Original articles

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Long-term outcomes of surgical treatment of patients with acetabular fractures

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Objective To review long-term outcomes of surgical treatment of patients with acetabular fractures using an original outcome assessment questionnaire. **Material and methods** The study included 79 patients with acetabular fractures. The patients' age ranged from 16 to 67 years. Long-term follow-ups were evaluated with an original questionnaire measuring pain intensity, timings of primary surgery, reoperations including total hip replacement, technical details, accuracy of bone reduction/residual displacement and extent of restricted working capacity. **Results** Good and satisfactory long-term outcomes of acetabular fractures repaired with a primary surgery performed 22.7 ± 5.7 days of injury were observed in 43 (54.4 %) patients with complete bone reduction or 1–2 mm of residual displacement. Severe posttraumatic coxarthrosis, complications (avascular necrosis of the femoral head) or incomplete bone reduction with residual displacement of 2 mm to 2 cm detected in 36 (45.6 %) patients were rated as a poor outcome and required total hip replacement. **Conclusion** An active surgical approach to acetabular fractures employing open reduction and arthroplasties has shown to provide a good rehabilitation effect even for neglected cases with adequate restitution of the hip joint congruence ensured.
Keywords: acetabulum, fracture, surgical treatment, long-term result

INTRODUCTION

Acetabular fractures constitute about 25 % of all pelvic injuries and result from high-energy trauma or polytrauma sustained in a motor vehicle accident (40–76 %) or a fall from a height (up to 11 %). Acetabular fractures primarily occur in young men and are associated with significant medical and social problems, high morbidity and mortality rate. These injuries, therefore, can be life threatening and result in long-term disability due to residual deformities, malunions, nonunions, persistent subluxation/dislocation of the hip joint, incongruent articular surfaces and poor outcomes of surgical treatment. Acetabular fractures can have long-term consequences for health-related quality of life due to progression of hip joint degeneration and associated pain, impaired mobility, lower limb shortening; sciatic neuropathy, avascular necrosis of the femoral head, intra-articular bone displacement and pelvic heterotopic ossification[1–6].

Failure to timely diagnose an acetabular fracture and provide early surgical treatment within at least 10 days, application of nonsurgical modalities (skeletal traction, plaster cast) due to the severity of the condition, the complexity in restitution of topographic and anatomical relationships in the hip joint can often result in poor outcomes of surgical repair that are reported to be as high as 20-25 % even with the congruence achieved in the joint and treatment provided at specialized trauma wards. This can also be caused by delayed reduction of the femoral head, arthritic hip, a variety of fracture patterns, excessive body weight and qualification of operating surgeons [7–9].

Although total hip replacement (THR) is the method of choice for acetabular fractures due to the limited functionality of hip arthrodesis and eventually decompensated function in the lumbar-sacral spine and the knee joint it does not always allow primary stability of the acetabular component with the use of the cement, augmentation, bone auto- and allografts, fixation with reconstructive plates and screws, the Müller acetabular reinforcement rings, Burch-Schneider cages. The timing of reduction with standard techniques can be also limited due to scarring and stiffness at two weeks of injury [10–16].

Surgical treatment of acetabular fractures with adequate choice of surgical approach has evolved into the treatment of choice to obtain an anatomic reduction and functional outcome and allow faster rehabilitation of the patients [17].

Objective of the study was to review long-term outcomes of surgical treatment of patients with acetabular fractures using an original outcome assessment questionnaire.

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MATERIAL AND METHODS

The study included 79 patients with acetabular fractures surgically treated at the trauma and orthopaedic department № 1 at the Saratov State Medical University hospital (headed by A.G. Chibrikov, PhD) between 2010 and 2018. The monocentric study was a prospective review of long-term follow-ups. There were 69 (87.3 %) male and 10 (12.7 %) female patients. The patients' age ranged from 16 to 67 (38.4 ± 1.6) years. The patients matched by age with the mean age of 39.6 ± 11.8 years in males and 36.2 ± 8.3 years in females. The mechanism of injury included road traffic accidents (83.5 %), a fall from a height (14 %) and others (2.5 %). Comprehensive diagnostic workup consisted of polyprojectional radiography, the anteroposterior pelvic radiograph made with the patient supine on the x-ray table with both lower extremities oriented in internal rotation. A computed tomography scan was also helpful in some cases to confirm a suspected diagnosis with horizontal and vertical profiles.

AO [8] type A acetabular fractures were detected in 27 patients (34.2 %); AO type B, in 45 (57 %) and type C, in 7 (8.8 %). Posterior dislocation of the femoral head was diagnosed in 24 (30.37 %) cases and central dislocation, in 13 (16.45 %) patients. Surgical intervetion was performed on day 1 to 8 months following trauma with the mean time to surgery 49 ± 12.2 days. Posterolateral approach to the acetabulum (Kocher-Langenbeck) modified by Iselin with fixation of the posterior column with reconstructive plates was employed in 78 (98.73 %) patients [9]. Anterior and posterior approaches to the acetabulum were used in one case (1.27 %) [9].

Long-term follow-ups were evaluated at the end control point individually for each patient using an original questionnaire with the total score from 0 to 9 measuring pain intensity (from 0 to 3 – 0 point; 4 to 7 – 1 point; 8 to 10 – 2 points), timings of primary surgery (acute period – 0 point; longer term – 1 point), quality of bone reduction (complete bone reduction – 0 point; residual displacement up to 2 mm – 1 point; residual displacement of more than 2 mm – 2 points), reoperations (none – 0 point; reoperation performed – 1 point) including the use of acetabular reinforcement rings (none – 0 point; the ring used – 1 point), disability (none – 0 point; assigned – 1 point). The total score of 0 to 2 indicated to a good outcomes, 3 to 4, a fair result and 5 to 9 meant a poor outcome. Radiological evaluation of acetabular consolidation, quality of bone reduction/residual displacment and function of the lower limb girdle was also considered for the assessment of long-term outcomes in addition to the total score of the questionnaire. The outcome was rated as good with no complaints, functional impairment of the lower limb and radiological changes in the hip joint; as fair, in presence of discomfort with the gait at a longer distance, limited range of motion by 15–20 %, signs of early stage I coxarthrosis without fast progression, general patient satisfaction, absence of disability with no need of further rehabilitation. Severe, rapidly progressing joint degeneration (coxarthrosis stages III and IV), avascular necrosis of the femoral head, acute pain, persistent contractures that needed correction with THR indicated to a poor outcome. The data were summarized using the arithmetic mean and error of the arithmetic mean.

RESULTS

Good and fair results were recorded in 43 (54.4 %) patients following primary reconstructive procedures (osteosynthesis) performed for acetabular fractures at a long term. Good results were seen in 18 (22.8 %) patients with complete bone reduction or residual displacement of less than 2 mm (n = 14) and incomplete bone reduction and residual displacement of more than 2 mm (up to 5 mm) (n = 4). The patients underwent surgical treatment at 22.7 ± 5.7 days of injury.

Fair results were recorded in 25 (31.6 %) patients with complete bone reduction and residual displacement of less than 2 mm (n = 8) and incomplete bone reduction and residual displacement of more than 2 mm (up to 5 mm) (n = 17). The patients underwent surgical treatment at 37.1 ± 9.3 days of injury.

A clinical instance is presented to demonstrate a good long-term result of surgical treatment (osteosynthesis) of acetabular fractures with no reoperation required. A patient P., born 1959, diagnosed with acetabular fracture on the left AO type A 3.1 (fracture of the anterior wall and the anterior column) was admitted to the trauma and orthopaedic department №1 at the Saratov State Medical University hospital in 2012. The patient sustained acetabular injury in a fall playing football. Skeletal traction to the left tibial tubercle and nonopertaive treatment were provided at a municipal hospital. He was referred to the University hospital after 6 days. Computerized tomography scan of the pelvis performed on admission showed a fracture of the anterior wall and the anterior column of the acetabulum (Fig. 1). Posterolateral approach to the acetabulum (Kocher-Langenbeck) modified by Iselin was used for open reduction and osteosynthesis of the acetabulum with a reconstructive plate and screws next day of admission/8 days of injury (Fig. 2).

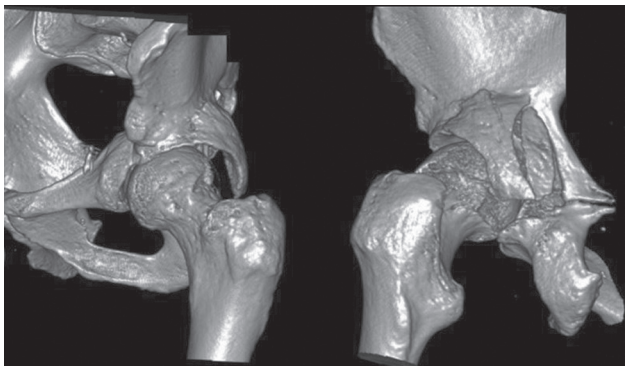

Fig. 1 CT scan of the left hip joint of patient P., born 1959, showing AO type B 1.3 acetabular fracture on the left

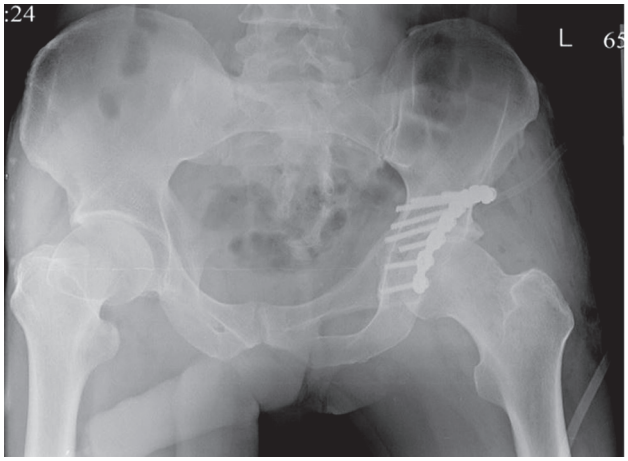

Fig. 2 Anteroposterior view of the pelvis and the hip joints of patient P., born 1959, showing bone fixation 6 days following surgical intervention

Skeletal traction with the weight of 5 kg was applied at the hospital to unload the acetabulum. The patient was discharged from the hospital being in a satisfactory condition 6 days after surgical intervention. He presented neither complaints nor functional impairment at a follow-up visit in 2017. Radiographs showed consolidated fracture of the left acetabulum and stable fixation with the metal construct (Fig. 3).

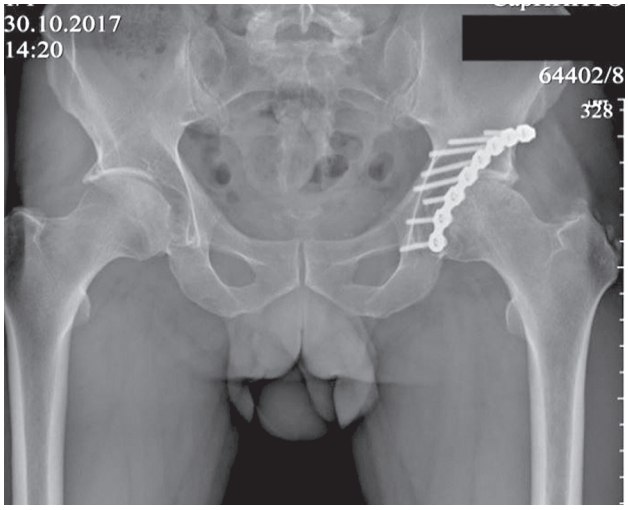

Fig. 3 Anteroposterior view of the pelvis and the hip joints of patient P., born 1959, showing consolidated acetabular fracture at a 5-year follow-up

The questionnaire score of 0 corresponded to a positive patient response at a long term. The patient did not want to get the metal construct removed.

Severe posttraumatic coxarthrosis was observed in 36 (45.6 %) cases that were rated as a poor long-term result and required THR. Five patients developed no clinical and radiological signs of the femoral head dislocation, and 31 had neglected dislocation of the femoral head (21 posterior and 10 central involvement) that resulted in avascular necrosis of the femoral head in 21 cases. These patients received surgical treatment at 69 ± 11.2 days. Complete bone reduction was successful in 12 cases following primary surgical intervention and the rest 24 patients had residual bone displacement measuring from 2 mm to 2 cm due to an old injury and evident traumatic defects. Acetabular reconstruction performed prior to THR allowed us to avoid using reinforcement rings that were impractical for younger patients. However, Burch-Schneider cages were used in 8 (10.1 %) cases following osteosynthesis of the acetabulum due to severe sectoral defects.

There is a clinical instance to demonstrate a poor long-term result of surgical treatment (osteosynthesis) of acetabular fracture that finally required THR. A patient Sh., born 1963, diagnosed with acetabular fracture on the left AO type B 1.3 (transverse fracture and fracture of the posterior wall) was admitted to the trauma and orthopaedic department №1 at the Saratov State Medical University hospital in 2012. The patient sustained acetabular injury in a balloon explosion accident being trapped under concrete slab. He was treated nonsurgically at a local hospital. He was referred to the University hospital after his burns had healed. Computerized tomography scan of the pelvis performed on admission showed an acetabular transverse fracture and fracture of the posterior wall (Fig. 4).

Fig. 4 CT scan of the left hip joint of patient Sh., born 1963, showing AO type B 1.3 acetabular fracture on the left

Posterolateral approach to the acetabulum (Kocher-Langenbeck) modified by Iselin was used for open reduction and osteosynthesis of the posterior wall acetabulum with a reconstructive plate

and screws next day of admission/41 days of injury. Complete reduction was successful (Fig. 5).

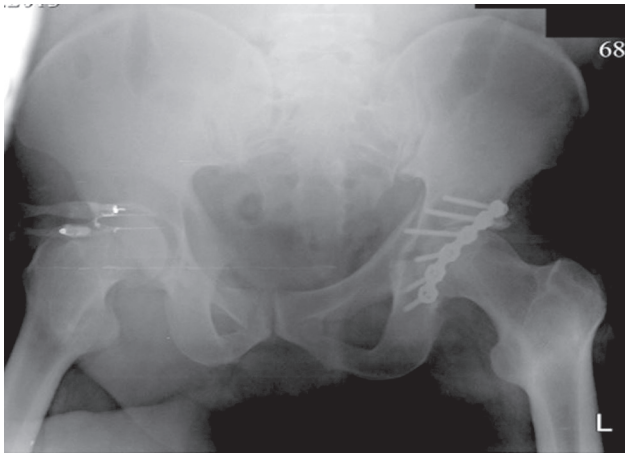

Fig. 5 Anteroposterior view of the pelvis and the hip joints of patient Sh., born 1963, showing bone fixation 7 days after surgical intervention

Skeletal traction with the weight of 5 kg was applied at the hospital to unload the acetabulum. The patient was discharged from the hospital being in a satisfactory condition 7 days after surgical intervention. Radiographs (Fig. 6) produced at 4 months showed avascular necrosis of the femoral head. He reported pain, impaired quality of life and presented with shortening of the left lower limb and contracture of the hip joint. The questionnaire score of 5 corresponded to a poor outcome of surgical treatment. The patient had the metal construct removed at 3 months and underwent THR (Fig. 7).

The patient experienced slight discomfort with the gait at a longer distance, limited range of motion in the hip joint, reported satisfaction with no need of further rehabilitation at a follow-up visit. The questionnaire score of 4 corresponded to a satisfactory outcome of surgical treatment of acetabular fracture.

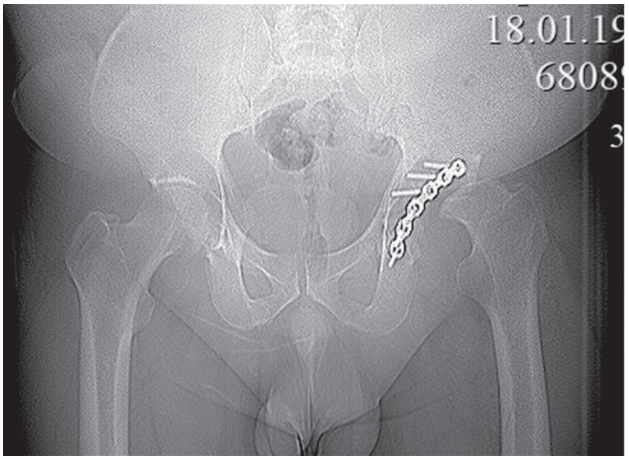

Fig. 6 Anteroposterior view of the pelvis and the hip joints of patient Sh., born 1963, showing osteosynthesis of the acetabulum at a 4-month follow-up

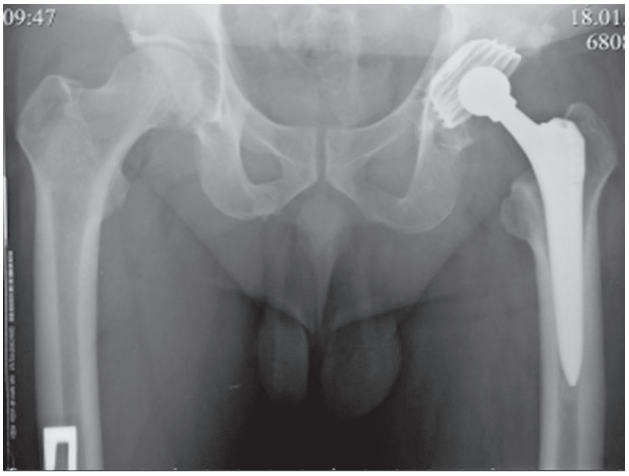

Fig. 7 Anteroposterior view of the hip joint of patient Sh., born 1963, showing THR at 3 months following arthroplasty

DISCUSSION

Surgical approaches for exposure of an acetabular fracture commonly include ilifemoral (Smith-Petersen-Levine) and ilioinguinal approaches. We cannot support the approaches due to traumatic involvement of the posterior and superior posterior portions of the acetabulum resulting from mechanisms of dashboard injury sustained during motor vehicle accidents or falls on the abducted leg from height. Superior posterior portion of the acetabulum has the largest bone stock, so the recovery of the most weight-bearing area is the priority. This is also the bone bed which is to be adequate enough to amalgamate acetabular shells to address intra-articular fractures of the hip, in particular [18–22]. Anterior approaches are practical for reconstruction of the iliac crest, superior and anterior walls of the acetabulum. The anterior wall of the acetabulum is not that thick bearing less weight and its incomplete reduction has not shown to result in expressed functional and radiological distortions. Although anterior approaches allow partial visualization of the posterior column it cannot be fixed using the anterior approach. The Kocher-Langenbeck approach to the acetabulum has been found to allow good reduction maneuvres with greater bone stock of the posterior column to enable placement of instrumentation and fixation plates [23–27].

A variety of tests and questionnaires is offered to interpret long-term outcomes [28–30]. Patient reported outcome measures allow both objective (extent and severity of bony changes) and subjective (pain, claudication) quantification of the response that often correlate with each other. Anatomical parameters of the hip joint can be evaluated with a variety of

instrumentation methods, primarily, diagnostic imaging, and a comprehensive health assessment with physical exam questionnaires is a crucial component in clinical practice. The combination of the findings can be used for outcomes assessment in an orthopedic surgery practice to validate use of procedures, particularly in arthroplasty, and shape clinical decisions about best practices.

CONCLUSION

An active surgical approach to acetabular fractures has been shown to provide a good rehabilitation effect even for neglected cases. Poor long-term outcomes following primary surgical treatment of acetabular fractures can be ascribed to degenerative features in the femoral head that can develop even with good intraoperative reduction achieved and complete bone consolidation. Presence/absence of femoral head dislocation, an interval between injury and surgical intervention, extent of trauma to the articular surface of the acetabulum can play a role in a long-term outcome with the first factor being crucial for appropriate intraoperative reduction and the rest determining an extent of bone reduction. Early bone reduction can provide potentials for surgical rehabilitation in the form of primary THR with the development of severe coxarthrosis and avascular necrosis of the femoral head. Maximum recovery of bone stock in weight-bearing areas allows us to avoid reinforcement rings that appear to be impractical for younger patients.

***Conflict of interests**: The article is part of a research project of Research Institute of Traumatology, Orthopaedics and Neurosurgery, Saratov State Medical University named after V.I. Razumovsky, Saratov, on Improvement of diagnosis techniques, treatment and prevention of injuries and diseases of musculoskeletal and nerve systems. Registration number AAAA-A18 118060790019 0.*

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