DOI 10.18019/1028-4427-2020-26-2-266-274

Current trends in the surgical treatment of patients with pelvic and acetabular injuries (literature review)

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Introduction There is evidence in the literature over the past 5 years that pelvic and acetabular fractures are increasing in prevalence with the rise of injuries sustained in road traffic accidents, the growing number and severity of trauma, significant complication rate and unsatisfactory outcomes due to untimely surgical treatment. **Objective** Review current trends in the selection of surgical approaches and fixation of the pelvis and acetabulum, the postoperative rehabilitation strategies and identify factors for poor outcomes of surgical treatment. **Material and methods** We performed searches using HAC peer-reviewed and SCOPUS indexed journals, EMBASE, MEDLINE, Cochrane library, eLibrary.ru, Wiley Online Library with search criteria of pelvic fractures, displaced acetabular fractures, open reduction of the pelvis and acetabulum, osteosynthesis, minimally invasive osteosynthesis and primary total hip arthroplasty, approaches and complications of acetabular fracture surgery. **Results** Indications to surgical treatment of patients with concomitant, multiple and isolated fractures of the pelvis and acetabulum were identified with the use of current strategy and principles of damage control surgery and damage control orthopaedics. Surgical approaches for two-column acetabular fractures have been shown to be extensile and traumatic. **Discussion** Most authors report use of the active surgical strategy for displaced fractures of the pelvis and acetabulum. Open reduction internal fixation is the standard of care for pelvic and acetabular fractures. **Conclusion** Postoperative complications and long term rehabilitation of patients with pelvic and acetabular fractures support further research and development of new more effective approaches to address the solution of the challenging issue.

Keywords: osteosynthesis, minimally invasive osteosynthesis, primary total hip arthroplasty, surgical treatment, acetabular fracture

INTRODUCTION

There is evidence in the literature over the past 5 years that pelvic and acetabular fractures are increasing in prevalence with the rise of injuries sustained in road traffic accidents, the growing number and severity of trauma, significant complication rate and unsatisfactory outcomes due to untimely surgical treatment [1–6].

As the elderly population is increasing, the incidence of acetabular fractures is rising as well. D. Butterwick et al., (2015) reports that the elderly population has become the fastest growing subset of those affected by acetabular trauma and acetabular fractures demonstrated a 2.4-fold increase in patients of age 65 and older over the last quarter century [7]. Many publications report increase in pelvic and acetabular fractures [3, 8–12]. The age of patients with pelvic and acetabular fractures is reported to range between 19 and 90 years with a mean age of 51.5 years [13–18].

Objective Review current trends in the selection of surgical approaches and fixation of the pelvis and acetabulum, the postoperative rehabilitation strategies and identify factors for poor outcomes of surgical treatment.

MATERIAL AND METHODS

We performed searches using HAC peer-reviewed and SCOPUS indexed journals, EMBASE, MEDLINE, Cochrane library, eLibrary.ru, Wiley Online Library with search criteria of pelvic fractures, displaced acetabular fractures, open reduction of the pelvis and acetabulum, osteosynthesis, minimally invasive osteosynthesis and primary total hip arthroplasty, approaches and complications of acetabular fracture surgery. We analyzed 61 articles including 36 foreign publications and a Russian report identified in SCOPUS indexed journals (Table 1). The table does not include Web of Science (emerging sources citation index) indexed Travmatologiya Ortopediya Rossii Journal (Trauma Orthopaedics of Russia Journal).

Pelvic fractures constitute 5 to 25 % of all skeletal fractures [1, 5, 19–22] with combined injuries ranging from 30 to 58 %, and 15–30.7 % of patients suffer from associated blood loos and traumatic shock [16, 18, 19, 23–25].

Zagorodny N.V., Kolesnik A.I., Lazarev A.F., Solod E.I., Ochkurenko A.A., Bukhtin K.M., Sergeev S.V., Shesternya N.A., Donchenko S.V., Dorokhin A.I. Current trends in the surgical treatment of patients with pelvic and acetabular injuries (literature review). *Genij Ortopedii*, 2020, vol. 26, no 2, pp. 266-274. DOI 10.18019/1028-4427-2020-26-2-266-274

Pelvic and acetabular fractures are usually caused by significant trauma, such as motor vehicle accidents (70.4 %) or falls from height (21.3 %) [12, 16, 26, 27]. Reza Firoozabadi et al. (2017) retrospectively reviewed 1123 acetabular fractures and 156 of them were sustained by patients over the age of 65 (average age of 78). Falls and motor vehicle accidents account for the two most common mechanisms of injury [16]. Multiple and combined injuries to the pelvic ring are most challenging with the incidence of 80 % [4, 8, 23, 26]. Concomitant injuries are reported in 60 to 91 % of patients with unstable pelvic fractures [8, 16, 19, 28, 29, 30] with disability and mortality observed in 59.0 % and 10 to 75.0 % of the cases, respectively [3, 6, 10, 14, 24].

An algorithm of current approach to the treatment of combined pelvic injuries has been developed with use of the strategy and principles of damage control surgery and damage control orthopaedics [18, 19, 31] to facilitate individual approach for specific patient population. The application of external fixation and C-clamp has become an integral part of blood loss treatment prophylaxis of disseminated intravascular coagulation syndrome and fat embolism [5, 29, 32].

The incidence of acetabular fractures is reported to range between 2 and 18.3 % [1, 19, 28, 33] and from 18 to 23.4 % [5, 26]. Motor vehicle crashes are the most common cause of acetabular fractures [19, 21, 22, 27] that occur in 83 % of the cases following a high energy trauma [1, 12, 18, 19, 21, 22]. T.A. Ferguson et al. (2010) reported 82 % (884) of acetabular fractures occurring from a high energy injury among 1072 acetabular fractures sustained by younger and adult patients [30]. Acetabular fractures have a bimodal distribution. High energy trauma accounts for the majority of fractures in young patients, while low energy trauma is primarily responsible for these injuries in elderly patients [6]. Acetabular fractures from low energy trauma are rare and mostly seen in elderly patients [6. 22].

Table 1

List of SCOPUS indexed journals

#	Authors	Scopus
1	Bondarenko A.V. et al. (2014)	Polytrauma
2	Neil R Sardesai et al. (2017)	Orthopedic Research and Reviews
3	Butterwick D et al. (2015)	J Bone Joint Surg Am
4	Чегуров О.К., Менщиков И.Н. (2018)	Гений ортопедии
5	Borg T. et al. (2019)	Bone Joint J
6	Kempland C. Walley et al. (2017)	Eur J Orthop Surg Traumatol.
7	Stibolt, R. D. et al. (2018)	Chinese Journal of Traumatology
8	Verbeek DO et al. (2018)	Injury
9	Rickman M. et al. (2012)	Eur J Trauma Emerg Surg
10	Lont, T. et al. (2019)	Acta Orthopaedica
11	Brun J. et al. (2019)	Injury
12	Kubota M. et al. (2015)	Arch Phys Med Rehabil
13	Ferguson T.A. et al. (2010)	J Bone Joint Surg. Br.
14	San-Bao Hu et al. (2012)	J. Chin. Med. J.
15	Letournel E. (1993)	Clin. Orthop. Relat. Res
16	Judet R. et al. (2012)	J Bone Joint Surg Am
17	Letournel E. (1980)	Clin. Orthop. Relat. Res
18	Butler, Bennet A. et al. (2019)	Journal of Orthopaedic Trauma
19	Butler, Bennet A. et al. (2019)	Journal of Orthopaedic Trauma
20	Liu ZJ, et al. (2017)	Orthop Surg.
21	Deng C., Ni W et al. (2018)	Zhonghua Wai Ke Za Zhi (Chinese)
22	Erem M. et al. (2019)	Nigerian journal of clinical practice
23	Frietman B. et al. (2018)	Bone Joint J
24	Meesters A.M.L. et al. (2019)	PLOS ONE
25	Leyi Cai et al. (2017)	International Orthopaedics
26	Tornetta P. (1999)	J. Bone Joint Surg. Br.
27	Li C.L. et al. (2014)	Eur Rev Med Pharmacol Sci
28	Mehdi Boudissa et al. (2019)	Aging Clinical and Experimental Research
29	Christine Tempelaere et al. (2019)	Arthroplasty Today
30	Boelch S.P. et al. (2016)	International Orthopaedics
31	Wang P. et al. (2016)	SpringerPlus
32	Wael Salama et al. (2016)	International Orthopaedics
33	Faizan Iqbal et al. (2018)	European Journal of Orthopaedic Surgery Traumatology
34	Necmettin Salar et al. (2017)	Ulus Travma Acil Cerrahi Derg
35	De Bellis UG. et al. (2014)	Injury
36	Sheth, H. et al. (2016)	Chinese Journal of Traumatology
37	McDowell S. et al. (2012)	Orthopedics

Acetabular and pelvic fracture classification systems developed by Judet R., Judet J., E. Letournel, M. Tile, AO/ASIF foundation have been used by the authors of the above publications [9, 28, 33, 34, 35, 36]. The AO/ASIF classification is the most widely used classification system for pelvic and acetabular fractures [1, 4, 36, 37, 38]. M. Erem et al. (2019) classifies acetabular fractures using the classification developed by R. Judet, J. Judet, E. Letournel, whereas AO/ASIF and M. Tile system is the preferred method for describing acetabular fractrures for different authors [14, 18, 21, 27, 38, 39]. Butler, Bennet A. et al. (2019) summarize the strengths and weaknesses of the Judet and Letournel acetabular fracture classification and its place in the current understanding of acetabular fractures with the attempts to modify the system for acetabular fractures in elderly patients [36]. Donchenko S.V. and Dubov V.E. (2013) apply the Young and Burgess classification for characterization of unstable pelvic ring fractures [3]. Unstable pelvic fractures constitute about 80 % of all pelvic injuries [4, 8, 21, 36, 37, 38]. Type A injuries are encountered in 50 to 70 %, type B, in 15 to 37.5 % and type C, in 6.3 to 47.4 % [4, 21]. Unilateral acetabular injuries are observed in 80-94 % and bilateral involvement is seen in 6-18 % of the patients [24]. Butterwick D. et al. (2015) report the associated both column acetabular fractures being common in 23-26 % of the patients [7].

The diagnosis of fractures of the acetabulum and pelvis is primarily radiological and plain radiography of the pelvis and affected hip is mandatory. Further imaging in the form of 2D and 3D reconstruction CT scanning of the acetabulum and the hip is nearly always recommended to allow clearer imaging of the fracture pattern and extent of bone displacement [7, 15, 30, 40, 41, 42]. Careful evaluation of the images can help to identify all injuries, fracture stability, condition of the bony fragments and acetabular cartilage, and congruency of the hip joint [1, 7, 9, 36, 37, 38].

RESULTS

Literature review shows that surgical treatment is indicated for type B and type C pelvic fractures [9]. Immediate external stabilization of pelvic fractures becomes the first priority along with careful and thorough assessment of the patient's hemodynamic status and hemorrhagic shock [8, 31, 32, 42]. The timing of surgery on the pelvis and acetabulum is also an important consideration and associated with the patient's condition, severity of anatomical and functional impairment, length of resuscitation period and ranges between 1-3 to 34 days [31, 37, 39, 42, 43, 44]. Most of authors support early surgical treatment of the patients [16, 20, 27, 45, 46] within 6 to 10 days postinjury. Decision making regarding the timing of definitive open reduction and internal fixation (ORIF) is one of the most difficult aspects to be correlated with the type of fracture, severity of injury, the patient's functional status, the extent of surgical intervention, surgical approach and optimal anesthesia [28, 31, 42]. To assess the stability of the hip after acetabular fracture, dynamic fluoroscopic stress views [43, 44] are taken of acetabular fractures on admission or at a longer term to specify the criteria for non-operative management.

Indications for surgical management of displaced and multiplanar acetabular fractures can be absolute and relative [9, 44, 47]. Absolute indications include more than 5 mm of displafcement involving the weight-bearing dome, lost congruency (subluxation) as measured on any of the three views, fracture of the posterior wall and signs of instability, the presence of intra-articular osteochondral fragments, impaction of the articular cartilage of the acetabulum and femoral head [44]. ORIF of the pelvis can be considered as well by some surgeons. Multiple factors influence clinical outcome following an acetabular fracture, including well coordinated team of orthopaedic and trauma surgeons, a clear understanding of the code and pattern of injury based on clinical, radiological and magnetic resonance assessments, availability of image intensifier and the current internal fixation systems to facilitate anatomical reduction, stable bone fixation and blood transfusion if needed [8, 28, 31].

Borg et al. (2019) suggest that there is no consensus on whether displaced, comminuted acetabular fractures in the elderly should be treated non-surgically, surgically with ORIF, with acute total hip arthroplasty (THA) or with a combination of ORIF and acute THA, an approach called 'combined hip procedure' (CHP). The authors retrospectively reviewed a total of 27 patients with similar acetabular fractures with a mean age of 72.2 years (50 to 89) followed for a minimum of two years. In all, 14 were treated with ORIF alone and 13 were treated with a CHP [17]. Mehdi Boudissa et al. (2019) support surgical treatment of displaced acetabular fractures [46]. Kempland C. Walley et al. (2017) retrospectively reviewed 243 elderly and severely comorbid patients aged 65 to 75 years who sustained an acetabular fracture. Acetabular fractures can be associated with

high morbidity and mortality; however, no differences in outcomes of acute ORIF versus non-operative care were detected. Non-operative treatment of acetabular fractures of this cohort of patients can be the preferred option despite a somewhat longer length of hospital stay at the time of injury [14]. Christine Tempelaere et al. (2019) support acute total hip arthroplasty as the best treatment option for elderly patients [48]. Active surgical strategy in treatment of displaced acetabular fractures is also supported by many authors [3, 37, 39, 42, 44, 49]. Lazarev A.F. et al. (2013) report decrease in disability from 37.5 to 12 % due to current active surgical strategy employed [44]. An increase in disability rate is reported in patients with severe pelvic injury (from 30 to 66.7 %) [5, 8, 26, 31].

ORIF is the mainstay of surgical treatment for pelvic and acetabular fractures [35, 44, 50, 51, 52]. E. Letournel (1980) who had been experienced in treatment of acetabular fractures reported open reduction as the method of choice for displaced fractures [35]. Primary internal osteosynthesis was performed early to stabilize the pelvis of patients who were in satisfactory condition within the first two weeks [10, 28, 37, 39, 42, 43]. The timing of surgery performed for acetabular fractures ranged from 6 to 34 days postinjury [31, 37, 39, 42–44]. Lazarev A.F. et al. (2013) report good and excellent outcomes in 80 % of the cases if the surgery is performed within the first three weeks of injury (with mature scar formed) and in 65 %, if the surgery is produced after 3 weeks [44]. Some authors focus on surgical anatomical recovery of the acetabulum, and 33 % of patients show good outcomes of primary THA [27, 39, 53]. However, M. Hanschen et al. (2017) report about 25 % of acetabular fractures in the elderly who needed revision and conversion to delayed THA following ORIF [52]. S.P. Boelch et al. (2016) suggest that treating acetabular fractures with ORIF may lead to poorer outcomes in older patients [51]. Different designs of neutrilization plates and screws [8, 28, 32, 44], precurved and reconstructive pelvic plates, LC — DCP plates and other constructs are commonly used for internal osteosynthesis [2, 3, 8, 23, 54, 55]. Percutaneous cannulated screw fixation of acetabular and pelvic fractures has gained popularity as a minimally invasive technique with less surgery length [23, 43, 44, 47, 49, 50]. The technology can be applied as a standalone procedure and in conjunction with external fixation [31, 32]. Percutaneous fixation of the pelvis is indicated for fractures with disturbed integrity of the pelvic ring and minimum displacement, fractures that can be addressed with closed techniques, and complicated fractures that require combination of closed and open reduction. The operating time ranges from 20 to 40 minutes. It should be noted that percutaneous cannulated screw fixation of acetabular and pelvic fractures has advantages and limitations [9, 47].

Recent publications report controversies in the stragegy of post-ORIF care of acetabular and pelvic fractures. Patients are encouraged to sit in bed and produce active and passive gradually increasing movements in the operated hip joint starting from the first postoperative days. They are allowed to use crutches without axial loads on the operated limbs if they feel comfortable with that. Patients are normally discharged from the hospital after 12-14 days with the wounds healed and the hip joint partially recovered [9, 47]. Many authors report simultaneous application of ORIF and THA in elderly patients [18, 20, 22, 51, 56]. T. Lont et al. (2019) suggest that acute THA including a reinforcement ring results in fewer reoperations than ORIF alone in elderly patients with acetabular fractures. These findings support acute THA as first-line treatment for complex acetabular fractures in elderly patients [22]. There is a trend observed in acute THA to be common for displaced acetabular fractures [18, 48, 57] providing early mobilization and preventing bed-rest-associated morbidity. Salar Necmettin et al. (2017) report good functional outcomes in patients with acetabular fractures treated with acute TKA in appropriately selected patient population [58]. U.G. De Bellis et al. (2013) reviewed outcomes of acute and delayed primary THA in patients with acetabular fractures and found better outcomes of delayed THA that those of acute THA, although the differences were not statistically significant between the groups [59]. H. Sheth et al. (2013) reported a good outcome in an elderly patient with bilateral acetabular fracture sustained from a low enegry injury and treated with acute THA [60].

It is well accepted that the choice of operative intervention and surgical approach relies on the comprehensive classification of acetabular fractures developed the AO/ASIF Foundation based on M. Tile and E. Letournel classification [8, 16, 18, 21, 53, 61]. The Kocher-Langenbeck approach is used to repair posterior wall and posterior column of the acetabulum, and the anterior ilioinguinal exposure is applied to address posterior column of the acetabulum. Both-column fractures of the acetabulum require ORIF of anterior column using the anterior ilioinguinal exposure followed by ORIF of posterior column using the Kocher-Langenbeck approach or Y-exposure [8, 16, 18, 21, 53, 61]. E.I.Solod et al. employed the anterior ilioinguinal approach for transverse fractures and fractures of anterior column of the acetabulum, and extended approach for type C fractures [9]. Some

authors report the use of anterior ilioinguinal exposure combined with less invasive posterior approach [16, 18, 21, 37, 53, 61]. Lukas Negrin et al. (2017) appreciated the Kocher-Langenbeck approach as the gold standard for posterior exposure of the hip and posterior column of the acetabulum [21]. Wang, P. et al. (2016) and Deng C. et al. (2018) applied modified anterior ilioinguinal exposure combined with the Kocher-Langenbeck approach [37, 53]. M. Rickman et al. (2012) successfully used the Kocher-Langenbeck approach for fractures of posterior column of the acetabulum for simultaneous application of ORIF and primary THA [18]. Blood loss is reported to be associated with ORIF of posterior column being dependent on traumatic nature and extension of the approaches used and can measure from 600 to 2000 mL and over, with length of surgery exceeding 2 hours and averaging to 3 hours 50 minutes [8, 9, 18, 39, 53]. Intra- or postoperative transfusion or reinfusion system are used for blood replacement [9].

Outcomes of surgical treatment are reported to be followed up from 1 month to 12 months and over [15, 18, 28, 37, 57, 58]. Leontiev et al. (2016) used Harris Hip Score (HHS) to evaluate functional results at a month following surgical treatment of pelvic and acetabular fractures [28]. E.I.Solod et al. (2009, 2014) reviewed results of minimally invasive osteosynthesis of the acetabulum with cannulated screws at 1 year to 10 years with excellent outcomes recorded in 70 % (n = 45), good, in 19 % (n = 12) and fair in 11 % (n = 7) of patients. HHS is normally used to assess long-term outcomes of acetabular fractures [9, 28, 47, 57], outcomes of pelvic fractures are graded on the S.A. Majeed scale, less frequently on the D'Aubigné and Postele scale, Matta J.M., and the Oxford Hip Score (OHS), and Life quality scales (SF-36 scores) and its Russian version are employed to measure health-related quality of life [22, 27, 37, 38, 44, 47]. Patients are recommended to sit up in bed and walk using crutches on the second-to-seventh postoperative days to facilitate good early functional results [9, 18, 27, 47]. It should be noted that full weight-bearing on the operated joint is allowed at 6-8 months postsurgery [9, 27]. Good functional outcomes are reported in 22–81.5 % [53] at 1 to 12 months and excellent results are reported in 20 to 67 % of the cases at 1 month to 12 months following ORIF [18, 28, 37, 53]. Poor functional outcomes following ORIF are reported in 22–81.5 % at 1 to 12 months [6, 18, 19, 27, 28, 53] due to many factors including type B and type C acetabular fractures, obesity and osteoporosis. Pelvic consolidation is reported to occur at 3 to 6 months [18, 56]. Iqbal Faizan et al. (2018) recognized that all patients achieved radiological union of complex acetabular fractures at an average duration of 21 weeks [57].

Early complications associated with surgical treatment of pelvic and acetabular fractures include lower lobe pneumonia, deep vein thrombosis, fat embolism syndrome, wound infection [9, 21, 28, 47, 53]. Adverse events that can occur at a long-term follow-up include posttraumatic avascular necrosis of the femoral head and posttraumatic coxarthrosis [9, 28, 47]. It is noteworthy that primary THA is normally performed for acetabular fractures within 12 to 29 months following ORIF in 22-33 % of cases [9, 28, 40, 47] due to posttraumatic coxarthrosis and avascular necrosis of the femoral head.

DISCUSSION

Pelvic and acetabular fractures are reported to increase in prevalence in the past years with the rise of injuries sustained in road traffic accidents and the growing number and severity of trauma [1, 2, 3, 4, 6, 7].

Motor vehicle crashes are the most common cause of pelvic fractures [19, 21, 22, 27] that occur in 70.4 % of the cases [9, 16, 20, 22, 23, 24]. Multiple and combined injuries to the pelvic ring are most challenging with the incidence of 65 % [1, 19, 22, 26, 37], are accompanied by blood loss and traumatic shock in 15-30.7 % of the cases [14, 15, 16, 18, 20, 21] with disability and mortality reported in 59.0 % and 10 to 75.0 %, respectively [5, 6, 20, 25, 26, 27]. Severe condition of the patients influence the timing of definitive internal pelvic fixation. Injuries to the pelvic ring are reported to occur in 78–80 % [16, 17, 18, 25, 28] including 23.4 % of acetabular fractures [2, 11, 13, 17, 24, 36]. Unstable injuries to the pelvic ring (AO/ASIF type B and type C) are encountered in 80 % of all pelvic trauma cases [1, 25, 26, 28].

An algorithm of current approach to the treatment of combined pelvic injuries has been developed with the use of current strategy and principles of damage control surgery and damage control orthopaedics [12, 30–33] with external fixation and C-clamp applied for unstable pelvic injuries during resuscitation stage. Once the patient with pelvic and acetabular fracture is resuscitated and stabilized, definitive surgical management and anatomic restoration of the pelvic ring become the goal, normally after 2-12 days postinjury [3, 9, 13, 27, 32]. Standard surgical approaches are used by orthopaedic and trauma surgeons for repair of complicated transacetabular fractures. Authors unanimously report

traumatic nature and extension of the approaches that can be accompaned by blood loss of 2000 mL and over, with length of surgery averaging to 3 hours 50 minutes [36, 37, 40, 52]. Surgical management is indicated for displaced and multiplanar acetabular fractures. Lazarev A.F. et al. (2013) provide a detailed description of absolute and relative indications to surgical treatment of acetabular fractures. We would cite only absolute indications reported by the authors: 'more than 5 mm of displafcement involving the weight-bearing dome, lost congruency (subluxation) as measured on any of the three views, fracture of the posterior wall and signs of instability, the presence of intra-articular osteochondral fragments' [44]. E.I. Solod et al. (2014) report the principles of direct anatomical reduction and fixation of acetabular fractures with screws and neutralization plates as an adequate option for these injuries [47]. The surgical treatment of complex acetabular fractures through extended approaches is to be considered carefully and may lead to an increased incidence of wound infection [24, 31, 35,36, 37, 55]. Recent advancements in minimally invasive techniques have allowed percutaneous cannulated screw fixation to gain popularity in the treatment of acetabular and pelvic fractures [31, 46, 50, 53, 57, 58]. Outcomes of surgical treatment have been reported at 1-to-12 year follow-ups [15, 18, 28, 37, 57, 58]. HHS is the commonly used scale to assess long-term outcomes of acetabular fractures [9, 28, 47, 57], outcomes of pelvic fractures are normally graded on the S.A. Majeed scale and less frequently on the D'Aubigné and Postele scale [9, 22, 27, 28, 47, 57]. Poor functional outcomes following ORIF are reported in 20 % to 67 % at 1 month to 12 months postsurgery [6, 18, 19, 27, 28, 53] due to many factors including complicated type B and type C acetabular fractures, obesity and osteoporosis [6, 18, 19, 27, 28, 53]. Pelvic consolidation is reported to occur at 3 to 6 months [18, 56, 57]. Primary THA is performed for acetabular fractures within 12 to 29 months following ORIF in 22-33 % of cases [9, 28, 40, 47] due to posttraumatic coxarthrosis and avascular necrosis of the femoral head [9, 28, 40, 47].

CONCLUSION

Overview of pelvic and acetabular fractures, treatment options described in recent Russian and foreign publications shows the complex nature of these fractures with the increasing prevalence and severity of the injuries sustained mostly in road traffic accidents.

Standard surgical approaches and fixation techniques are used for repair of complicated pelvic and acetabular fractures by orthopaedic and trauma surgeons reporting traumatic nature and the extension of the approaches with associated blood loss of 2000 mL and over, with length of surgery averaging to 3 hours 50 minutes. Those can be considered a limiting factor for their wide use in acute period of trauma while ORIF remains the standard of care for acetabular and pelvic fractures.

'Classical' complications encountered in pelvic and acetabular fractures treated by experienced specialists over decades include secondary bone displacement, pelvic and acetabular nonunions, unaddressed defects of the acetabular socket and walls, dense scars and heterotopic ossification in the hip joint, atrophied muscles of the femur, pelvic deformity, posttraumatic avascular necrosis of the femoral head and coxarthrosis. The adverse events make THA more difficult.

Patients are recommended to sit up in bed and walk using crutches on the second-to-seventh postoperative days to facilitate good early functional results, and full weight-bearing on the operated joint is allowed at 6–8 months postsurgery.

Despite strenuous efforts of surgeons to improve outcomes with high technologies rehabilitation period ranges from 3 to 6 months following less invasive treatment of acetabular and pelvic fractures using percutaneous screw fixation, and 6 months to 12 months and over following surgical treatment of acetabular fractures.

Poor functional outcomes following ORIF are reported in 20 % to 67 % at 1 month to 12 months postsurgery due to many factors including complicated type B and type C acetabular fractures, obesity and osteoporosis. Poor outcomes of surgical treatment of acetabular fractures are mostly associated with substantially impaired function of the hip joint.

Primary THA is performed for acetabular fractures within 12 to 29 months following ORIF in 22-33 % of cases [9, 28, 40, 47] due to posttraumatic coxarthrosis, avascular necrosis of the femoral head and expressed pain. The disability prevelance following surgical treatment of pelvic and acetabular fractures suggests a figure of 37.5 %.

Further research and development of new more effective approaches are needed to find a solution to the challenging issue.

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Received: 31.01.2020

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