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## Surgical Treatment of Closed Fractures of Long Bones of Extremities with Polytrauma

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*The purpose of the study* was to improve the functional results of treatment of patients with closed fractures of long bones of the extremities with polytrauma.

*Materials and methods.* The results of treatment of 95 patients with fractures of long bones of the extremities with polytrauma were analyzed. Among them there were 70 (73.9%) men and 25 (26.1%) women. The victims had one or more closed fractures of the long bones of the limbs. Persons of young and able-bodied age from 31 to 50 years old prevailed – 47 (48.9%) patients.

*Results and discussion.* Active restorative treatment was started on the second and third days after the operation at the beginning of passive movements in the joints then, as the postoperative wound healed, on the sixth and seventh days, it was active. Depending on the nature of the fractures various implants were used, in most cases, low-contrast ones, which in a particular case allow achieving maximum anatomical reposition and achieving stable fixation of fragments, which provides the possibility of an early start in the development of the joint.

In the immediate postoperative period in 11 patients with open fracture type B3, superficial suppuration of the soft tissues around the pins was noted, which was easily dealt with using a device for injecting drugs into the infected pin channel. Four patients with granulating wounds of the lower leg underwent autodermoplasty with a free skin graft, all 100% were healed. Phlebothrombosis developed in three patients with hip fractures: they underwent an urgent operation by angiosurgeons – vessel plexization. Long term results of treatment in terms of 8 months to 5 years were studied in 76 patients.

Treatment outcomes were assessed with some criteria (union, neurovascular disorder, varus or valgus, rotation, shortening of the limb, movement in the knee and hip joint, pain, walking hanging activity). Four patients developed chronic osteomyelitis, they underwent sequestrectomy with subsegment recovery. Delayed consolidation was noted in six patients with complex fractures (type C). Two patients developed a defect in the bones of the lower leg up to 5 cm, they subsequently underwent lengthening of the segment. Post-traumatic contracture was noted in four patients.

Three patients had persistent leg edema, chronic post-traumatic thrombophlebitis, equinus deformity of the feet, significant chromate – the result was rated as “poor”. According to the results of ratings as “excellent”, “good”, “satisfactory” and “poor”, quantitative designations were assigned as 5, 4, 3, 2 points, respectively.

In the 76 patients studied, the long-term results were assessed as follows: in 24 (31.6%) patients the result was regarded as excellent (5 points), in 37 (48.7%) patients it was good (4 points), in 12 (15.8%) – satisfactory (3 points), in 3 (3.4%) – poor (2 points).

*Conclusion.* As a result of the use of low-contrast on-bone plates in the osteosynthesis of complex comminuted fractures of long bones, with combined injuries, 90.3% gave excellent and good functional results. With a combined chest injury, intramedullary osteosynthesis with a pin with reaming is contraindicated, due to the risk of developing fat embolism. In these patients, it is necessary to operate with bone plates.

**Keywords:** polytrauma, multiple and concomitant trauma, fractures of long extremities.

**Introduction.** According to leading experts, in the process of choosing a scheme for providing medical care to victims with closed multiple fractures of long limb bones in conditions of polytrauma, it is necessary to focus on the severity of the injuries received, determining the degree of their threat to life, the shockogenicity of multiple fractures of long limb bones [1, 2].

At the present stage, the damage to the bones of the skeleton is becoming increasingly severe and complex due to the increase in the frequency of road accidents, the intensification of urbanization processes and hence the increase in the total number of injuries, and mainly in people of working age [3, 4]. According to many authors, fractures of long bones of the extremities are observed in 52–82% of victims with polytrauma, significantly aggravating their condition and complicating the diagnosis and treatment of damage to internal organs, the skull of the chest, fractures of the pelvis, spine [5, 6]. Polytrauma is always accompanied by complications such as traumatic shock, thromboembolism, fat embolism in the early period with the development of hypostatic complications, bedsores due to the forced position of the patient and

his immobility [7, 8]. The choice of therapeutic tactics in patients with multiple fractures is a difficult task, a favorable outcome of treatment depends on the optimal sequence of all manipulations. The main principle of treatment is to preserve the patient's life from the moment of injury. The struggle for the patient's life is carried out by resuscitation measures aimed at normalizing lung ventilation, cardiovascular activity, replenishing blood loss, novocaine blockades of fracture sites, good immobilization of damaged limbs, the fight against brain edema, diagnostic manipulations (laparocentesis, thoracocentesis) [2, 3, 5, 9, 10].

**The purpose of the study** was to improve the functional results of treatment of patients with closed fractures of long bones of the extremities with polytrauma.

**Materials and methods.** The results of treatment of 95 patients with fractures of long bones of the extremities with polytrauma treated in the traumatology departments of Emergency Hospital No. 1 (Baku) were analyzed. Among them there were 70 (73.9%) men and 25 (26.1%) women. The victims had one (61) or several (34) closed fractures of the long bones of the limbs. The victims had 124 fractures. The main causes of injury were road traffic accidents – 60 (63.6%) victims, falling from height – 19 (19.8%), household and other – 16 (16.6%). By age, patients were distributed as follows: from 16 to 20 years – 12 (12.5%), 21–30 years – 19 (19.8%), 31–40 years – 26 (27.2%), 41–50 years – 20 (23.2%), 51–60 years – 10 (11.2%), older than 61 years – 7 (7.3%). Thus, persons of young and able-bodied age from 31 to 50 years prevailed – 47 (48.9%) patients.

The study was carried out in compliance with the basic provisions of the "Rules of ethical principles of scientific medical research with human participation", approved by the Declaration of Helsinki (1964–2013), ICH GCP (1996), EEC Directive No. 609 (dated 24.11.1986), Orders of the Ministry of Health of Ukraine No. 690 (dated 23.09.2009), No. 944 (dated 14.12.2009), No. 616 (dated 03.08.2012). All the participants were informed about the goals, organization, methods of examination and signed an informed consent to participate in the completely anonymous study.

As can be seen from **Table 1**, fractures of the hip and lower leg prevailed, and they were mainly comminuted and complex fractures (type B and C according to the AO classification). In case of polytrauma and combined injuries, from the moment of admission of the patient to the clinic in the first six hours, priority belongs to operations on the abdominal cavity, skull, damage to the main vessels, chest injuries. We perform operations for closed fractures of long bones in a delayed period from 7 to 21 days, depending on the severity of the patients' condition, after normalization

of all indicators of homeostasis. In the intensive care stage, laparocentesis was performed in 23 cases, of which 14 patients were operated on with various injuries of internal organs, 11 patients – with brain contusions with subdural and epidural hematomas had decompressive trepanations of the skull with removal of hematomas and impression fragments of the skull. In thoracic injuries with a complication of hemopneumothorax, thoracocentesis with drainage of the pleural cavity by Bluau was applied in 18 patients.

**Table 1** – Distribution of closed fractures by localization with combined trauma

Localization of the fracture	Type of closed fracture according to AO			Total	
	A	B	C	Abs	%
Shoulder	4	6	9	19	15.3
Forearm	5	4	6	15	12.1
Hip	10	18	26	54	43.5
Shin	6	12	18	36	29.1
Total	25	40	59	124	100

Types of surgical interventions for closed fractures of long bones are presented in **Table 2**.

**Table 2** – Distribution of patients by type of osteosynthesis

Types of osteosynthesis	Number of operations	
	Abs	%
Osteosynthesis with a bone plate	83	66.9
Osteosynthesis by intramedullary pin	6	4.8
Osteosynthesis by Ilizarov apparatus	35	28.3
Total	124	100

We widely use bone plates (83 operations), as the bone plate by bicortical fixation provides stable osteosynthesis. In 28.3% of cases, the Ilizarov apparatus was used for osteosynthesis only for fractures of the lower leg bones, the device creates inconvenience and discomfort for other segments, and therefore we give priority to the bone plates in 66.9% of the examined patients, operations were performed with small-contact bone plates. Due to high-energy trauma, 47.5% of patients had complex fractures (type C), 32.2% had comminuted fractures (type B). It should be noted that intramedullary osteosynthesis with a pin is risky in patients with breast injury due to the risk of developing pulmonary complications (fat embolism). This is due to the fact that an increase in pressure in the medullary canal when it is drilled and a pin is inserted promotes intravasation of lipids and leads to secondary damage to the pulmonary capillaries. Therefore, in patients with chest trauma and closed hip fractures, it is preferable to perform bone osteosynthesis with a plate.

**Statistical research.** In the course of the study, the numerical indicators obtained were subjected to statistical processing. Statistical analysis was carried out by discriminant correlation methods.

**Results and discussions.** Regardless of the method of osteosynthesis used, active restorative treatment was started on the second and third days after surgery, at the beginning passive movements in the joints, then as the postoperative wound healed on the sixth and seventh days it was active. Depending on the nature of the fractures, various implants were used, in most cases, non-contact, allowing in a particular case to achieve maximum anatomical reposition and achieve stable fixation of fragments, providing the possibility of early development of the joint. According to many authors at the present stage, the most important perspective for improving the results of fracture treatment is the preservation of blood supply to bone fragments and soft tissues. This is the main condition for optimal regeneration of bone tissue, since only fragments of living bone can fuse in the presence of micro-mobility, which in turn is a biological prerequisite for the onset of calcification [1, 5, 8]. Therefore, we adhere to the opinions of these authors, with submerged bone osteosynthesis, it is necessary to have the most sparing attitude to fragments, not to skeletonize much, minor traumatization of soft tissues, if possible, preserve the periosteum of fragments and fixation with low-contact plates. In the immediate postoperative period, 11 patients with open type B3 fractures had superficial suppuration of soft tissues around the spokes, which could be easily dealt with using a device for injecting drugs into the infected spoke canal. In four patients with granulating wounds of the lower leg, autodermoplasty was performed with a free skin graft, all 100% took root. Three patients with hip fractures developed phlebothrombosis, and angiologists performed an urgent operation-vascular plexation. Long-term results of treatment in terms from 8 months to 5 years were studied in 76 patients. The treatment results were evaluated in accordance with the criteria presented in **Table 3**.

Four patients developed chronic osteomyelitis, they underwent sequestrectomy with subsequent recovery. Delayed consolidation was noted in six patients with a complex fracture (type C). In two patients, a defect of the shin bones up to 5 cm was formed, they subsequently elongated the

segment. Post-traumatic contracture was noted in four patients. Three patients had persistent swelling of the lower leg, the phenomena of chronic post – traumatic thrombophlebitis, equine deformity of the feet, significant chromaticity – their result was assessed as “bad”. According to the results of assessments as “excellent”, “good”, “satisfactory” and “bad”, quantitative designations were assigned 5, 4, 3, 2 points, respectively. In the studied 76 patients, the long-term results were evaluated as follows: in 24 (31.6%) patients, the result was regarded as excellent (5 points), in 37 (48.7%) – good (4 points), in 12 (15.8%) – satisfactory (3 points), in 3 (3.9%) – bad (2 points).

**Conclusion**

1. Thus, as a result of the use of low-contact bone plates in the osteosynthesis of complex, comminuted fractures of long bones (type B and C according to the AO classification), 90.3% of excellent and good functional results were obtained with combined injuries.
2. In case of combined breast injury, intramedullary osteosynthesis with a pin with drilling is contraindicated, due to the danger of developing a fat embolism. In these patients, it is necessary to operate with bone plates.
3. Carrying out surgical interventions in the delayed period, as well as early activation of patients in the postoperative period is the basis of good functional results.

**Perspectives of further research.** The perspective is to continue improving the results of treatment of patients with closed fractures of the long bones of the extremities with polytrauma.

**Table 3** – Results of treatment were evaluated in accordance with the criteria

Evaluation criteria	Treatment results			
	Exl.	Good	Satisfactory	Bad
Non - union	No	No	No	Yes
Neurovascular disorders	Missing	Weakly expressed	Moderately pronounced	Significantly pronounced
Varus (valgus)	No	2–5	6–10	>10
Antecurvation/Recurvation	0–5	6–10	11–20	>20
Rotation	0–5	6–10	11–20	>20
Shortening of the limb	0–5 mm	6–10 mm	11–20 mm	>20 mm
Movement in the knee joint	Normal	>80%	>75%	<75%
Movement in the hip joint	Normal	>75%	>50%	<50%
Pain	No	Periodic	Moderate	Significant
Walking	Normal	Normal	Slight limp	Significant lameness
Increased activity	Possible	Limited	Significant lameness	Impossible

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### ХІРУРГІЧНЕ ЛІКУВАННЯ ЗАКРИТИХ ПЕРЕЛОМІВ ДОВГИХ КІСТОК КІНЦІВОК ПРИ ПОЛІТРАВМІ

*Ісаєв І. А., Мамедов А. Ш., Мамієв І. І.*

**Резюме.** *Мета.* Поліпшити функціональні результати лікування хворих із закритими переломами довгих кісток кінцівок при політравмі.

*Матеріали та методи.* Проаналізовано результати лікування 95 постраждалих з переломами довгих кісток кінцівок при політравмі, пролікованих у травматологічних відділеннях лікарні швидкої медичної допомоги №1, Баку, Азербайджан.

Залежно від характеру перелому застосовувались різні імпланти, в більшості випадків малоконтактні, що дозволяло у конкретному випадку досягти максимальної анатомічної репозиції та домогтися стабільної фіксації уламків, що забезпечувало можливість раннього початку розробки суглоба.

*Результати.* При занурювальному накістковому остеосинтезі необхідно максимально щадне відношення до уламків, мінімальна скелетизація, мала травматизація м'яких тканин, по можливості збереження окістя уламків, і фіксація малоконтактними пластинами.

Віддалені результати лікування у строки від 8 місяців до 5 років досліджені у 76 хворих. Результати лікування оцінювали за наступними критеріями - зрощення, нейроваскулярні порушення, варус або вальгус, ротація, укорочення кінцівки, рух у колінному суглобі, рух у кульшовому суглобі, біль, ходьба, підвищена активність.

У 76 хворих, які прийняли участь у дослідженні, віддалені результати оцінені наступним чином: у 24 (31,6%) хворих результат розцінений як відмінний (5 балів), у 37 (48,7%) хороший (4 бали), у 12 (15,8%) задовільний (3 бали), у 3 (3,4%) поганий (2 бали)

*Висновки.* Застосування малоконтактних накісткових пластин при остеосинтезі складних уламкових переломів довгих кісток (тип В і С за класифікацією AT), при поєднаних ушкодженнях дало 90,3% відмінних та гарних функціональних результатів. При поєднаній травмі грудей протипоказаний

інтрамедулярний остеосинтез штифтом з розсвердлюванням у зв'язку з небезпекою розвитку жирової емболії, рекомендовано застосовувати накісткові пластини. Проведення оперативних втручань у відстрочений період, і також рання активізація хворих в післяопераційному періоді є основою хороших функціональних результатів.

**Ключові слова:** політравма, множинні та поєднані ушкодження, переломи довгих кісток кінцівок.

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