

REHABILITATION OF PATIENTS WITH UNSTABLE PELVIC RING INJURY IN POLYTRAUMA IN THE EARLY POSTOPERATIVE PERIOD

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BACKGROUND	<p>The relevance of such an issue as the treatment of patients with unstable pelvic ring fracture is caused by the high frequency of this pathology in the general structure of polytrauma - up to 34% and a high rate of poor functional treatment outcomes - up to 20%.</p> <p>Purpose of the study: the improvement of rehabilitation treatment in patients with polytrauma operated on for complex fractures of the pelvis, using mechanotherapy and electro stimulation in the complex of therapy of an early postoperative period.</p>
MATERIAL AND METHODS	<p>There were 81 patients with severe pelvic ring injuries treated in N.V. Sklifosovsky Research Institute for Emergency Medicine in 2010 - 2013. The main group consisted of 29 patients who were recommended a comprehensive methodology of rehabilitation, including therapeutic exercises (TE), mechanotherapy using the simulator "RECK MOTomed letto2" and electro stimulation using the "Galatea" apparatus. The comparison group consisted of 52 patients who underwent rehabilitation treatment only by methods of therapeutic exercises. Overall effectiveness of the treatment was evaluated using the Majeed score.</p>
CONCLUSION	<p>Early use of therapeutic exercises in combination with mechanical therapy and electrical stimulation in patients operated on for unstable pelvic ring injuries, helps reduce pain syndrome, shortens the period of bed rest from 17.5 to 7.6 days and the duration of hospital stay from 46.1 to 35.2 days. At the same time, the 14.1% increase of excellent and good functional outcomes based on Majeed score is registered.</p>
Keywords:	rehabilitation, polytrauma, fractures of pelvic bones, mechanotherapy, electro stimulation.

EF – external fixator

THE RELEVANCE

Damage to the pelvic ring constitutes 27–34% of the total number of victims in the overall structure of polytrauma [1-3]. Mortality in this type of damage reaches sufficiently high rates, and according to different authors it ranges from 6.1 to 8.5% [2, 4]. The frequency of poor functional outcomes of patients with this injury reaches 15–20%, and the duration of their stay in the hospital is very long [5]. The unrepaired pelvic deformation leads to permanent disability in more than 65% of the patients.

Unsatisfactory results of treatment of patients with severe unstable pelvic injuries in polytrauma have several reasons. Unreasonable refusal of surgical stabilization of the pelvis with an external fixator in the early stages of treatment is among major reasons [6–8]. Another reason for poor outcomes is failure to eliminate displacement of bone fragments and the joints of the pelvic ring timely, which leads to deformation of the pelvis, the development of degenerative processes in the hip joints, secondary functional disorders of statics and dynamics [9, 10].

Recent advances in traumatology and anesthesiology allow surgical interventions in this category of injured in the earlier periods after trauma to be performed which speed up activation of patients on the one hand, and set new challenges for implementation of appropriate methods of rehabilitation treatment, leading to a decrease in rates of complications and terms of disability [9, 10].

The purpose of this work: the improvement of rehabilitation treatment in patients with polytrauma operated on for complex fractures of the pelvis, using mechanotherapy and electro stimulation in the complex of therapy of an early postoperative period.

MATERIALS AND METHODS

We treated 81 patients aged 21 to 60 years with severe unstable pelvic ring fractures in polytrauma in a hospital emergency room during the period from 2010 to 2013. The patients were divided into two groups: the comparison group and the main group, depending on the method of rehabilitation. All patients received **conventional rehabilitation therapy**, which included physiotherapy. Together with physiotherapy, mechanic therapy and electrical stimulation were included into restorative treatment for the main group. This group consisted of 29 patients (average age 34.1 ± 11.5). The comparison group consisted of 52 patients (average age 36.4 ± 10.3), whose rehabilitation treatment was performed using a standard methodology. The following table shows the distribution of patients by groups of multisystem injuries according to the classification of polytrauma proposed by V.A. Sokolov (2006). The table shows that patients in both groups are comparable in severity of the injury.

Fig. 1 shows a radiography image of a patient A. with unstable pelvic fracture before and after the surgery.

The tactics of treatment was determined by the most life-threatening injury. First of all, surgical treatment of injuries of the chest and abdomen with signs of intracavitary hemorrhage was performed. Then, the external fixator was applied (EF) on the bones of the pelvis. After finishing the surgeries mentioned above, operations for traumatic amputations, fractures of limbs and extensive soft tissue injuries were performed. With the stabilization of the general condition of the patient, EF was dismantled and internal osteosynthesis techniques were carried out (usually on the 3rd–10th day). Some patients were treated with the EF until the very consolidation of the fracture.

Rehabilitation treatment of patients started in the intensive care unit, usually on the 2nd–3rd day after the primary fixation of the pelvic bones and stabilization of the general condition.

All patients underwent physiotherapy, experiencing progressively increasing load, which is sequential from class to class, increasing physical activity and exposure to physical exercise throughout the course of rehabilitation with the use of static and dynamic, respiratory and general developing exercises for all muscle groups. On the first 2–3 days, ideomotor exercises (mental motion replay), active movements of toes, isometric tension of leg muscles, hip, flexion and extension of the knee were widely used to restore the function of the lower extremities (Fig. 2).

Then, if the condition permitted, the range of exercises was widened, extensive alternate and simultaneous movements of the joints of the lower extremities, involving the hip joints where possible, isometric tension in the muscles of the pelvic girdle were performed (Fig. 3).

As a patient recovered, sessions were supplemented with resistance exercises and weight training exercises. When a patient was put in an upright position, he started training to walk with crutches.

Patients of the main group were additionally given mechanic therapy and electrical stimulation. Mechanotherapy was performed 1–2 h after physiotherapy using therapeutic simulator *RECK MOTomed letto-2*. Physiotherapy is both active and passive form of kinesiotherapy and represents the use of special devices and appliances with a view to facilitate the implementation of any movement (robotized mechanical therapy) and to strengthen the motor system by increasing exercise intensity (active mechanical therapy). Controlled, rhythmically repetitive exercise on special simulators allow to restore mobility and range of motion in the joints, facilitate movement and increase muscle strength, improve overall physical performance.

Mechanotherapy was performed in a patient lying in bed, both in passive (due to electric veloergometer), and active positions. Mechanotherapy parameters were selected individually, starting with the minimum load, with its gradual increase throughout the course of treatment. The first session was conducted in the passive position for 15 minutes at a speed of 3–5 rotations per minute. With 2–3rd procedure, patients began to work on the simulator in the active position; the speed was 15–20 rotations per minute, the duration was 15–20 minutes. The number of procedures per course was from 10 to 12. Fig. 4 shows the procedure of mechanotherapy in the intensive care unit.

Electrical stimulation procedures were performed according to the severity of pain. If a patient worried about the pain in the morning before physiotherapy, the electrical stimulation was performed before physiotherapy. If the pain appeared after physiotherapy or mechanical therapy, the electrical stimulation was performed immediately after the relevant procedures. When the pain syndrome was low, electrical stimulation was performed 1–2 hours after mechanical therapy. We used apparatus "Galatea" (Russia) EMC-4/400-1. The electrodes were arranged in such a way as to affect the muscles of the thigh, pelvic girdle, abdomen, and back muscles. Frequency of bipolar pulses was 100–125 Hz. Amperage was selected individually, gradually increasing to a subjective feeling of painless muscular contractions by a patient. The duration of electrical stimulation was 15 minutes, 1 time per day; the total number of procedures was 8–10 for the course.

The requirement for physiotherapy, mechanotherapy and electrical therapy was the performance of Doppler ultrasound of lower limb vessels, since the detection of floating thrombi makes sessions contraindicated. If the clot is fixed or in the process of recanalization, the above procedures are carried out. Moreover, the systolic blood pressure in patients prior to and during the procedure should not exceed 160 mmHg.

The effectiveness of the treatment was evaluated by the integrated *Majeed* score [11], taking into account the following criteria: pain, walking and sitting, working capacity, sexual activity. When the total score is 100–85 the result is considered excellent, 84–70 – good, 69–55 – satisfactory, less than 55 – unsatisfactory. Moreover, the range of motions was measured at the hip with a standard goniometer, before regenerative treatment and over time. The obtained results were subjected to statistical processing by conventional methods. Statistically significant difference was determined by χ^2 , while differences at $p < 0.05$ were considered reliable.

Pain syndrome was assessed by numeric rating scale (*NRS*), consisting of values from 0 to 10. Patients rated their pain from 0 (no pain) to 10 (maximum possible pain). Statistical significance of differences was determined by the Mann — Whitney U-test, and the differences were considered statistically significant at $p < 0.05$.

THE RESULTS

Clinical observations have shown that all patients unwillingly began to move for fear of "hurt themselves" before exercises. After the first session the fear decreased, the patient began to move more actively, perform basic activities of daily living. However, in the main group of patients, mechanotherapy and electrical stimulation caused more positive emotional response and increased the motivation for further exercising.

Analysis of pain using *NRS* score prior to restorative treatment revealed that the majority of patients of main and comparison groups corresponded to the level of pain scores 6–7 (93% and 94% respectively). Two patients of the main group and three patients in the comparison group assessed the level of pain in 10 points. After electrostimulation, 86% of patients of the main group noted a decrease in pain within 1.5–2 hours after the procedure by 1–2 points. At the end of treatment in 69% of patients of the main group, the pain level decreased to 3–4 points, in 27.5% – up to 5 points and in 1 patient (3.5%) it was maintained at the level of 8 points. During this period, 50% of the patients from the comparison group had pain level of 3–4 points, in 46.2% – 5 points, and 2 patients (3.8%) – grade 7–8 according to *NRS* ($p < 0.05$).

Complex method of rehabilitation treatment helped restore a more active range of motions in the joints involved. After the first treatment, we did not observe a significant increase in range of motions, but after 5–7 days of sessions the amplitude of flexion in the hip increased by $22.4 \pm 6.5^\circ$ in the main group. The increase of the range of motions in the hip joint was significantly lower and amounted to 15.2 ± 5.8 ($p < 0.05$) in patients of the comparison group.

Inclusion of mechano-electrical therapy into rehabilitation contributed to the restoration or maintenance of intestinal motility. After 2–3 procedures of mechanical and electro stimulation the stool was normalized in patients of the main group. Most of the patients in the comparison group had to resort to use laxatives or microclysters occasionally.

Reduction of pain, positive emotional state and an increase in the amplitude of painless motion in the hip joints led to the fact that the patients of the main group practiced therapeutic exercises more actively. As a result, they began to sit up in bed and get up relying on crutches on the 3rd–4th day (Fig. 5).

The average term bed rest in the main group was 7.6 ± 4.1 days, and in the comparison group – 17.5 ± 9.7 ($p < 0.05$).

Patients of the main group started walking unassisted in the pelvic bandages with additional support on crutches on the 6–8th day (Fig. 6), and in comparison group – on the 12–16th day.

Analysis of the functional results of the treatment using the *Majeed* score in 2 groups showed a statistically significant increase of excellent and good results in the main group compared with the comparison group (from 65.3 to 79.3%) and a decrease of unsatisfactory results from 11.5 to 6.8% ($p < 0.05$).

Early use of progressive physical therapy, increasing the load in conjunction with the procedures and electrical neurostimulation and mechanotherapy in patients with unstable pelvic fractures allowed them to switch to the advanced activity and reduce the duration of hospital rehabilitation phase by 1.3 times compared to the comparison group. The average hospital stay was 35.2 and 46.1 days in the main group and in the comparison group, respectively ($p < 0.05$).

CONCLUSION

Comparative analysis of the results of treatment of patients of the main and comparison group with unstable pelvic injuries showed that early use of therapeutic exercises in conjunction with the electrical stimulation and mechanical therapy reduced pain, helped restore range of motions in the hip joints and shortened bed rest from 17.5 to 7.6 days. This has led to an increase of excellent and good results in 14.0% and a decrease of poor results by 4.7% ($p < 0.05$). Coordinated work of surgeons, trauma and rehabilitation treatment specialists has reduced the length of hospital rehabilitation phase by 10.9 days on the average ($p < 0.05$).

Table

Distribution of the injured with complex pelvic fractures by groups of associated trauma

Leading damage	Main group		Comparison group	
	n	%	n	%
Multisystem chest injury	8	27.6	16	30.8
Multisystem abdominal trauma	4	13.8	4	7.7
Multisystem injury of the musculoskeletal system	7	24.1	17	32.7
Multisystem injury of two and more areas	10	34.5	15	28.8
Total	29	100	52	100

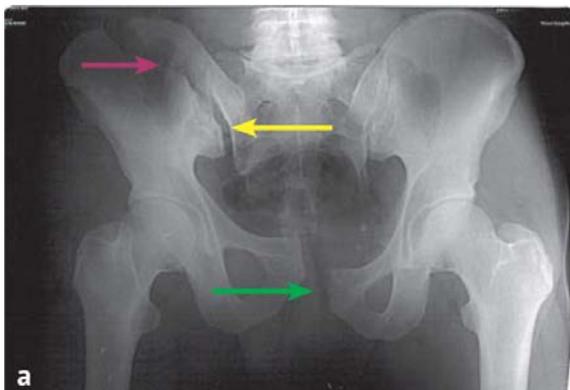


Fig. 1. Radiography image of the patient with unstable pelvic fractures: *a* – before surgery, *b* – after surgery



Fig. 2. Therapeutic exercises in the intensive care unit: the third day after surgery



Fig. 3. Therapeutic exercises in the intensive care unit: 5th day after surgery



Fig. 4. Mechanotherapy in the intensive care unit



Fig. 5. Patient A – 4th day after application of an external fixator



Fig. 6. Controlled walking with crutches

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