

REHABILITATION

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DOI: <http://dx.doi.org/10.15674/0030-59872025182-89>**The efficiency of surgical treatment and rehabilitation in the recovery of patients with a cetabular posterior wall fractures****M. L. Ankin¹, V. O. Ladyka¹, O. O. Glynyana², M. M. Barylovych¹**¹ Shupyk National Medical Academy of Postgraduate Education, Kyiv. Ukraine² Bogomolets National Medical University, Kyiv. Ukraine

Fractures of the posterior wall of the acetabulum are one of the most difficult injuries to treat in Orthopedics and traumatology. The most common causes of this fracture are road traffic accidents, falls from heights, and injuries resulting from military actions. There is a high risk of post-traumatic arthritis at later stages and avascular necrosis, often leading to future disability. Objective. to assess the efficiency of surgical treatment and rehabilitation in patients with acetabular posterior wall fracture. Methods. The study was conducted at the Kyiv Regional Clinical Hospital and Kyiv City Clinical Hospital No. 8 from 2021 to 2023. A total of 44 patients aged 19 to 68 participated in the study. Treatment outcomes and rehabilitation measures were assessed using the Matta and Harris Hip Score scales. All patients underwent open reduction and internal fixation of the posterior wall of the acetabulum with plates and screws. The Kocher-Langenbeck surgical approach was used in all cases. Clinical and radiological results were analyzed at 3, 6, and 12 months in all patients. Results. The Harris Hip Score in the main group was (81.51 ± 4.03) points at 6 months and (87.09 ± 5.31) points at 12 months. In the control group, the scores were (75.43 ± 4.45) at 6 months and (84.01 ± 4.17) at 12 months ($p < 0.01$). Conclusions. Early closed reduction of hip joint dislocation and surgery with reconstruction of normal joint anatomy and stable fracture fixation is crucial for efficiency of surgical treatment.

Перелом задньої стінки кульшової западини є однією з найскладніших травм, з якою стикаються ортопедичні травматологи. Найпоширенішими його причинами є дорожньо-транспортні пригоди, кататравми й ушкодження внаслідок воєнних дій. Високий ризик розвитку посттравматичного артрозу на віддалених етапах чи аваскулярного некрозу, часто призводить у подальшому до інвалідизації. Мета. Оцінити ефективність хірургічного лікування та реабілітаційних заходів щодо відновлення пацієнтів із переломом задньої стінки кульшової западини. Методи. Здійснено проспективний аналіз хворих, яких лікували на базі КНП КОР «Київська обласна клінічна лікарня» та КНП «Київська міська клінічна лікарня № 8» у період з 2021 по 2023 роки. До дослідження було залучено 44 пацієнти, середній вік яких становив $(42,2 \pm 13,1)$ року. Результати лікування та реабілітаційні заходи оцінювали за шкалами Матта й Harris Hip Score. Усім хворим виконано оперативне втручання — остеосинтез задньої стінки кульшової западини пластинами та гвинтами. Хірургічний доступ Кохера-Лангенбека використовувався у всіх випадках. Проаналізовано клініко-рентгенологічні результати через 3, 6 і 12 місяців. Результати. Показники, отримані за шкалою Harris Hip Score через 6 міс. в основній групі склали $(83,51 \pm 4,03)$ бала, через 12 місяців — $(87,09 \pm 5,31)$; у контрольній групі через 6 міс. — $(75,43 \pm 4,45)$ бала, через 12 — $(84,01 \pm 4,17)$ ($p < 0,01$). Висновки. На ефективність хірургічного лікування пацієнтів із переломами задньої стінки кульшової западини впливають: вчасне закриття усунення вивиху головки стегнової кістки, проведення оперативного втручання в найбільш ранній термін із відновленням нормальної анатомії суглоба, стабільною фіксацією перелому та ранній початок реабілітаційних заходів. Ключові слова. Перелом, реабілітація, задня стінка кульшової западини.

Keywords. Fracture, rehabilitation, posterior wall of the acetabulum

Introduction

Fractures of the posterior wall of the acetabulum are the most common type of injury to the acetabulum, often high-energy and combined with injuries to other organs. Surgical treatment is indicated in case of fractures of the acetabulum that lead to instability and incongruence of the joint, as well as in cases of injuries with the presence of bone fragments or soft tissues within this localization.

This group of fractures is characterized by a high level of early and late post-traumatic complications, which lead to disability in 73–88 % of cases [1]. Treatment tactics can vary from closed or open reduction of the dislocation of the femoral head, arthroscopy, osteosynthesis, and even hip arthroplasty [2]. Posterior hip fracture is intra-articular, presents a high risk of developing post-traumatic arthrosis, avascular necrosis in the late stages, and often causes disability. The percentage of these complications increases significantly with displaced fractures and largely depends on achieving anatomical reduction [3]. A well-performed surgical intervention is an important component, but no less important is comprehensive rehabilitation, which should complement the measures taken and help reduce secondary disorders. Rehabilitation treatment should be aimed at improving mobility in the hip joint, increasing strength, endurance, and functional independence of the patient in the shortest possible time.

Purpose: to evaluate the effectiveness of surgical treatment and rehabilitation measures in the recovery of patients with posterior hip fracture.

Material and methods

The study was carried out in compliance with the provisions of the Helsinki Declaration of Human Rights (2000), the Constitution and legislation of Ukraine on healthcare. The issues of bioethical expertise and ethics of scientific research were considered and approved by the commission of the P. L. Shupyk National Institute of Health of Ukraine (protocol No. 11 dated 16.11.2021). Informed consent was obtained from all patients included in the study.

A prospective analysis of 44 medical records of patients who were inpatients at Kyiv Regional Clinical Hospital and Kyiv City Clinical Hospital No. 8 in the period from 2021 to 2023 was conducted.

A physical examination was performed, radiographs before and after surgery, and computed tomography results were studied. The reduction was assessed using the Matt scale, and hip joint function was assessed using the Harris Hip Score scale.

The results were calculated using mathematical statistical methods.

Postoperative assessment of the reduction was performed using the Matt scale: anatomical (displacement up to 1 mm), imperfect (2–3 mm), unsatisfactory (more than 3 mm) [4]. Clinical and radiological results were analyzed after 3, 6, and 12 months in all patients in the postoperative period. A separate task was to study the effectiveness of intervention in the case of fractures of the posterior wall of the hip socket using the Harris Hip Score scale. The following indicators were assessed using it: “Pain”, the maximum score of 44 meaning the absence of pain, while severe pain at rest means 0 points; for the categories “Function”, “Amplitude of movements” and “Deformity” — 47, 5 and 4 points, respectively. The assessment of function is based on 4 categories: preservation of usual daily activity — 14 points, absence of lameness — 11, absence of need for assistive devices during walking — 11, duration of walking — 11. Preservation of preoperative range of motion is assigned 5 points, absence of deformity — 4. The maximum number of points for one joint that can be obtained by assessing the patient’s condition using the Harris Hip Score scale is 100. The sum of points from 100 to 90 is considered excellent, from 89 to 80 — good, from 79 to 70 — satisfactory, and less than 70 — unsatisfactory [5]. The gender distribution is as follows: men — 28 (63.6 %), women — 16 (36.4 %). The average age was (42.2 ± 13.1) years. The main mechanisms of injury: road accidents — 19 patients (43.2 %), due to military actions — 16 cases (36.4 %), catatraumas — 9 subjects (20.4 %) (Fig. 1).

Right-sided injury was recorded in 23 people (52.3%), left-sided — in 21 (47.7 %). Unremoved dislocation of the femoral head during hospitalization was diagnosed in 19 patients (43.2 %), the period of dislocation reduction from 1 to 26 days, average — (8.9 ± 2.6) days. The criteria for excluding patients from the study were complex fractures, which were combined with damage to internal organs (rectum, bladder) and craniocerebral trauma.

The primary task for traumatologists was closed reduction of dislocation of the femoral head at the earliest possible date. Closed reduction was successfully performed on the day of injury in 11 (57.9 %) patients, in the first 3 days after injury in 5 (26.3 %) patients, and delayed reduction was performed in 3 (15.8 %) cases. The time of surgical intervention from the moment of injury ranged from 1 to 26 days, with an average of (10.8 ± 3.8) days.

The Kocher-Langenbeck surgical approach was used in all cases. Reduction was performed using

traction devices on the operating table to fix the patient at the intact area at the level of the posterior superior iliac spine and femoral diaphysis. All patients underwent the following interventions: osteosynthesis of the posterior wall of the acetabular fossa with plates and screws. The size of the plate depended on the number and size of the fragments. The main goal of osteosynthesis was to achieve anatomical reduction and stable fixation of the fracture. During the operation, revision of the *n. ischiadicus* and its protection from intraoperative damage.

For all patients, the management protocol included: after hospitalization, the imposition of a skeletal traction system over the supracondylar zone of the femur, ultrasound Dopplerography of the vessels of the lower extremities before and after osteosynthesis, surgical intervention for the timely detection of thrombotic complications.

Rehabilitation measures, which were an important component of the patients' recovery, began the day after their hospitalization.

The acute period (the patient was on skeletal traction) included therapeutic interventions: familiarization with the method of treatment of the injury, rehabilitation measures, possible complications and

measures to avoid them; cold therapy (to reduce pain and sensitivity). The following exercises were also performed:

- for a healthy lower limb (LL) — flexion/extension in the knee, hip, supracalcaneal-tibial joints, abduction/adduction in the hip joint;
- raising the pelvis with support on a healthy lower limb (prevention of bedsores);
- for the upper limbs (UL) — sitting in bed with support on a Balkan frame;
- for an injured LL — ideomotor, movements in the supracalcaneal-tibial joint;
- respiratory — diaphragmatic breathing, training in full exhalation, coughing and expectoration of secretions, use of a breathing simulator for the prevention of respiratory complications.

According to the results of the obtained reposition according to the Matt scale, patients were divided into two identical groups, the main ($n = 22$) and the control ($n = 22$).

The control group ($n = 22$) was engaged in the traditional program of medical institutions, which included: performing therapeutic exercises (general-developing, isometric, passive, passive-active and active), early verticalization of patients, movement with assistive devices, therapeutic massage, cold and magnetolaser therapy.

In the main group ($n = 22$), the developed program was used, which included, in addition to traditional ones, modern methods and means of rehabilitation: cryotherapy, TENS therapy, myofascial release, soft tissue mobilization (with elastic floss tape, blade), a set of therapeutic exercises with Thera-bend, on spheres and hemispheres (Table 1). The rehabilitation program after surgery included three periods, which are given in Table 1.

In addition to the listed methods and means in the acute period, an important aspect was the early mobilization of patients. At the beginning, verticalization was carried out with the mandatory use of compression therapy (elastic bandaging or compression stockings), learning to move with means for additional support. Patients who did not have excess weight and coordination problems moved with inguinal crutches without loading the operated limb, only the first toe was allowed to touch the floor, individuals with high risk factors for falling walked with the help of a walker. During training to walk on crutches, a two-support technique was used, in which the point of support was on the healthy LL, the crutches and the damaged limb acted as one whole, and the healthy one as a separate unit. Patients were taught to climb stairs using first the healthy

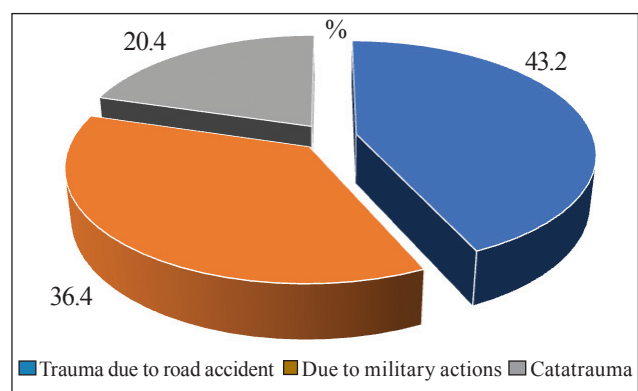


Fig. 1. Distribution of patients in the prospective group by mechanism of traumatic injury

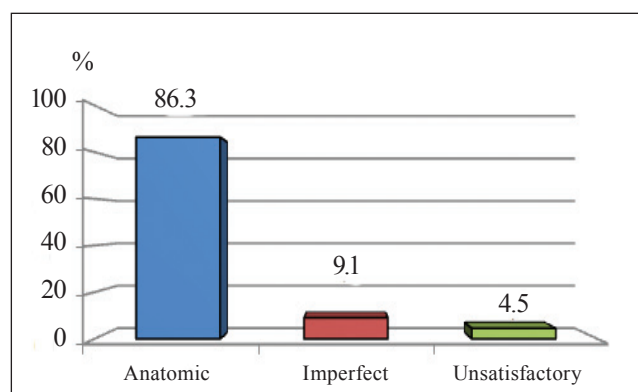


Fig. 2. Results of reduction according to the Matt scale

hip joint, then carry crutches simultaneously with the operated limb, and when descending the stairs, first lower the crutches and the damaged, and then the healthy hip joint.

In the presence of pronounced edema of the operated hip joint, elevation was performed 2–3 times a day for 20–30 minutes. Initially, the amplitude of movements in the operated hip joint was limited due to edema, inflammation, and initial adhesion between the lateral vastus femoris muscle and the tensor fascia latae femoris muscle, so movements were performed passively and passively-actively for several days. Patients were advised to avoid hyperextension, internal rotation, and lifting of the operated straight hip joint in the hip joint. Active therapeutic exercises for the gluteus maximus muscle and its strengthening were limited in the first 6 weeks due to the possibility of hip hyperextension.

The main aspect was the functional activity and independence of the patient: they were taught to roll over to the uninjured side, sit up independently, get out of bed, dress using the injured limb, and undress using the healthy limb. Initially, the patients needed help, and later they independently performed daily activities with the use of assistive devices (elevated

toilet seat, reach devices for putting on socks and pants) to reduce the load on the operated joint.

Therapeutic exercises were performed according to pain tolerance, the visual analogue scale (VAS) score was within 4 points [6]. Further change in the load on the operated limb was selected according to the results of the radiograph, fracture stability and the course of union.

Results

The average term of radiographic consolidation of the fracture was (12 ± 3) weeks. Among the patients in the postoperative period, the following complications were diagnosed: post-traumatic sciatic nerve neuropathy, in the main group in 1 (4.54 %) person and in the control group in 2 (9.09 %); heterotopic ossification in 4 (18.2 %) patients in the main group and in 7 (31.8 %) in the control group; aseptic necrosis of the femoral head in 6 (27.3 %) patients in the main group and 9 (40.9 %) in the control group.

After surgical treatment, an assessment was made using the Matt scale: in 38 patients (86.5 %) anatomical reduction of up to 1 mm was achieved, in 4 (9 %) it was not ideal (up to 2–3 mm), and in 2 patients (4.5 %) it was unsatisfactory (more than 3 mm), the results are shown in Fig. 2.

Table 1

Rehabilitation program for patients after surgical treatment for a fracture of the posterior wall of the acetabulum

Period	Acute	Post-acute	Prolonged
Task	1. Management of edema and pain 2. Early mobility and verticalization 3. Strengthening of the upper shoulder girdle muscles and healthy NC 4. Adaptation to load 5. Prevention of contracture in the hip joint	1. Management of edema and pain 2. Improvement of muscle strength, functional indicators in the hip joint 3. Improvement of balance and coordination 4. Maintenance of physical fitness 5. Return of the patient to self-care	1. Restoration of full function in the hip joint 2. Restoration of the correct gait pattern 3. Restoration of muscle strength 4. Return to professional activity
Methods and means	1. Cryotherapy 10 min 3 times a day (5 procedures) 2. Mechanotherapy on the CPM device 20 min once a day (10 procedures) 3. Lymphatic drainage massage 10–15 min (10 procedures) 4. Active therapeutic exercises in all joints of a healthy LL and UL 5. Passive, passive-active and active movements in the operated joint 6. Isometric tension of the quadriceps muscles 7. Isotonic exercises for the supracalcaneal-tibial joints 8. ADL training (skills in daily life)	1. Therapeutic exercises (general-developing, special, stretching, breathing, isometric, movements with a scar) 2. Myofascial release, mobilization of soft tissues (elastic floss tape, blade) 3. TENS therapy (once a day for 10 min) 4. Functional mobility training (moving in bed, walking up stairs) 5. ADL training (using aids for dressing, hygiene, etc.)	1. Therapeutic exercises (functional, stretching, with resistance to increase muscle strength with Theraband), coordination on spheres and hemispheres) 2. Mechanotherapy (Nautilus exercise bike to strengthen the quadriceps) 3. Heat compresses were applied remotely to the spasmed muscles before performing the exercises

The assessment of the results using the Harris scale in subgroups, carried out using the Shapiro-Wilk test, showed compliance with the parameters of the normal distribution ($p = 0.382\text{--}0.573$), which allows using the arithmetic mean (M) and standard deviation (SD) for descriptive statistics of the results. At the same time, the presence of the number of observations in subgroups less than 30 ($n = 22$), made it advisable to use non-parametric criteria for comparing the results between groups (Mann-Whitney test) and in time course (Wilcoxon test).

The results of treatment according to the Harris Hip Score scale are given in Table 2.

A statistical analysis of the influence of the timing of surgical intervention on the achievement of anatomical reduction of the fracture was performed (Table 3).

A study of the patterns of development of aseptic necrosis depending on the timing of the elimination of dislocation of the femoral head is given in Table 4.

Discussion

A significant part of domestic and foreign works presents conservative and surgical methods of treatment for fractures of the posterior wall of the acetabulum. The authors emphasize that the recovery of patients is influenced by a number of factors, including the type of fracture, damage to the femoral head, concomitant injuries, timing of the operation, quality of osteosynthesis and surgical access [3, 7, 8]. Complications in the case of fractures of the acetabulum

include postoperative infection, sciatic nerve damage, heterotopic ossification, thromboembolic complications, malunion and nonunion [9].

N. Kaple, M. Lakhwani provide rehabilitation measures for the recovery of patients with this type of fracture using the skeletal traction method. However, it requires a long stay of the patient in a horizontal position, which makes it impossible to quickly restore functional indicators in the hip joint and contributes to an increase in risks from the cardiovascular, respiratory systems and musculoskeletal system. Pressure ulcers, infections of the spinous canal and urinary tract, thrombosis, pneumonia are possible side effects of prolonged bed rest [10].

Most authors emphasize the importance of surgical treatment for a fracture of the posterior wall of the acetabular fossa and high-quality reconstruction of the fracture [3, 9, 11]. We believe that the best method of surgical intervention in patients with posterior acetabular fractures is a bridge-like bone metal osteosynthesis (the plate is located from the ischial tuberosity to the roof of the acetabular cavity) using the Kocher-Langenbeck approach. The main goal is to achieve anatomical reduction, which directly affects the outcome of treatment. A mandatory task during surgery is revision, protection and analgesia of the sciatic nerve.

A fairly small part of the studies is devoted to rehabilitation measures [10, 12], which are an important component of the prevention of pre- and postoperative complications in patients with posterior acetabu-

Results of assessing hip joint function using the Harris Hip Score (M $\pm$ SD)

Table 2

Stage (months)	Harris Hip Score criteria and groups		P (MW)
	main (n = 22)	control (n = 22)	
Pain level			
3	33.04 ± 4.01	30.19 ± 4.16	0.0250*
6	38.47 ± 4.41	34.51 ± 4.73	0.0060*
12	42.26 ± 4.52	39.36 ± 3.69	0.0240*
P (3–6)	0.0001*	0.0020*	—
P (3–12)	0.0001*	0.0001*	—
HHS (general)			
3	78.03 ± 4.15	69.14 ± 4.38	0.0001*
6	83.51 ± 4.03	75.43 ± 4.45	0.0080*
12	87.09 ± 5.31	84.01 ± 4.17	0.0380*
P (3–6)	0.0090*	0.0040*	—
P (3–12)	0.0001*	0.0001*	—

Notes: P (MW) — comparison between groups according to the Mann-Whitney test (* — difference is statistically significant); P (3–6), P (3–12) — assessment of indicators in dynamics according to the Wilcoxon test (* — difference is statistically significant); M $\pm$ SD — arithmetic mean and standard deviation.

lar fractures. Most programs include therapeutic exercises, massage and verticalization of the patient, but do not take into account a comprehensive approach involving educational work with the patient, the use of mechanotherapeutic means, physiotherapeutic, myofascial techniques for working with muscles and postoperative scar, which improves and accelerates recovery.

Studying the analysis, we believe that the result is influenced by the quality of reposition, the timing of surgical intervention from the moment of injury, early start of rehabilitation measures. The best result was found in patients who underwent surgery within 21 days from the moment of injury, achieved anatomical reposition and began rehabilitation measures immediately from the moment of hospitalization to the hospital. Among the rehabilitation measures, the following had the greatest impact: a comprehensive approach, early mobilization of the patient, measures to reduce swelling and stiffness in the hip joint,

increase muscle strength, improve daily activities and activity.

Clinical case number 1

A 52-year-old patient Z. was treated in the conditions of Communal Non-Profit Establishment Kyiv City Clinical Hospital No. 8. The injury was received as a result of a road accident on 27.06.2023. Diagnosis: closed fracture of the posterior wall of the left acetabular fossa with displacement, condition after removal of the dislocation of the left femoral head (28.06.2023).

He underwent conservative treatment at the Central Regional Hospital and was hospitalized in the Kyiv City Clinical Hospital No. 8 on 03.07.2023. Rehabilitation measures began on 04.07.2023. Surgical intervention was performed on 10.07.2023 — open reduction of fragments of the left acetabular fossa, metal osteosynthesis of the fracture with a plate and screws. Evaluation of results according to the Harris scale: after 3 months — (79.12 ± 2.41) points, after 6 months — (83.02 ± 3.84) , after 12 months — (85.42 ± 3.12) .

Clinical case No. 2

A 60-year-old patient G. was treated in the conditions of the Communal Non-Profit Establishment of Kyiv Regional Council “Kyiv Regional Clinical Hospital”. She received the injury as a result of a fall from a height on 03.12.2021. Diagnosis: closed fracture of the posterior wall of the left acetabular fossa with displacement. Hospitalized to the CNP KRC “Kyiv Regional Clinical Hospital” on 03.12.2021. Rehabilitation measures were started on 04.12.2021.

Table 3
Analysis of the influence of the timing of the surgical intervention on fracture reduction

Duration of surgery (number of days)	Patient distribution	Frequency of anatomical reduction
Up to 7	36 (81.8 %)	34/36 (94.4 %)
7–21	5 (11.4 %)	3/5 (60.0 %)
21 and more	3 (6.8 %)	1/3 (33.3 %)
p (χ^2)	—	p = 0.002*

Note. P (χ^2) is a comparison between groups (* — the difference is statistically significant).

Table 4
Results of the study of the patterns of development of aseptic necrosis

Day of dislocation reduction	Patient distribution	Frequency of initial signs of ANFH	Necrosis index (Koo and Kim)		
			A	B	C
First	11 (57.9 %)	8/11 (72.7 %)	6 (54.5 %)	2 (18.2 %)	—
Up to 3	5 (26.3 %)	5/5 (100.0 %)	1 (20.0 %)	4 (80.0 %)	—
3–26	3 (15.8 %)	3/3 (100.0 %)	—	2 (66.7 %)	1 (33.3 %)

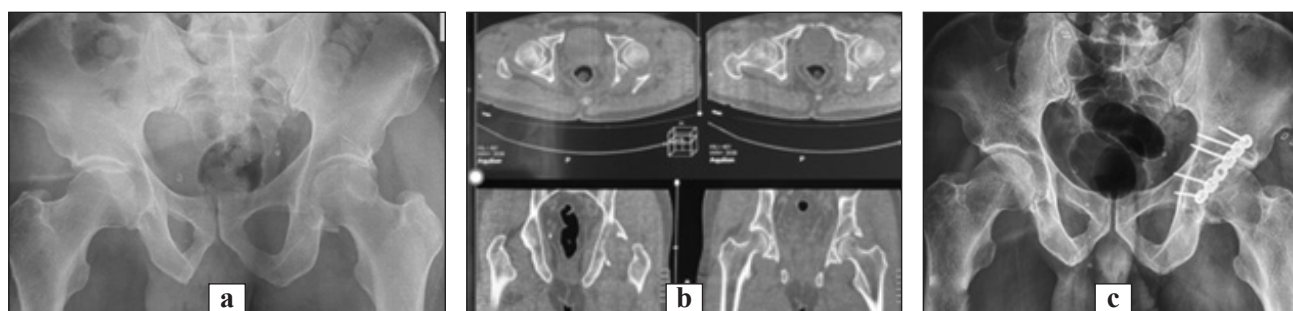


Fig. 3. Radiographs and CT scans of the posterior acetabular fracture of patient Z.: a), b) fracture of the posterior wall of the left acetabular fossa; c) condition after osteosynthesis of the acetabular fossa with a plate and screws

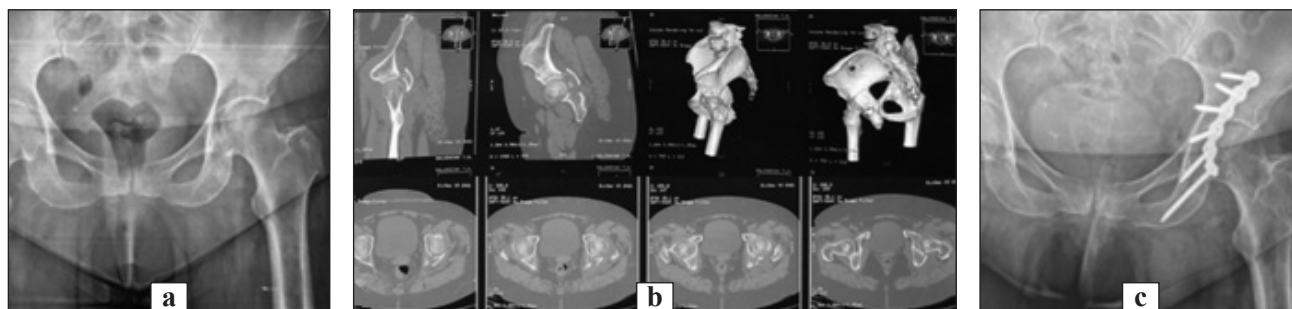


Fig. 4. Radiographs and CT scans of the posterior acetabular fossa fracture of patient G.: a, b) fracture of the posterior wall of the left acetabular fossa; c) condition after osteosynthesis of the acetabular fossa with a plate and screws

Surgery was performed on 06.12.2021 — open reduction of fragments of the left acetabular fossa, metal osteosynthesis of the fracture with a plate and screws. Evaluation of results according to the Harris scale: after 3 months — (80.02 ± 2.11) points, after 6 months — (83.21 ± 3.78) , after 12 months — (88.62 ± 5.37) .

Conclusions

The effectiveness of surgical treatment of patients with fractures of the posterior wall of the acetabulum is influenced by closed removal of the dislocation of the femoral head and surgical intervention at the earliest possible date with restoration of normal anatomy of the joint, stable fixation of the fracture. The statistical analysis showed that removal of the dislocation of the femoral head on the first day after the injury reduces the risk of aseptic necrosis by 26.3 % compared to a later date of removal of the dislocation. When surgical intervention is performed within the first 7 days after the injury, the possibility of achieving anatomical reduction of the fracture is 94.4 %, while if the intervention is performed within the period of 7–21 days or more, it is 60 and 33.3 %, respectively.

The proposed rehabilitation program for the main group: therapeutic exercises, cryo- and TENS-therapy, myofascial release, soft tissue mobilization (elastic floss tape, blade), a set of therapeutic exercises with Thera-band, on spheres and hemispheres contributed to the restoration of functional indicators in the hip joint according to the Harris Hip Score scale in comparison with the control group after 3 months by 12 and after 6 months by 10.7 %.

Conflict of interest. The authors declare the absence of a conflict of interest.

Prospects for further research. In the future, research on optimizing the comprehensive treatment of patients with hip joint damage is of interest.

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Authors' contribution. Ankin M. L. — concept and design, collection and processing of materials, editing of the text; Ladyka V. O. — analysis of the received data, editing of the text; Glynyana O. O. — analysis of the received data, writing and editing of the text; Barylovych M. M. — analysis of the received data, writing and editing of the text.

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THE EFFICIENCY OF SURGICAL TREATMENT AND REHABILITATION IN THE RECOVERY OF PATIENTS WITH A CETABULAR POSTERIOR WALL FRACTURES

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