

LONG-TERM RESULTS OF REHABILITATION OF PATIENTS WITH PELVIC RING UNSTABLE INJURIES AND COMBINED INJURIES WITH A RUPTURE OF THE SACROILIAC JOINT

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Unstable pelvic fractures with rupture of the sacroiliac joint are a serious medical, social and financial problem. Despite modern methods of diagnosis and treatment of this category of patients, the functional results of the consequences of such injuries in a significant number of cases are unsatisfactory. Aim: to study the functional capabilities of the musculoskeletal system in patients with unstable pelvic fractures with rupture of the sacroiliac joint after surgical restoration of the anatomical integrity of the pelvic ring and a rehabilitation program in the early postoperative period.

The functional results of surgical treatment and the developed early rehabilitation program were studied in 42 patients with polytrauma with unstable fractures of the pelvic ring as the dominant injury, who made up the main group A (n=25) and the control group B (n=17). In group B, a generally accepted physical therapy program was used, in group A, a new rehabilitation program was used, which was distinguished by the presence of training programs, isometric exercises for the paravertebral, gluteal muscles, pelvic floor muscles, ideomotor exercises and relaxation techniques of manual therapy for the muscles of the injured limbs. Clinical, radiological tests, statistical research methods were used. Functional assessment of treatment results was carried out after 10–12 months after injury using the Majeed scale and the SF-36 questionnaire.

The results of the study showed that surgical correction of sacroiliac joint rupture with vertical displacement of the ilium was observed in 84% in group A and in 76% in group B. In other observations, a final diastasis of more than 5 mm with an uncontrolled displacement of the ilium of more than 10 mm was found. The developed program of active rehabilitation in the early postoperative period made it possible to significantly ($p<0.05$) reduce the stay in bed for patients of the main group compared to the control group B.

Application of the early rehabilitation program made it possible to improve the functional results of surgical treatment both in the group with the anatomically restored sacroiliac joint and in its preserved final post-traumatic deformation.

Key words: unstable pelvic injury, rupture of the sacroiliac joint, surgical correction, residual post-traumatic deformity of the pelvic ring, early rehabilitation.

Connection of the publication with planned research works.

The article is a fragment of a planned research work "Diagnostics of osteoporosis in infectious inflammatory diseases of the musculoskeletal system" (state registration number 0120U102453).

Introduction.

Unstable pelvic fractures are a severe and life-threatening injury with a mortality rate of 19–31% [1]. The cause of these fractures, as a rule, is high-energy trauma, which in most victims leads to polytrauma with concomitant injuries to other parts of the body [2]. Unstable pelvic fractures are characterized by injury to the posterior part of the pelvic ring with an iliac fracture, sacroiliac joint (SIJ) rupture, transiliosacral fracture, or sacral fracture [3]. Healing of a pelvic fracture with residual displacement of fragments, especially in the area of the coronary artery, is a functionally unsatisfactory result, leading to significant impairment of standing and walking, decreased or lost ability to work, and decreased quality of life [4].

An unstable fracture of the pelvis with rupture of the SIJ and the presence of diastasis between the articular surfaces of the sacrum and the ilium of more than 5 mm, vertical displacement of the ilium is an indication for surgical correction and stabilization of the injury [5]. Anatomical comparison of the articular surfaces of the SIJ during the operation is a reliable factor in the favorable outcome of this severe injury [6]. We believe that active rehabilitation, starting from the early postopera-

tive period, is no less important factor in the restoration of functional capabilities in the post-traumatic period than the healing of the rupture of the SIJ in the anatomically correct position. However, there are not enough professional publications regarding the mutual influence of surgical treatment and early rehabilitation of patients with unstable fractures of the pelvic ring with rupture of the sacroiliac joint in the long term.

The aim of the study.

To research the functional results of the consequences of unstable fractures of the pelvis with rupture of the sacroiliac joint in the long term after surgical stabilization and early rehabilitation.

Object and research methods.

The object of the study is the protocols of a clinical and radiological examination of 42 patients with polytrauma with unstable fractures of the pelvic ring with a unilateral rupture of the SIJ as the dominant injury. All patients underwent surgical stabilization of fractures in the trauma department of the KNP "City Clinical Hospital of Acute and Emergency Medical Care named after prof. O.I. Meshchaninov" of the Kharkov City Council (KNP "CCHAECM named after Prof. O.I. Meshchaninov") according to the principles of damage control surgery and damage control orthopedics. Also, all patients underwent a rehabilitation program in the early postoperative period. Control group B (n=17; 35% men, 65% women) included patients from a retrospective study who used the exercise therapy program generally accepted at the KNP "CCHAECM named after prof. O.I. Meshchaninova",

for the prevention of joint contractures and muscle atrophy of the lower extremities. The main group A (n=25; 44% men, 56% women) consisted of patients from a prospective study that studied the results of using the developed rehabilitation program. The new rehabilitation program was distinguished by the presence of educational programs regarding the injury received and its effect on the musculoskeletal system, features of the orthopedic regimen in the postoperative period; performing isometric exercises for the paravertebral, sciatic muscles, pelvic floor muscles, ideomotor exercises and relaxation techniques of manual therapy (post-reciprocal relaxation, stretching, or fascial reduction) for the muscles of injured limbs (with an acetabular fracture, fracture of the femur, humerus, shin bones). The average age of the patients was (34.5±14.9) and (38.8±18.2) years, respectively.

Inclusion criteria for the study: closed unstable fractures of the pelvic ring with unilateral rupture of the sacroiliac joint as the dominant injury.

Exclusion criteria from the study: open pelvic fractures; unstable pelvic fractures associated with severe traumatic brain injury or chest injury with rib fractures and hemopneumothorax, or abdominal injury with intra-abdominal bleeding, or open limb fractures type III.

Research methods:

- clinical;
- assessment of the functional state after pelvic fractures according to the Majeed scale [7], includes 4 clinical indicators: pain intensity, nature of work; possibility of sitting; possibility of walking. The result is assessed as excellent (100-85 points), good (84-70 points), fair (69-55 points) and poor (less than 55 points);

- assessment of quality of life using the SF-36 questionnaire, which contains eight scales: physical functioning, role-physical functioning, bodily pain, general health, vitality, social functioning, role-emotional and mental health. The scores on each scale vary between 0 and 100, with 100 indicating complete health, and all scales form two indicators: the mental well-being outcome (MWB) and the physical well-being outcome (PWB). Assessment of the functional state using the Majeed scale and the SF-36 questionnaire was carried out within 10–14 months. after operation.

- X-ray using radiography and computed tomography (CT) in dynamics; reduction was considered anatomical if the sacroiliac joint was symmetrical in CT diagnostics, and the width of the joint joint did not exceed 4 mm [7];

- data processing was carried out separately for the main and control groups with the determination of relative values, mean values and standard errors. Statistical processing of the data was performed using XLSTAT statistical analysis software (Lumivero, USA). The difference between comparative values was determined using the Student's t test [8].

The study was conducted in accordance with the bio-ethical standards of the World Medical Association Declaration of Helsinki on Ethical Principles for Scientific and Medical Research and the Council of Europe Convention on Human Rights and Biomedicine. Each study participant provided written informed consent to participate in the study.

Research results and their discussion.

The general characteristics of both groups are presented in **table 1**.

Table 1 – Demographic data of patients in groups A and B before treatment

Indicators	Groups	
	A (n=25)	B (n=17)
Mechanisms of injury		
– road traffic accident	19; 76%	12; 71%
– catatrauma	6; 24%	5; 29%
Damage to the pelvic ring		
– rupture of the sacroiliac joint	23; 92%	15; 88%
– acetabular fracture	6; 24%	4; 24%
– fracture of the branches of the pubic bone	24; 96%	15; 88%
– fracture of the ischium	6; 24%	5; 29%
– sacral fracture	3; 12%	1; 6%
Combined injuries		
– brain injury	22; 88%	12; 71%
– chest injury	9; 36%	5; 29%
– abdominal injury	12; 48%	8; 47%
– bladder injury	4; 16%	2; 12%
– perineal organ injury	3; 12%	1; 6%
– injury of the musculoskeletal system	18; 72%	13; 76%
– damage to the upper limb	4; 16%	4; 24%
– lower limb injuries	9; 36%	6; 35%

As can be seen from **table 1**, the most frequent mechanism of injury in our material was road traffic accidents (76% in group A and 71% in group B). Among the injuries of the pelvic ring, one-sided ruptures of the SIJ (92% and 88%, respectively) and fractures of the branches of the pubic bone (96% and 88%, respectively) prevailed. Almost a third of patients in each group had an acetabular fracture and a fracture of the ischium. In our material, unstable pelvic ring injury was most often combined with craniocerebral injury (88% and 71%, respectively), musculoskeletal injury (72% and 76%, respectively), and abdominal injury (48% and 47%, respectively).

All patients underwent surgical treatment taking into account the principles of damage control surgery and damage control orthopedics. The sacroiliac joint was subject to stabilization with external fixation devices; fractures of the femur and humerus – intramedullary locking osteosynthesis. Patients in both groups were included in early rehabilitation programs. It should be noted that almost from the first days, patients from the main group more willingly and consciously engaged in physical therapy, they had a positive emotional attitude toward a faster recovery. We consider this result as a manifestation of educational programs, during which patients understood the characteristics of their condition, the goals and objectives of early rehabilitation, and the safety of medical treatment. Carefully selected gentle therapeutic exercises (ideomotor exercises, post-reciprocal relaxation, stretching, or fascial redressing) for damaged limbs, as well as isometric exercises for paravertebral, gluteal muscles, muscles of a hips, shins flexor and extensor, active movements of the joints of the upper limbs, toes, allowed to significantly ($p<0.05$) reduce the stay in bed for patients of the main group

Table 2 – Functional results of unstable pelvic fractures depending on the postoperative state of the sacroiliac joint in the main and control groups

Indicators	Groups	
	A (n=25)	B (n=17)
Restoration of the anatomy of the sacroiliac joint		
Number of patients	21; 84%	13; 76%
Average age, years	31,8±10,4	37,82±11,6
Sex		
– male	9; 36%	5; 29%
– female	12; 48%	8; 48%
Majeed scale, points	88,3±16,7	79,3±18,6
SF-36		
– total physical well-being score	65,6±14,2	58,2±16,2
– total mental well-being score	70,3±16,5	56,4±11,6
Preservation of post-traumatic discordance of articular surfaces in the sacroiliac joint		
Number of patients	4; 16%	4; 24%
Average age, years	49,7±16,2	51,3±12,8
Sex		
– male	2; 8%	1; 6%
– female	2; 8%	3; 18%
Majeed scale, points	74,4±9,7	68,5±9,2
SF-36		
– total physical well-being score	56,3±14,7	51,7±18,9
– total mental well-being score	54,5±13,8	49,3±16,3

compared to control group B from (16.9±10.2) days to (8.2±3.7) days.

The developed active early rehabilitation in the post-operative period contributed to a significant improvement in functional results in the long-term post-traumatic period, both with the complete restoration of anatomical relationships in the SIJ, and with the preservation of unresolved displacement of the articular surfaces of the ilium and sacrum (**table 2**).

From **table 2** it can be seen that when normal anatomical relationships were restored in the torn SIJ in both groups A and B, the studied indicators of the functional state of patients were significantly higher than in cases of preservation of residual displacement of the articular surfaces of the ilium and sacrum. Also, the Majeed scale and SF-36 questionnaire scores were higher in the main group compared to the control group both in cases of restoration of the anatomy of the SIJ and in cases of remaining post-traumatic incongruity in the sacroiliac joint (**table 2**).

Significantly better functional results in patients with restored anatomical relationships in the SIJ compared to cases with preserved post-traumatic displacement are

well known [5, 9-11]. Factors that significantly negatively affect the functional outcome of surgical treatment of unstable pelvic ring injuries were also studied. For the short-term results, these are fractures of the lower limb, conservative treatment, unreduced dislocation of the SIJ and nerve damage, while in the long-term period, nerve damage and post-traumatic deformities of the pelvic ring of more than 20 mm have the most negative impact [6]. A potentially unfavorable factor for the outcome of treatment in older patients is sarcopenia with atrophy of the gluteal muscles [12], which will significantly complicate walking, especially when climbing stairs, inclined surfaces, etc. However, in the available literature, we have not found professional reports on the effect of early rehabilitation on the functional results of various anatomical states of the SIJ.

Conclusions.

1. Unstable injuries of the pelvic ring with unilateral rupture of the sacroiliac joint as the dominant injury are accompanied by injuries to other organs and systems, among which the most common are traumatic brain injury (88% in group A and 71% in group B), damage to the musculoskeletal systems (72% and 76%, respectively) and abdominal trauma (48% and 47%, respectively).

2. The functional results of the consequences of an unstable pelvic injury depend on the effectiveness of surgical intervention to restore the anatomical integrity of the pelvic ring. In cases with restored anatomical relationships in the sacroiliac joint in the main group A and control group B, the best average scores were observed on the Majeed scale ((88.3±16.7) points and (79.3±18.6) points, respectively) and the questionnaire SF-36 compared with groups A and B with residual incongruence of the SIJ (for the Majeed scale ((74.4±9.7) points and (68.5±9.2) points, respectively).

3. The use of an early rehabilitation program made it possible to improve the functional results of surgical treatment both in the group with the restored anatomy of the SIJ and with preserved residual post-traumatic deformity of the SIJ: for SF-36, the FWB indicator in groups A: (65.6±14.2) points and (56.3±14.7) points, respectively; in groups B: (58.2±16.2) points and (51.7±18.9) points, respectively; MWB indicator in groups A: (70.3±16.5) points and (54.5±13.8) points, respectively; in groups B: (56.4±11.6) points and (49.3±16.3) points, respectively.

Prospects for further research.

In further studies, it is promising to investigate the functional results of surgical treatment and early rehabilitation of patients with unstable fractures of the pelvic ring in different age groups.

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ВІДДАЛЕНІ РЕЗУЛЬТАТИ РЕАБІЛІТАЦІЇ ХВОРИХ З НЕСТАБІЛЬНИМИ УШКОДЖЕННЯМИ ТАЗОВОГО КІЛЬЦЯ ТА ПОЄДНАНИМИ УШКОДЖЕННЯМИ З РОЗРИВОМ КРИЖОВО-КЛУБОВОГО ЗЧЛЕНУВАННЯ

Журавлев В. Б.

Резюме. Вступ. При нестабільних переломах тазу з розривом крижово-клубового зчленування у випадках діастазу між суглобовими поверхнями крижів та клубової кістки більше 5 мм й вертикальним зміщенням постраждали потребують хірургічної корекції та стабілізації ушкодження. Ми вважаємо, що активна рання реабілітація є також необхідним фактором відновлення функціональних можливостей у післятравматичному періоді, однак тематичних фахових публікацій недостатньо.

Мета дослідження – визначити функціональні результати наслідків нестабільних переломів тазу з розривом крижово-клубового зчленування у віддаленому періоді після хірургічної стабілізації й ранньої реабілітації.

Об'єкт і методи дослідження. Матеріал – протоколи клініко-рентгенологічного обстеження 42 хворих з політравмою з нестабільними переломами тазового кільця як домінуючою травмою, які склали основну групу А (n=25) та контрольну групу В (n=17). Всім пацієнтам проводилось хірургічна стабілізація переломів в травматологічному відділенні КНП «Міська клінічна лікарня швидкої та невідкладної медичної допомоги ім. проф. О.І. Мещанінова» Харківської міської Ради, і в ранньому післяопераційному періоді застосовувались програми реабілітації: в групі В – загальноприйнята в даному лікувальному закладі, в групі А – нова, яка відрізнялася наявністю навчальних бесід, ізометричних вправ для паравертебральних, сідничних м'язів, м'язів тазового дна, ідеомоторних вправ та релаксацийних технік мануальної терапії для м'язів ушкоджених кінцівок. Методи: клінічний, в тому числі з оцінкою функціонального стану після переломів таза за шкалою Majeed та опитувальником SF-36, рентгенологічний; статистичний.

Результати. Хірургічна корекція розриву крижово-клубового зчленування спостерігалася у 84% в групі А та у 76% у групі В. У інших спостереженнях виявлено залишковий діастаз більше 5 мм з невправленим зміщенням клубової кістки більше 10 мм. Розроблена програма активної реабілітації в ранньому післяопераційному періоді дозволила достовірно ($p < 0,05$) скоротити перебування в ліжку для пацієнтів основної групи порівняно з контрольною групою В. Застосування навчальних бесід допомогло пацієнтам зрозуміти особливості свого стану, мету і завдання ранньої реабілітації, безпеку лікувальних справ, сприяло суттєвому покращенню функціональних результатів в основній групі у віддаленому післятравматичному періоді.

Висновки. Застосування програми ранньої реабілітації дозволило покращити функціональні результати хірургічного лікування як у групі з анатомічно відновленим крижово-клубовим зчленуванням, так і при його збереженні залишкової післятравматичної деформації.

Ключові слова: нестабільна травма таза, розрив крижово-клубового зчленування, хірургічна корекція, залишкова післятравматична деформація тазового кільця, рання реабілітація.

LONG-TERM RESULTS OF REHABILITATION OF PATIENTS WITH PELVIC RING UNSTABLE INJURIES AND COMBINED INJURIES WITH A RUPTURE OF THE SACROILIAC JOINT

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Abstract. *Introduction.* In unstable pelvic fractures with a rupture of the sacroiliac joint in cases of diastasis between the articular surfaces of the sacrum and the ilium of more than 5 mm and vertical displacement, the victims require surgical correction and stabilization of the damage. We believe that active early rehabilitation is a necessary factor in restoring functionality in the post-traumatic period, but there are not enough thematic professional publications.

The aim of the study is to research the functional results of the consequences of unstable pelvic fractures with rupture of the sacroiliac joint in the long-term period after surgical stabilization and early rehabilitation.

Object and research methods. Material – protocols of clinical and radiological examination of 42 patients with polytrauma with unstable fractures of the pelvic ring as the dominant injury, who made up the main group A (n=25) and the control group B (n=17). All patients underwent surgical stabilization of fractures in the trauma department of the KNP "City Clinical Hospital of Acute and Emergency Medical Care named after prof. O.I. Meshchaninov" of the Kharkov City Council, and in the early postoperative period, rehabilitation programs were used: in group B – generally accepted in this hospital, in group A – a new one, characterized by the presence of educational programs, isometric exercises for paravertebral, sciatic muscles, pelvic floor muscles, ideomotor exercises and relaxation techniques of manual therapy for the muscles of injured limbs. Methods: clinical, including assessment of the functional state after pelvic fractures using the Majeed scale and the SF-36 questionnaire, radiological; statistical.

Results. Surgical correction of a rupture of the sacroiliac joint was observed in 84% in group A and 76% in group B. Other observations revealed residual diastasis of more than 5 mm with unreduced displacement of the iliac bone of more than 10 mm. The developed program of active rehabilitation in the early postoperative period made it possible to significantly ($p < 0.05$) reduce the stay in bed for patients of the main group compared to control group B. The use of educational programs helped patients understand the features of their condition, the goals and objectives of early rehabilitation, and the safety of treatment, contributed to a significant improvement in functional results in the main group in the long-term post-traumatic period.

Conclusions. The use of an early rehabilitation program made it possible to improve the functional results of surgical treatment both in the group with an anatomically restored sacroiliac joint and in those with preserved residual post-traumatic deformity.

Key words: unstable pelvic injury, rupture of the sacroiliac joint, surgical correction, residual post-traumatic deformity of the pelvic ring, early rehabilitation.

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EVALUATION OF THE EFFICIENCY OF COMBINED TREATMENT OF ISOLATED GUNSHOT INJURIES OF SOFT TISSUES

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An analysis of 120 patients with gunshot shrapnel blind wounds of soft tissues was carried out. Patients were divided into two groups depending on the timing of suturing. The treatment methods of the main group were modified by combining suturing with the introduction of platelet-rich autoplasm into the wound.

The results showed that the incidence of postoperative complications in patients of the main group was significantly reduced (subgroup C), wound suppuration was detected in 2 (3.33%) patients ($U=120.00$, $p=0.000001$). And in subgroup D, seroma formation was detected in one patient (1.67%) ($U=220.00$, $p=0.0385$), while in the comparison group 24 (40.00%) patients were diagnosed. The duration of inpatient treatment of the wounded in the comparison group (subgroup A) was 21 ± 2.3 days, while in the main group (subgroup C) this indicator was 16 ± 3.1 days ($U=290.00$, $p=0.0354$). In the comparison group (subgroup B), the duration of inpatient treatment was 27 ± 3.5 days, while in the main group (subgroup D) it was 22 ± 2.1 days.

The modification method of treatment of gunshot shrapnel blind wounds of soft tissues significantly reduced the number of postoperative complications and accelerated the duration of inpatient treatment, which indicates the antibacterial, fungicidal and regenerative capabilities of platelet-rich autoplasm.

Key words: gunshot wound, autoplasm, secondary sutures.

Connection of the publication with planned research works.

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Introduction.

In the current conditions of hostilities and war on the territory of Ukraine, the problem of gunshot wounds is becoming relevant and extremely important for medical

practice. With the increasing number of isolated blind gunshot shrapnel wounds, there is a need to develop and improve surgical treatment methods aimed at maximising tissue repair and ensuring rapid recovery of the functions of injured organs [1, 2, 3, 4]. Traditional methods of treating such injuries are often associated with a long rehabilitation period, the risk of developing infectious complications and insufficiently effective repair of damaged tissues.

Current medical progress demonstrates the importance of optimising the treatment of gunshot wounds. In the context of the military conflict on the territory of Ukraine, an essential stage in the treatment of the