. The study was initiated and supported by Bogomolets National Medical University (Kyiv, Ukraine), the Ukrainian representative of AO CMF (Arbeitsgemeinschaft für Osteosynthesefragen Craniomaxillofacial Surgery) and the University of Helsinki (Finland). The questionnaire was developed by specialists in maxillofacial surgery and sociologists and contained 65 close-ended questions. Surgeons who had not worked in this specialty in inpatient departments of hospitals since at least the beginning of the full-scale war were excluded from the study. We received and analyzed 97 responses that met the abovementioned criteria. The geography of respondents covered all the regions and the main cities of Ukraine, expect for the occupied territories. Results. After a year of warfare, the percentage of surgeons who treated patients with blast and gunshot injuries increased from 43.4% to 86.6%. This percentage was higher in military hospitals and in regions located in the vicinity of the front line. We found that, during the war, 78.6% of respondents performed osteosynthesis in cases of high velocity multifragmented facial bone fractures (in such cases, 58.3% of them strictly followed AO CMF recommendations, while 41.7% performed the fixation based on available hardware, existing technical possibilities and their own preferences). We found that 70.2% of respondents had the opportunity to apply CAD/CAM technology and patient specific implants (PSI) for the treatment of gunshot injuries, 38.1% reported that their hospitals were able to perform microsurgical reconstructions for facial defects, 79.4% of respondents reported that their departments received humanitarian aid and support from volunteer organizations (either Ukrainian or international), which significantly facilitated the treatment process. Conclusions. According to this nationwide survey of Ukrainian maxillofacial surgeons during a year of the full-scale war, 86.6% of respondents were involved in the treatment of gunshot and ballistic injuries in civilians and combatants. The main problems reported by the respondents were 1) a lack of experience and knowledge related to the treatment of severe wounds, especially by secondary reconstruction, and 2) a deficit of resources (equipment, materials and medications) under conditions of disrupted logistics and changes in the numbers and nosological distribution of patients. There were the opportunity to transfer the patients to European clinics (29.9%), online consultations (45.4%), collaboration with foreign surgeons who come to Ukraine as a volunteers (32%).
Suggested Reviewers:	
Opposed Reviewers:	
Response to Reviewers:	Dear Reviewers, Thank you very much for your comments and suggestions concerning our paper. We have revised the text and made the following changes in the manuscript according to your recommendations: Reviewer #1: Thank you very much for the assessment of the manuscript. According to your recommendation, the article was reviewed and edited by Cambridge Proofreading LLC (Order Reference:#900-86-41). Reviewer #2: Thank you very much for your comments concerning the manuscript First, either nosologic(al) emusto be defined or more like desirably substituted. This can be easily accomplished by just referring to disease or trauma classifications. In Ukraine the currently used classification system for facial trauma is AO CMF classification system and ICD-10, International Classification of Diseases. The reference is added to the text (part "Materials and methods", p. 3 and "Literature", p. 12) and marked by yellow. A statement regarding the percentage of total trauma surgical cases involving head-and-neck wounds in any war would be helpful. Then the increase in cases seen by oral maxillary surgeons can perhaps be reframed for Ukraine. We added the information concerning the head and neck wounds in contemporary wars to the discussion section (part "Discussion", p. 6) followed by reframe for Ukrainian war situation. I would like to know more garding cases seen by oral maxillary surgeons versus head-and-neck surgeons. If they don't have the data then perhaps they can reference a study. Currently in Ukraine the subspeciality "head and neck surgery" does not exist. As in

	several European countries, head and neck surgery is an umbrella term for multispecialty head and neck surgery. In Ukraine, the treatment of facial injuries and facial fractures is coordinated by maxillofacial surgery units. There is close cooperation with several different specialties. The statement concerning this situation is added to part “Discussion” marked by yellow (see page 8) I believe our readers would like to know more regarding military versus civilian surgeons providing care and also how military primary care providers may be referring patients to surgeons. There's not much detail provided regarding specifics of surgical supplies, anesthesia machines or anesthetics that are in short supply. That would be helpful, too. Statement about medical care for maxillo-facial injuries is mentioned in part “Introduction” (see page 1) Statement about lack of devices and equipment’s is pointed in part “Discussion” (see page 11) The authors state this as their objective: Analysis of objective state and reserves of the health care system NOT the subject of this study - our primarily interest was the subjective assessment provided by maxillofacial surgeons concerning the problems they encountered directly in the course of their everyday professional activities. This is a rather odd statement and can be interpreted several ways and I don't believe it conveys that they are seeking. Only in a very limited view would wartime casualty care be described as an 'everyday professional activity.' Please clarify. What is the primary objective of this paper and how did their approach match that end? Thank you for the clarifying note. We have modified the objective. The aim of the present study was to analyze the challenges and solutions in patient care faced by the Ukrainian system of maxillofacial surgery during the war in different regions of the country. With the help of the survey, we reached a comprehensive range of respondents with special expertise on the subject. We found a lack of experience and knowledge related to the surgery, especially secondary reconstructions to be the main challenge followed by a deficit of resources (equipment, materials and medications) as presented in the results and the conclusion. With the help of mobility and consultations, also across country borders, we are able to improve our skills and patient care in current war conflicts. Nowadays, online-consultations and educational collaboration are easily achieved, and these were felt to be valuable. The usage of CAD/CAM technology and patient specific implants (PSI) is high despite the war. Our research findings reveal aspects of modern warfare in the field of maxillofacial surgery that, to our knowledge, have not been published before. As least one of the authors is Finnish. Many readers would like to know if selected cases need to be referred to other specialized European hospitals. The idea of this survey and the design of the study was developed in collaboration with surgeons from Helsinki University (Finland) who visited Ukrainian hospitals few times with humanitarian missions since the war began. Memorandum of understanding: academic and research co-operation was signed. The exact number of patients transferred to foreign clinics for treatment with severe forms of damage is a military secret and is not disclosed at the moment, as well as the list of those clinics that caught the wounded from Ukraine According to our questionnaire, 29.9% respondents have the opportunity to transfer the patients to European clinics. At the same time, the huge number of international mission (USA, Canada, France etc.) works in Ukraine. So, this patient ratio “stay home/went abroad” for treatment and recovery was quite dynamic. The number of patients is quite significant. (see pages 12). Also how does the series of hospitals (Bogomolets, Kyiv and Dnipro) compare with the total number of definitive university care settings. The significant number of respondents (61%) represented the main maxillo-facial centers (there are military hospitals and clinics which were the clinical premises of medical universities in Kyiv, Dnipro, Odessa, Lviv etc). In Ukraine, there are centers in which the wounded of the maxillofacial profile are concentrated, where there is appropriate infrastructure, equipment and highly qualified doctors for such activities, but in the framework of this study we included maxillofacial surgeons from various institutions, including children's specialized hospitals and oncological centers, to a lesser extent involved in the treatment of the wounded. Corresponding clarifications are made in the text of the article (part “Discussion”, see page 9, 10).

	The article also suggests the interdisciplinary teams are important but never provides an outline of what they have in mind. The question is clarified by statement (see part “Discussion”, page 8) Finally, would a short case series perhaps to illustrate their point and how might scarce resources be further diminished if the war continues. The statement concerning the limited resources in case of long-lasting war is added (part “Discussion”, see page 11) We a planning to publish the multicenter case series (more than 800 cases of ballistic injuries of the maxilla-facial area) in a separate article. The permanent increase in number of wounded as result of ongoing hostilities of high intensity on the front line as well as the necessity for secondary reconstructions in patients with defects and deformities will overload the health care system of the country if the war will continue. The experience of I and II world war …. may be quite useful for prognosis of the long lasting circumstances of the war trauma of the head and neck in intensive conflicts with massive casualties. The problem of limited resources may even increase, despite a rational distribution of the state resources. The international regular base support thus remains an issue of the essential importance to provide the appropriate care for Ukrainian patients with ballistic injuries.

Dear Reviewers,

Thank you very much for your comments and suggestions concerning our paper. We have revised the text and made the following changes in the manuscript according to your recommendations:

Reviewer #1: Thank you very much for the assessment of the manuscript.

According to your recommendation, the article was reviewed and edited by Cambridge Proofreading LLC (Order Reference:#900-86-41).

Reviewer #2: Thank you very much for your comments concerning the manuscript

First, either nosologic(al) emusto be defined or more like desirably substituted. This can be easily accomplished by just referring to disease or trauma classifications.

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Maxillofacial Surgery In Ukraine During A War: Challenges And Perspectives. A National Survey

Short Title: Maxillofacial Surgery In Ukraine

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Keywords: armed conflicts, medical service, maxillofacial surgeons, maxillofacial trauma, gunshot wounds, ballistic injuries, surveys, questionnaires.

Declarations:

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Individual author contribution statement: All authors contributed to conception, design, data acquisition, analysis, and interpretation, drafted and critically revised the manuscript. All authors gave final approval and agreed to be accountable for all aspects of the work.

Data availability statement: the data underlying this article are available in the article and on the request from the corresponding author. All data is freely accessible. The link to access of questionnaire in native language https://forms.gle/eXfVEDFGRNFhvddM6

Disclaimer: The views expressed are solely those of the authors and do not reflect the official policy or position of Ministry of health of Ukraine, professional associations and any other foundations.

Institutional Clearance: Institutional clearance approved.

Introduction. The invasion of Ukraine by Russian troops on February 24th, 2022, and the beginning of the full-scale war had huge humanitarian consequences. The major challenges facing the Ukrainian health care system included the disruption of medical infrastructure and logistics, the termination of the supply of expendable materials, significant migration and a dramatic increase in high-velocity blast and gunshot injuries among combatants and civilians.

The aim of the present study was to analyze the challenges and solutions in patient care faced by the Ukrainian system of maxillofacial surgery during the war in different regions of the country.

Materials and Methods. A cross-sectional study was designed and implemented as an online survey to collect national data concerning maxillofacial surgeons' experiences and professional activities. The study was initiated and supported by Bogomolets National Medical University (Kyiv, Ukraine), the Ukrainian representative of AO CMF (Arbeitsgemeinschaft für Osteosynthesefragen Craniomaxillofacial Surgery) and the University of Helsinki (Finland).

The questionnaire was developed by specialists in maxillofacial surgery and sociologists and contained 65 close-ended questions. Surgeons who had not worked in this specialty in inpatient departments of hospitals since at least the beginning of the full-scale war were excluded from the study. We received and analyzed 97 responses that met the abovementioned criteria. The geography of respondents covered all the regions and the main cities of Ukraine, expect for the occupied territories.

Results. After a year of warfare, the percentage of surgeons who treated patients with blast and gunshot injuries increased from 43.4% to 86.6%. This percentage was higher in military hospitals and in regions located in the vicinity of the front line. We found that, during the war, 78.6% of respondents performed osteosynthesis in cases of high velocity multifragmented facial bone fractures (in such cases, 58.3% of them strictly followed AO CMF recommendations, while 41.7% performed the fixation based on available hardware, existing technical possibilities and their own preferences). We found that 70.2% of respondents had the

opportunity to apply CAD/CAM technology and patient specific implants (PSI) for the treatment of gunshot injuries, 38.1% reported that their hospitals were able to perform microsurgical reconstructions for facial defects, 79.4% of respondents reported that their departments received humanitarian aid and support from volunteer organizations (either Ukrainian or international), which significantly facilitated the treatment process.

Conclusions. According to this nationwide survey of Ukrainian maxillofacial surgeons during a year of the full-scale war, 86.6% of respondents were involved in the treatment of gunshot and ballistic injuries in civilians and combatants. The main problems reported by the respondents were 1) a lack of experience and knowledge related to the treatment of severe wounds, especially by secondary reconstruction, and 2) a deficit of resources (equipment, materials and medications) under conditions of disrupted logistics and changes in the numbers and nosological distribution of patients. There were the opportunity to transfer the patients to European clinics (29.9%), online consultations (45.4%), collaboration with foreign surgeons who come to Ukraine as a volunteers (32%).

Introduction. The invasion of Ukraine by Russian troops on February 24th, 2022, and the beginning of the full-scale war had huge humanitarian consequences. The invasion resulted in an overload of Ukraine's existing health care system and dramatically changed the everyday professional activities of medical workers, both at the front line and in regions far from the battlefield. The major challenges facing the Ukrainian health care system included the disruption of medical infrastructure and logistics, the termination of the supply of expendable materials, significant migration and a dramatic increase in high-velocity blast and gunshot injuries among combatants and civilians. To provide medical support for the Territorial Defense Forces and the Armed Forces of Ukraine, a multifunctional three-level medical support system was developed.

Medical care for wounded maxillofacial profiles is provided at stages III and IV (specialized and qualified medical care). The organizational and staff structure of the dental service of the military mobile hospital generally corresponds to its tasks, and the mobile dental office of the military mobile hospital makes it possible to bring assistance to patients wounded in the maxillofacial area at the battalion or brigade level. However, highly specialized medical care is provided by maxillofacial surgeons in military medical clinical centers, public health institutions and communal properties.

Military and civil hospitals were integrated into the unified medical space of the state, with the aim of providing high-quality medical care either to servicemen of the Defense Forces or to civilians, depending on existing needs and conditions [12, 14].

In such circumstances, maxillofacial surgeons in both military and civil hospitals were widely involved in the treatment of war victims and continued to provide regular services to patients with head and neck pathology. For many years, maxillofacial surgery in Ukraine was not established as a separate specialty but was developed within the framework of oral surgery. However, a wide network of maxillofacial departments existed in regional hospitals, in big cities and at universities, providing a wide range of medical care for head and neck pathology, including craniofacial surgery, microsurgery, Computer-Aided Design/Computer-Aided Manufacture

(CAD/CAM) technologies and minimally invasive endoscopically assisted procedures. Finally, on April 23rd, 2021, maxillofacial surgery was included on the Ukrainian register of medical specialties, and all the necessary regulations and qualifying characteristics were approved by the health care ministry in accordance with existing international practice [3, 7, 8, 9, 10]. A year later, the new specialty encountered a great challenge: a full-scale military conflict with a huge number of severe maxillofacial injuries. Although the structure of military trauma of the Russian and Ukrainian war, the approaches to its management and its outcomes are important questions for scientific analysis, in the present study we focused only on the subjective perception of the main problems and difficulties facing practicing maxillofacial surgeons in Ukraine during the war using a nationwide survey.

The aim of the present study was to analyze the challenges and solutions in patient care faced by the Ukrainian system of maxillofacial surgery during the war in different regions of the country.

We hypothesized that the main challenges associated with the increased number of patients with severe gunshot and ballistic maxillofacial injuries, which overload the existing capacities of the healthcare system, are a lack of experience in treating such patients and a need for additional equipment, instruments and hardware (e.g., plates and screws). We also analyzed how disruptions of infrastructure and logistics, as well as the response measures taken by the government, civil society and foreign partners, influenced current activities of maxillofacial professionals.

Materials and methods. A cross-sectional study was designed and implemented as an online survey to collect national data concerning maxillofacial surgeons' experiences and professional activities. The study was initiated and supported by Bogomolets National Medical University (Kyiv, Ukraine), the Ukrainian representative of AO CMF (Arbeitsgemeinschaft für Osteosynthesefragen Craniomaxillofacial Surgery) and the University of Helsinki (Finland).

The questionnaire was developed by specialists in maxillofacial surgery and sociologists and contained 65 close-ended questions. Answers included alternative options, multiple options or

ascending scales, depending on the wording of each question. The first section consisted of 25 obligatory questions regarding the qualifications, competence and education of respondents, including their experience in civil and combat trauma, existing facilities, equipment and provision of supplies to departments and hospitals. The second section consisted of 34 questions regarding practical aspects of respondents' everyday work, including approaches to facial trauma management, plastic and reconstructive surgery and treatment of gunshot and ballistic injuries. The last section contained general questions about respondents' backgrounds (occupation, position and academic and professional experience). The last two questions related to respondents' own opinions and assessment of the survey. Some questions were mandatory, while others were optional, depending on the surgeon's experience and contingent of treated patients. The injury types and treatment options presented in the questions were based on the classifications used in clinical work, i.e. AO CMF classification for facial bone trauma [15] and ICD-10.

The online questionnaire was constructed using Google Forms, and settings were configured to ensure anonymity. Personal information identifying the participants (e.g., passport data or affiliation) was not required. The questionnaire was not time limited. The participants could change their answers freely before submission. The questionnaire was sent through a Google Drive link to personal email addresses of practicing maxillofacial surgeons and to official email addresses of maxillofacial departments in hospitals and universities (including departments of pediatric maxillofacial surgery and oncological centers) and was spread among the contacts of professional associations. The database of email addresses was provided by a group of experts from the Healthcare Ministry of Ukraine and the Association of Maxillofacial Surgery. The questionnaire was available from February 16th to May 3rd, 2023.

The online Google Form was pilot tested by 10 maxillofacial surgeons, who checked the content and validity of questions as well as the time required to respond (the average time was 17.2 ± 5.37 min).

Survey target, audience coverage and survey bias

The exact number of maxillofacial professionals currently working in Ukraine is unknown, as the national register of medical specialists is still under development. The estimated number of maxillofacial surgeons working at the departments of hospitals and academic institutions in 2013 (before the occupation of Crimea and the Donbas region) was near 250. Since then, this number has probably decreased due to Russian occupation of almost 20% of Ukrainian territory and the consequences of healthcare reforms and the COVID pandemic, when the numbers of both maxillofacial departments and beds were reduced [4]. Some medical professionals remained in the occupied territories or became refugees. We also had no opportunity to obtain responses from the personnel of mobile military hospitals at the frontline zone or medical institutions of the Defense Ministry or Security Service of Ukraine, which maintain a high degree of secrecy. The total number of questionaries sent therefore was 236. Surgeons who had not worked in this specialty in inpatient departments of hospitals since at least the beginning of the full-scale war were excluded from the study. We received and analyzed 97 responses that met the abovementioned criteria. The geography of respondents covered all the regions and the main cities of Ukraine, expect for the occupied territories.

Statistical analyses

The percentages for each question were calculated in relation to the total number of participants who participated in the project. A χ^2 test was used for statistical analysis of the qualitative variables, and a p-value ≤ 0.05 was considered to be statistically significant.

Ethical considerations

The research protocol was reviewed and approved by the bioethics committee of Bogomolets National Medical University (the decision dated on June 19th, 2023; protocol #173).

Results. The professional backgrounds of the 97 respondents included in the study are presented in Table 1.

After a year of warfare, the percentage of surgeons who treated patients with blast and gunshot injuries increased from 43.4% to 86.6%. This percentage was higher in military hospitals

and in regions located in the vicinity of the front line. The number of patients with combat injuries per surgeon is presented in Fig. 1.

We found that, during the war, 78.6% of respondents performed osteosynthesis in cases of high velocity multifragmented facial bone fractures (in such cases, 58.3% of them strictly followed AO CMF recommendations, while 41.7% performed the fixation based on available hardware, existing technical possibilities and their own preferences). We found that 70.2% of respondents had the opportunity to apply CAD/CAM technology and patient specific implants (PSI) for the treatment of gunshot injuries, and 38.1% reported that their hospitals were able to perform microsurgical reconstructions for facial defects.

A substantial number of respondents (even those who reported a high level of competence in trauma management) reported a lack of knowledge, professional skills and experience related to the treatment of severe war injuries, especially secondary reconstructions and management of traumatic defects of facial bones and soft tissues (Supplemental item 1). Additionally, 64.9% of respondents reported that insufficient qualifications of the relevant medical specialists in multidisciplinary teams had a negative impact on treatment outcomes in cases of combined injuries or polytrauma. We found that 36.9% of participants reported that the number of nurses in departments was insufficient for adequate organization of clinical activities, and 33.3% noted that nurses were insufficiently qualified to care for patients with gunshot or blast wounds.

Nearly all respondents tried to improve their knowledge of military trauma using different resources available under the existing conditions. The most popular sources of accurate and useful information in this field (as determined by a multiple choice question) are presented in Fig. 2. We found that 68% of participants reported that cooperation of clinical institutions and universities, as well as the involvement of academic staff in the treatment of severe war injuries, had a positive influence on the efficacy of the department's work. Direct support from foreign colleagues was also frequently reported by respondents (Supplemental item 2).

Most respondents emphasized that a lack of resources was an important factor that influenced the quality of treatment of war injuries (Supplemental item 1). However, 79.4% of respondents reported that their departments received humanitarian aid and support from volunteer organizations (either Ukrainian or international), which significantly facilitated the treatment process. We found that 97.8% of respondents reported that their clinical institutions had the technical capabilities to provide medical care (at least in emergency cases) during an electric blackout or other disruptions of critical infrastructure.

Except for the dramatic increase in military trauma cases, respondents reported changes in the nosological structure of the contingents treated by their departments (Fig. 3). This depended on the military situation and changes in the front line, as well as migration processes within the country. In general, the numbers of trauma cases and infections remained the same or increased in the majority of departments. The number of scheduled surgeries (e.g., orthognathic, plastic and reconstructive, oncological, TMJ, sinus and salivary gland surgeries) significantly decreased.

Discussion. The present cross-sectional study analyzed the challenges faced by Ukrainian maxillofacial surgeons after the onset of Russia's full-scale military invasion, based on the subjective perceptions of practicing maxillofacial surgeons who provided medical care in both civil and military hospitals. We also identified possible operative and strategic solutions for existing problems in the context of the ongoing military conflict, which is of an intensity not seen since World War II. The Ukrainian experience can be important for the further development of this specialty and the organization of the maxillofacial network in military and civil medical institutions of other countries [2, 5].

In current conflicts, the most frequently injured regions of the body are the head, face and neck (54.2%). Injury profiles differ notably by combat posture [18]. Thus, the occurrence and types of facial injuries vary depending on the stage of the conflict. Facial injuries are typically related to explosive events but are also caused by shrapnel and gun shots, to a lesser extent. Of wounded combatants, 18–25% have injuries in the facial region, of which more than one-third are

bony injuries. For instance, of US army combatants air-evacuated from Afghanistan and Iraq and classified as having combat injuries, 21% presented with at least one head and neck trauma code; other authors reported a rate of maxillofacial injury ranging from 26–36% [17]. The rates of head or neck injuries reported for other conflicts include 3.5–4.5% for World War II, 8.5–9% for soldiers from the USSR in Afghanistan (1980–1987), 8.5% for soldiers from the USA in Korea, 10.5–15% for soldiers from the USA in Vietnam, 22.2% in Lebanon (1982), 21.6% in Iraq (1991), 36% in Somalia (1993) and 54.2% in Palestine [16].

In general, the situation in Ukraine since the beginning of the full-scale Russian invasion was characterized by 1) active hostilities along the extended front line, which was near or directly inside large cities during the first months of the war, and 2) occupation of a large territory, complete destruction of settlements near the battlefield and rocket and bomb attacks throughout the country. A substantial portion of medical institutions and their employees remained in the occupied territories, many hospitals were destroyed and much medical equipment was completely lost. Along with the direct damage of medical infrastructure, during the first few months, there were significant disruptions of logistics and the delivery of medicines and consumables. Medical facilities had to work under conditions of electric blackouts and blocked transport lines. The number of wounded among the soldiers of the Defense Forces and the civilian population increased significantly [13]. For appropriate treatment of the wounded, both military and civilian hospitals in all regions of the country were involved due to the extensive evacuation system and establishment of a unified medical space. Migration processes and the temporary unavailability of medical care associated with active hostilities significantly changed the structure of the maxillofacial pathology to be treated by specialized departments. However, objective analysis of the state and reserves of the health care system was not the aim of this study. When conducting the survey, our primary interest was the subjective assessment provided by maxillofacial surgeons concerning the problems they encountered directly in the course of their everyday professional activities.

In 2021, the community of surgeons working in inpatient maxillofacial departments totaled approximately 250. Among them, 40 were members of European association for cranio maxillofacial surgery (EACMFS) or other international maxillofacial associations. There were approximately 1150 oral surgeons for Ukraine's population of 37 million people [12].

We interviewed 97 maxillofacial surgeons representing all the regions of the country and the departments of all the regional hospitals and hospitals in large cities, including pediatric and oncological maxillofacial departments. As the exact number of practicing maxillofacial surgeons is unknown (there is currently no national register), we can estimate that the number of respondents represents approximately 50% of all practicing surgeons, or possibly more (many specialists changed their place of residence or remained in the occupied territories while suspending their practice). One of the limitations of our study was that the distribution of participating surgeons was not even across the country: the ratio of the number of responses to the number of questionnaires sent was larger in regions with a stable situation and much lower in hospitals near the front line and in military hospitals. It was virtually impossible to interview maxillofacial professionals working where troops were present on battlefields, so this important category of medical staff was not adequately represented in this study. (However, it should be mentioned that the number of maxillofacial surgeons in the vicinity of the battlefield is small; medical care there is mainly provided by general surgeons.)

Currently in Ukraine the subspeciality "head and neck surgery" does not exist. Most of the patients with head and neck wounds are admitted to maxillofacial departments (or neurosurgical departments if severe CNS trauma exists) and treated by a multidisciplinary team including ENT specialists, ophthalmologists and/or plastic surgeons. The only exceptions are burns, which are treated in specialized combustiological departments, regardless of the locations of burns.

The survey revealed that maxillofacial departments across Ukraine continue to work under the complex conditions associated with the ongoing military conflict. The number of surgeons who had gained experience in the treatment of blast and gunshot injuries increased from 43.4% to

86.6% ($p < 0.05$). However, the number of cases treated by each individual surgeon during a year varied significantly: the number of cases treated in military hospitals, where the wounded are concentrated, was more than 100 patients/year/surgeon, while in civil hospitals it could be less than 20 patients/year/surgeon.

Contemporary military conflicts are associated with a significant increase in blast injuries, caused by explosions, which commonly affect the head and neck region [1, 11]. In such circumstances, the main problems reported by respondents were a lack of knowledge or experience related to the treatment of high velocity war trauma and limited resources (lack of equipment, medicines and consumables, such as plates and screws).

The present study considered only the subjective self-estimations of the surgeons concerning their competence with the treatment of blast and gunshot wounds. The objective quality of primary and secondary surgeries performed was not analyzed in this study.

First aid (the simplest medical measures) is provided directly at the location where the wound (lesion) occurred or in the nearest shelter by the servicemen themselves as self- or mutual assistance. First aid can also be administered by archer-orderlies, orderlies, driver-orderlies, combat medics and senior combat medics. At this stage, asphyxia is eliminated, bleeding is temporarily stopped, anesthesia is provided, the jaws are immobilized for transport and steps are taken to prevent wound infection. To receive further pre-medical (feldsher) and first medical aid, wounded soldiers are sent to medical companies (points), stabilization points and medical and nursing teams of civil medical institutions. At this stage, medical evacuation is conducted by ground transport.

The next step is the military mobile hospital (MMH), where the wounded are provided with qualified medical care to eliminate serious, life-threatening consequences and complications of injuries, are prepared for further evacuation and are provided with favorable conditions for further treatment. Medical evacuation of the wounded to the MMH is conducted by ground and air transport.

The wounded, who need specialized medical care (provided by specialist doctors), are sent to different regional Military Medical Clinical Centers (MMCCs) (Lviv MMCC for neurosurgery, Odessa MMCC for ophthalmic injuries, Dnipro MMCC, Kharkiv MMCC), military hospitals or specialized healthcare institutions. Depending on the state of health of the wounded, they are transported by land, rail or air.

If it is necessary to provide the wounded with highly specialized medical care, they are medically evacuated directly to the National MMCC "GMKH" (Kyiv) by any means of transport.

Military doctors of all healthcare institutions in the system of the Ministry of Defense of Ukraine work closely with the teaching staff of institutes, universities and healthcare institutions of the National Academy of Medical Sciences. Therefore, medical assistance to the personnel of the Armed Forces of Ukraine is provided according to the most modern principles.

Nevertheless, the need for additional training of Ukrainian surgeons in different aspects of trauma management may be much higher. We found that 54.7% to 64.9% of surgeons felt that their competence was not adequate for certain aspects of wartime surgery. The most problematic procedures, according to the respondents' opinions, were secondary reconstructions. Most of the respondents tried to deepen their knowledge in various ways. Under the existing conditions, the importance of online communications and online education resources has significantly increased.

Another problem reported by the respondents was the lack of resources associated with significant changes in the nosological structure of the contingents treated. Most of the hospitals were provided with all necessary means to maintain their work in the case of blackouts or rocket/bomb attacks, at least for emergency care. Additionally, most hospitals had access to adequate equipment. We found that 70.2% of respondents reported that they had the opportunity to use CAD/CAM technology and PSI in their hospitals, and 38.1% had the necessary equipment and staff for microsurgery at their disposal. The use of 3D printing is common already, particularly for producing 3D models for making custom implants for procedures such as orbital floor reconstruction and facial contouring [6, 9].

However, a lack of instruments was reported by 71.4% of respondents, a lack of consumables (e.g., plates, screws and suturing material) by 78.6% and a lack of medications by 53.6%. Possible ways to conserve consumables in the event of a prolonged armed conflict are local and general registers of received materials, cooperation with volunteer organizations and charitable foundations, recruiting units of the medical forces of the Armed Forces of Ukraine and clear logic and objectives for each stage of medical care and evacuation.

We found that 41.7% of surgeons could not strictly follow existing protocols of internal fixation (such as AO CMF recommendations) due to limited equipment and materials and lack of time and/or qualified personnel. A lack of anesthesia machines and suppliers for anesthesiologic and/or intensive care was occasionally reported by maxillofacial surgeons included in the survey. This problem existed in military hospitals close to the front line and evacuation routes.

The mobilization of the country, volunteer movement and support from international institutions, including the European professional community, were important factors that facilitated the functioning of medical institutions. The influence of these factors on the regular activities of maxillofacial surgeons was also analyzed in this study. According to the survey, volunteers, charity organizations and international humanitarian aid became important mechanisms for quick solutions to the problem related lack of resources. We found that 79.4% of respondents reported that their departments benefited from this kind of support when it was provided regularly.

Support from an international professional community also became an important positive factor influencing maxillofacial care in Ukraine during the war. We found that 29.9% of respondents have seized the opportunity to transfer patients with complex facial injuries to one of the European clinics. Additionally, 45.4% of respondents had online consultations with experts from foreign centers, and 32% collaborated with foreign surgeons who came to Ukraine as volunteers and performed surgeries for complex clinical cases (mainly secondary reconstructions).

Conclusions. According to this nationwide survey of Ukrainian maxillofacial surgeons during a year of the full-scale war, 86.6% of respondents were involved in the treatment of gunshot and ballistic injuries in civilians and combatants. The main problems reported by the respondents were 1) a lack of experience and knowledge related to the treatment of severe wounds, especially by secondary reconstruction, and 2) a deficit of resources (equipment, materials and medications) under conditions of disrupted logistics and changes in the numbers and nosological distribution of patients. We found that 79.4% of respondents received some kind of support and assistance from international organizations and/or professional associations, either in terms of education (via online communication) or direct support (the opportunity to transfer patients to European clinics, reported by 29.9% of respondents; online consultations, reported by 45.4%; and collaboration with foreign surgeons who came to Ukraine as volunteers, reported by 32%).

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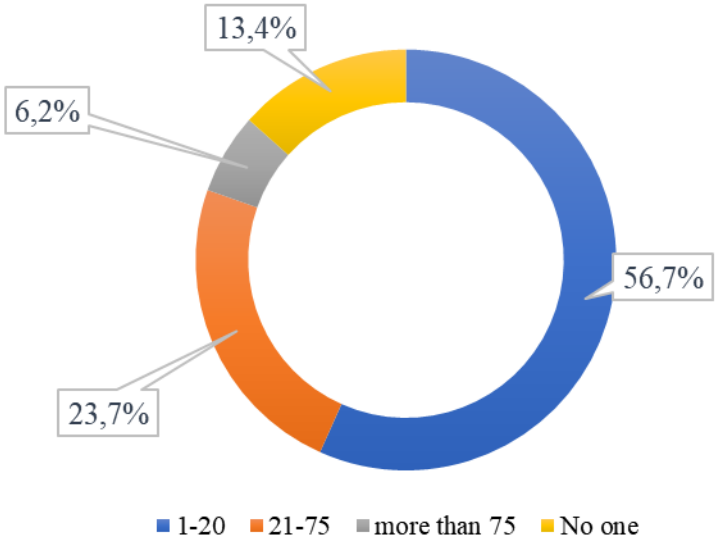


Fig.1. The number patients with gun-shot and balistic injuries per surgeon, treated by the respondents

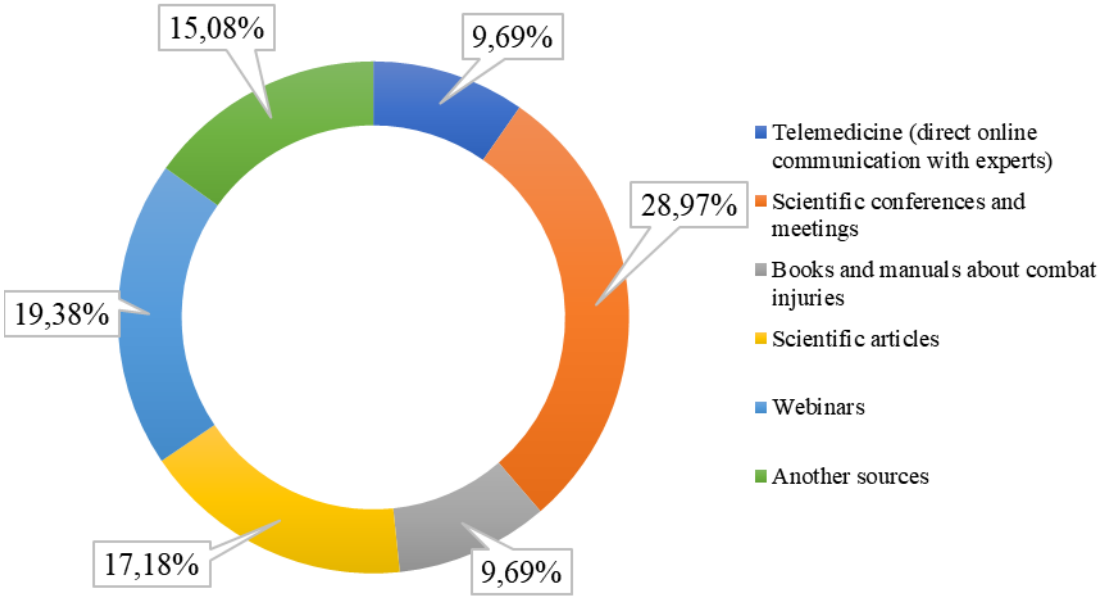


Fig.2. Sources of information concerning military trauma used by respondents to improve their knowledge and choose the appropriate treatment strategy in treatment of war injuries

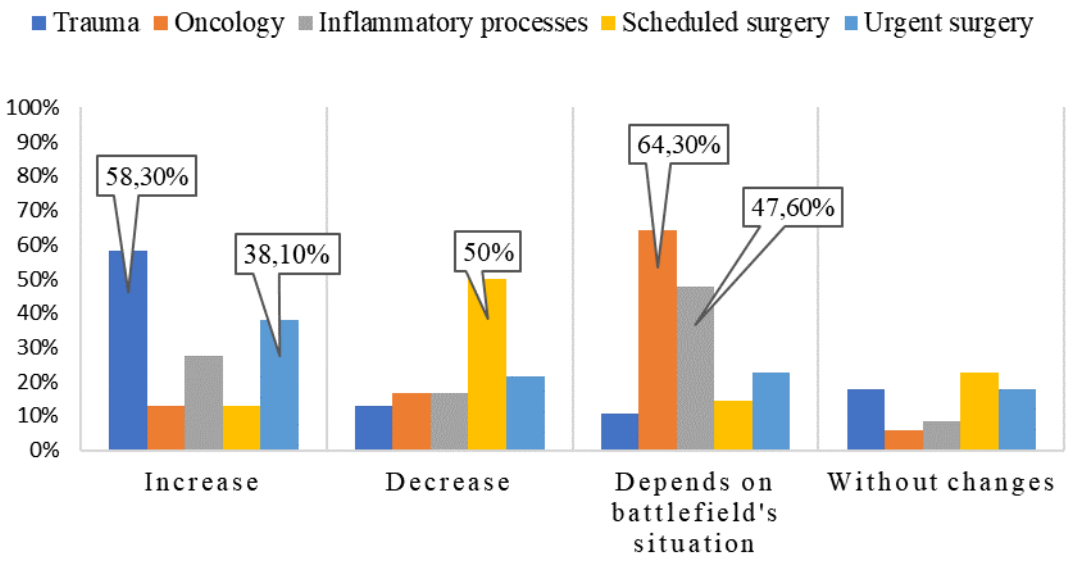


Fig.3. Changes in nosological structure of the contingents treated at maxillofacial departments caused by the war

Table 1

Descriptive statistics of the oral and maxillofacial surgeons who responded to the survey

Title of participants	MD [a] n=59 (60.8%)	Academic staff [b] n=22 (22.7%)	Trainee n=16 (16.5%)	Total n=97 (100%)
Working experience in maxillofacial surgery [c]				
0-5 years	28 / 47.5%	2 / 9%	16 / 100%	46 / 47.4%
6-10 years	12 / 20.3%	1 / 4.5%	-	13 / 13.4%
above 10 years	19 / 32.2%	19 / 86.5%	-	38 / 39.2%
Respondents who ever performed osteosynthesis of facial bones				
Common trauma cases	53 / 89.8%	22 / 100%	4 / 25%	79 / 81.4%
Gun-shot and ballistic injuries	48 / 81.4%	15 / 68.2%	3 / 18.8%	66 / 68%
level of experience in osteosynthesis				
basic level	19 / 35.8%	3 / 13.6%	4 / 100%	26 / 32.9%
middle level	24 / 45.3%	9 / 40.9%	-	33 / 41.8%
advanced level	10 / 18.9%	10 / 45.5%	-	20 / 25.3%
Experience of combat injuries [d]				
Before 24th of 2022,	35 / 59.3%	15 / 68.2%	3 / 18.8%	53 / 54.6%
After a year of the warfare	52 / 88.1%	19 / 86.4%	4 / 25%	75 / 77.3%

[a] MD means who got bachelor's degree in field of Dentistry and postgraduate education in oral and maxillofacial surgery

[b] participants who had scientific degree (PhD or MD)

[c] means job/practicing in inpatient maxillofacial departments

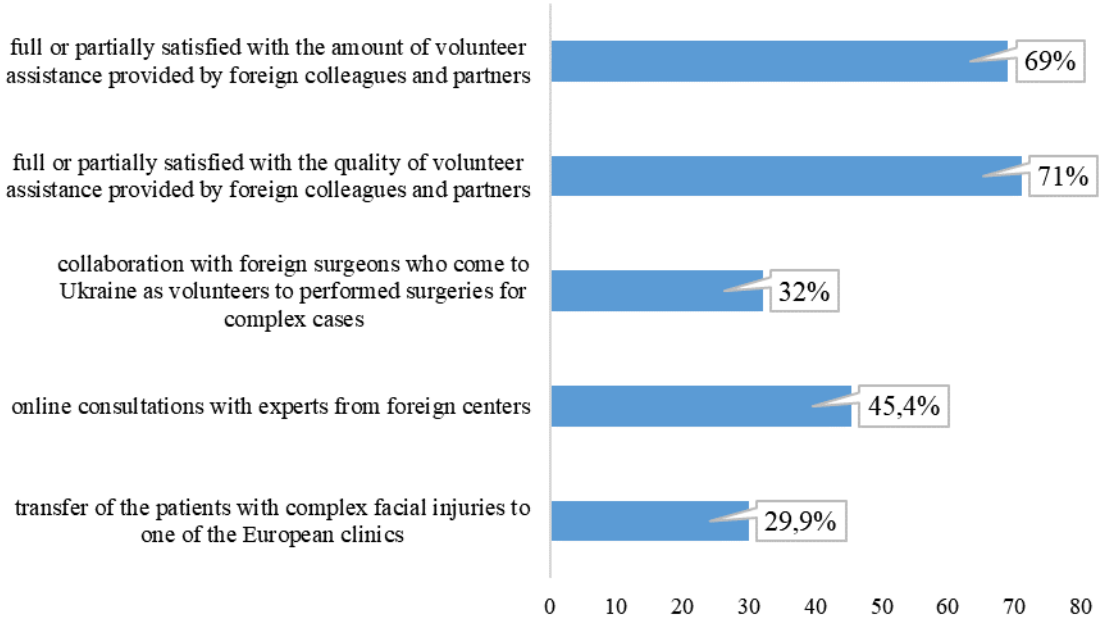
[d] means those all who performed treatment of patients (civilians and combatants) suffered by gun-shot and other ballistic injuries

Supplemental item 1

Main problems, facing Ukrainian maxillofacial surgeons during the war, according to the survey data

Existing problem	Responses (N=97)		
	Yes, %	No, %	Difficult to answer, %
Lack of practical skills, experience and qualification			
in post-op complication management	28.8	53.6	17.6
in primary surgery	10.3	49.5	40.2
in post-op treatment	7.2	74.2	18.6
in emergency care	14.4	43.3	42.3
in secondary reconstruction	28.8	40.2	31
insufficiency of consumables	72.3	27.7	n/a*
lack of medical instruments and equipment	67	33	n/a
limited medication supply	53.6	46.4	n/a
insufficient qualifications of related medical specialists in multidisciplinary teams	33.3	66.7	n/a
insufficient number of nurses at the departments	36.9	63.1	n/a
inappropriate qualification of nurses in care for patients with gunshot or ballistic injuries	33.3	66.7	n/a

*It was a type of general question and just included Yes or no answers



Supplemental item 2. Direct support for Ukraine from the foreign maxillofacial surgeons, professional associations and clinics