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Criteria for predicting risks in the case of replacing an external fixator with an internal fixator during the treatment of gunshot fractures of the extremities

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In the treatment of victims with gunshot fractures of the long bones of the limbs, important importance is attached to determining the need and conditions for performing conversion (replacing the fixation method) with the formulation of reasoned indications. At the first stage of specialized care, such patients are fitted with external fixators, which provides adequate stabilization and simple wound care. Their conversion at the second stage to intraosseous increases the effectiveness of treatment. The aim: To analyze the results of using a scoring scale to substantiate the replacement of the fracture fixation method in the system of treatment of victims with combat limb injuries. Methods. The medical documentation for the period 2014-2021 was studied. The number of patients with gunshot fractures of long bones was 350, the average age was (36.4 ± 1.42) years. Patients were divided into two groups: the main group (193 wounded) — in the preoperative period, the author's scale «Assessment of the possibility of conversion» was used; comparison (157 people) — point assessment was not performed. Methods. Descriptive, comparative analysis, systematic approach, statistical. The SF36 questionnaire was used to assess patients' quality of life. Results. The analysis of treatment results in the long term (1.2–1.5 years) showed that the use of the author's scale in the preoperative period and the subsequent treatment made it possible to improve the subjective quality of life indicator by an average of 22.2 %. Conclusions. Justification of the expediency of replacing the fixation method during the treatment of patients with gunshot fractures of long bones using the developed scoring scale makes it possible to avoid unjustified conversion, reduce risks and minimize the occurrence of infectious complications.

У лікування постраждалих із вогнепальними переломами довгих кісток кінцівок важливе значення надається визначенню необхідності та умов виконання конверсії (заміни методу фіксації) з формулюванням аргументованих показань. На першому етапі спеціалізованої допомоги таким пацієнтам встановлюють зовнішні фіксатори, що забезпечує адекватну стабілізацію та простий догляд за ранами. Конверсія їх на другому етапі на внутрішньокісткові підвищує ефективність лікування. Мета. Проаналізувати результати застосування бальної шкали для обґрунтування заміни методу фіксації переломів у системі лікування постраждалих із бойовою травмою кінцівок. Методи. Вивчено медичну документацію за період 2014-2021 рр. Кількість пацієнтів з вогнепальними переломами довгих кісток склала 350, середній вік — (36,4 ± 1,42) років. Хворих розподілили на дві групи: основна (193 поранених) — у передопераційному періоді використана авторська шкала «Оцінка можливості проведення конверсії»; порівняння (157 осіб) — бальне оцінювання не проводили. Методи. Описовий, порівняльного аналізу, системного підходу, статистичний. Для оцінювання якості життя пацієнтів використовували опитувальник SF-36. Результати. Аналіз результатів лікування у віддаленні терміни (1,2–1,5 року) показав, що використання авторської шкали у передопераційному періоді та проведене подальше лікування дає змогу покращити суб'єктивний показник якості життя в середньому на 22,2 %. Висновки. Обґрунтування доцільності заміни методу фіксації під час лікування пацієнтів із вогнепальними переломами довгих кісток із використанням розробленої бальної шкали дає можливість уникнути невиправданого виконання конверсії, зменшити ризики та мінімізувати виникнення інфекційних ускладнень. Ключові слова. Вогнепальні переломи, хірургічне лікування, конверсія, бальна шкала SF 36, бальна шкала оцінювання можливості проведення конверсії.

Key words. Gunshot fractures, surgical treatment, conversion, scoring scale SF 36, scoring scale for assessing the possibility of conversion

Introduction

Treatment of gunshot fractures of long bones is a complex and multi-stage process. The patient has to go from the initial fixation with extrafocal devices to the moment of full fusion and restoration of function of the damaged limb [1–3]. At the same time, it is of great importance to determine the necessity and conditions of the conversion with identification of the relevant indications for its implementation, as well as to its reasoned execution [4].

Conversion is the replacement of external fixation systems with submerged metal structures, the implementation of which depends on many factors listed in this article. There are no reliable sources in the literature regarding examples of the use of scores to assess the possibility of a reasoned replacement of the fixation method. So at the moment there are different opinions about the terms and indications for performing the conversion. Some authors, considering the issue of replacement of the fixation method, take into account their own experience; others keep in mind results of analysis of laboratory indicators or instrumental methods of study, visualization using radiography, etc. But there is no generally accepted approach and reasoned opinion.

In some scientific publications, attention is focused on the need for external fixation as the first stage of treatment of patients who seek medical attention due to gunshot fractures of the long bones of the limbs. According to the authors, this provides adequate stabilization and simple wound care, and the installation of intraosseous fixators at the second stage increases the effectiveness of treatment [5].

Other researchers draw attention to the fact that the final treatment of patients with gunshot fractures of long bones with the use of external osteosynthesis systems is an ideal method that provides good long-term results with a certain frequency of complications [6]. At the same time, in their opinion, there is no need to use open invasive surgical interventions, which can also lead to the development of infectious complications. However, a retrospective comparative clinical study (level of evidence 3) showed no differences in the frequency of complications and functional results between groups of patients who were fitted with an external or intramedullary fixator for the treatment of gunshot diaphyseal fractures of the femur [7].

That is why the issue of replacing the method of fixation is a subject of debate, because early conversion increases the risk of infection of the surgical wound and the subsequent development of gunshot osteomyelitis, and the use of external fixation devices as a method of final treatment of gunshot fractures of long bones mostly leads to the development of contractures and functional limitations [6, 8]. However, the reasoned replacement of the fixation method is a certain key to successful restorative treatment of patients of this severe category, because it creates optimal conditions for correcting the position of bone fragments, their stable fixation, and allows the medical rehabilitation process to begin as soon as possible after the injury [4]. Therefore, the issue of implementing a balanced and reasoned conversion is currently relevant and requires further study [8].

Purpose: to analyze the results of applying the point score of the possibility of replacing the method of fracture fixation in the system of treatment of patients with combat injuries of the limbs.

Material and methods

The study materials were discussed and approved by the Bioethics Committee at the State Establishment Institute of Traumatology and Orthopedics of the National Academy of Medical Sciences of Ukraine (Protocol No. 1 of 25.01.2023).

The study involved an assessment of statistical data of the ATO/JFO for the period of 2014–2021. The number of patients with gunshot fractures of long bones was 350. The average age of the wounded was (36.4 ± 1.42) years. The patients were divided into two groups: the main group (193 wounded), for whom the «Evaluation of the possibility of conversion» score was used in the preoperative period; comparison group (157 patients) for whom scoring was not performed. The comparison groups did not differ among themselves in terms of age, gender, clinical and nosological structure, origin of injury, nature and severity of gunshot wounds ($p > 0.05$), and the study sample was representative.

In order to assess the possibility of conversion under the conditions of a gunshot wound in the preoperative period, the elaborated score «Evaluation of the possibility of replacing the fixation method» was used. It takes into account the criteria listed in the Table.

Research methods: descriptive, comparative analysis, systematic approach, statistical. Statistical analysis of the information obtained during the research was carried out using the IBM SPSS Statistics Base v.22 application software package.

Table

Score for assessing the possibility of replacing the fixation method

Indicator	Description	Score
1	2	3
Wound size, (cm)	less 5 type I 5–10 type II 10–20 type III over 20 } Gustilo Anderson	0 1 3
Duration of healing of a gunshot wound, (days)	20–30 30–40 40–60	0 1 3
Trophic changes in the skin of the limb	Absent Mild Moderate Trophic ulcers	0 1 3 5
The state of the tissue of the segment in the area where the conversion is performed	Without abnormalities Presence of displaced pieces Cicatricial skin defect Muscle defect Consequences of compartment syndrome (ischemia, clinical manifestations)	0 1 2 3 5
Foreign bodies	Absent Single of small size Multiple of small size Bullets, large fragments	0 1 3 5
Concomitant abnormality	Varicose veins Obliterating diseases of main vessels Diabetes: compensated decompensated	1 2 3 5
Structural changes of bones	Absent Signs of local osteoporosis Signs of generalized osteoporosis	0 1 3
The degree of inflammatory changes in the area of removed rods (spokes)	Absent Local inflammatory changes of soft tissues Rod osteomyelitis	0 3 5
Damage to the main arteries of the segment due to injury with signs of ischemia	Absent Restoration of blood flow after injury Partial lack of blood flow (arterial ligation)	0 1 5
Phlebothrombosis	Absent PTS Present at the moment of examination	0 3 5
Microflora during primary bacteriological examination of wound contents	Not detected Gram-positive Gram-negative MRSA	0 2 3 5
Dynamics of body temperature normalization during the treatment of a gunshot wound	Available, with a tendency to normalization Wave-like Absent	0 1 5
At the moment of conversion planning:		
Edema	Absent Slight pastiness Moderate	0 1 3
Area of surgical intervention	Hardened scars Sutures not removed, holes from EFD Signs of inflammation of the limb segment	0 3 5
Body temperature, (°C)	36.5–36.9 37.0–37.3 37.4–37.7	0 3 5
CRP level, (mg/l)	0–10 Less than 50 Over 50	0 3 5

Continuation of Table

1	2	3
Platelet level	less than 8×10^9 $8–10 \times 10^9$ 10×10^9 and more	0 3 5
ESR, (mm/h)	less than 15 15–30 over 30	0 3 5

Note. EFD — external fixation device, PTS — post-thrombotic syndrome; MRSA — methylene-resistant Staphylococcus aureus; CRP — C-reactive protein; ESR — erythrocyte sedimentation rate

Results and their discussion

In order to determine the possibility of conversion in the preoperative period, 197 patients of the main group were evaluated according to the proprietary point score. In the comparison group (157 people), the conversion was applied according to subjective indications.

According to the score (Table), 0 points according to a certain criterion characterize confidence in performing the conversion, 1 point means that the indicator does not significantly affect the planning of the conversion, 2 — possible impact of the indicator, 3 — uncertainty regarding the performance of the conversion, 5 —impossibility of its performance. After calculating the points for all criteria, their sum was received, according to which the replacement of the method of osteosynthesis of a fracture due to a gunshot wound was determined: 0–5 points — conversion is possible, 6–9 — uncertainty (its possibility is not excluded, but additional examination or correction of medical indications is necessary), more than 10 - contraindicated.

The SF-36 questionnaire was used to assess the patients' quality of life, which reflects the general well-being and the degree of satisfaction with those aspects of a person's life that are affected by the state of health. The SF-36 consists of 36 items grouped into eight scales: physical functioning, role functioning, bodily pain, general health, vitality, social functioning, emotional state, and mental health. The indicators of each score are compiled in such a way that a higher value of the indicator (from 0 to 100) corresponds to a better assessment on the selected score. They comprise two parameters: psychological and physical components of health. The long-term results of treatment were evaluated in terms of 1.2 to 1.5 years. The ratio of patients of the main and comparison group according to the subjective assessment of the quality of life is shown in the Figure.

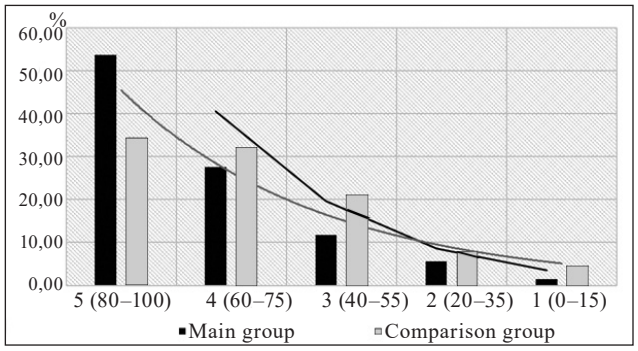

Figure. Graphic display of the subjective results of the treatment of patients of the main and comparison groups according to the SF-36 scale in the long term (1.2–1.5 years)

The assessment of the results of restorative treatment of the comparison group patients in the long term (1.2–1.5 years) according to the quality of life assessment scoring (SF 36) showed that in the main group, 53.6 % of patients received a score of 5 overall, 4 — 27.6, 3 — 11.7, 2 — 5.6, 1 — 1.5 %. In the comparison group, the indicators were as follows: score 5 — 34.5 % of patients, 4 — 32.1, 3 — 21.1, 2 — 7.7, 1 — 4.6 %. That is, the use of the «Evaluation of the possibility of conversion» scoring in the preoperative period and the performed justified further treatment improves the subjective assessment of the quality of life by an average of 22.2 %. Thus, a justified replacement ofthe osteosynthesis method (external fixators to internal fixators) is an important step in the treatment of patients with gunshot fractures of long bones. This statement is consistent with the opinion of other researchers about the safety and effectiveness of replacing temporary external fixation with intraosseous fixation in patients with a Gustilo type III or less open fracture of the lower extremity in satisfactory general condition and the state of soft tissues [8]. The same conclusion was reached by the authors regarding patients with multiple injuries who are in a critical condition [10], observed in patients with gunshot wounds.

Conclusions

Replacing the method of osteosynthesis (external fixators to internal ones) is an important step in the treatment of patients with gunshot fractures

of long bones. At the same time, a rational and comprehensive assessment of all indicators in the preoperative period is a guarantee not only of a successful surgical intervention, but also a criterion for reducing the risk of complications.

Justification of the expediency of replacing the fixation method during the treatment of patients with gunshot fractures of long bones using the elaborated scoring scale «Evaluation of the possibility of replacing the fixation method» makes it possible to avoid unnecessary conversion, reduce risks and minimize the development of infectious complications.

The assessment of treatment outcomes in the long term (1.2–1.5 years) showed that the use of the proprietary scale «Evaluation of the possibility of conversion» in the preoperative period and the subsequent treatment made it possible to improve the subjective quality of life indicator by an average of 22.2 %.

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

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CRITERIA FOR PREDICTING RISKS IN THE CASE OF REPLACING AN EXTERNAL FIXATOR WITH AN INTERNAL FIXATOR DURING THE TREATMENT OF GUNSHOT FRACTURES OF THE EXTREMITIES

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