Treatment of APCII Pelvic Fractures. Variables That Affect the Outcomes

Jesús Rey Moggia, Mauro Chiodini, Felipe Galán, Rafael Amadei Enghelmayer
Orthopedics and Traumatology Service, Hospital Interzonal General de Agudos "Gral. José de San Martín", La Plata, Buenos Aires, Argentina

ABSTRACT

Introduction: Pelvic fractures are frequently associated with high-energy trauma. Mortality varies from 5%-46%. In these patients, the factors related to poor outcomes are still controversial. **Purpose:** To explore if the variables analyzed were related with the long term outcomes of the treatment of an anterior-posterior compression type II pelvic fracture (APCII; AO/OTA: 61B2.3). **Materials and Methods:** 79 cases were analyzed and 23 patients remained for evaluation according to inclusion and exclusion criteria. Pelvic radiographs (anteroposterior, inlet and outlet) and CT-scans were evaluated. The Young & Burgess classification was used to define the fracture pattern and the Majeed Score for clinical outcomes. Variables analyzed: emergency treatment, associated injuries, delay for definitive fixation, method of fixation, quality of immediate postoperative reduction and surgical site infection. **Results:** We did not find any statistical relation between the type of emergency treatment, associated injuries, delay for definitive fixation, method of fixation, and the long-term clinical outcome. Patients who had an immediate postoperative reduction of less than 1 cm and those who did not have a surgical site infection obtained better functional outcomes (statistically significant). **Conclusion:** The quality variables of immediate postoperative reduction and surgical site infection in patients with APCII pelvic fracture had a direct relation with long-term functional and clinical outcomes.

Key words: Pelvic fracture; APCII; Majeed score; variables.
Level of Evidence: IV

Tratamiento de las fracturas de pelvis APCII. Variables que afectan el resultado final

RESUMEN

Introducción: Las fracturas de pelvis se asocian frecuentemente a un trauma de alta energía. La tasa de mortalidad varía del 5% al 46%. El objetivo de este estudio fue explorar si las variables analizadas se asociaron con el resultado final del tratamiento de las fracturas de pelvis APCII (AO/OTA: 61B2.3). **Materiales y Métodos:** Se evaluó a 23 de 79 pacientes luego de aplicarles los criterios de selección. Las fracturas fueron clasificadas, según Young y Burgess, en una radiografía panorámica de pelvis, de entrada y de salida, y tomografía computarizada. Se evaluó el resultado clínico según la escala funcional de Majeed. Las variables evaluadas fueron: tratamiento en la urgencia, lesiones asociadas, días de espera hasta la cirugía, fijación utilizada, reducción posquirúrgica inmediata, infección del sitio quirúrgico. **Resultados:** No se halló una diferencia estadísticamente significativa entre el tipo de tratamiento realizado en la urgencia, las lesiones asociadas, los días de espera hasta la cirugía y el tipo de fijación, con el resultado final a largo plazo. Los pacientes que tuvieron una reducción posoperatoria inmediata <1 cm y los que no sufrieron una infección del sitio quirúrgico obtuvieron mejores resultados funcionales, de manera estadísticamente significativa. **Conclusión:** Las variables calidad de la reducción posquirúrgica inmediata e infección del sitio quirúrgico en pacientes con fractura de pelvis APCII se asocian directamente con los resultados funcional y clínico a largo plazo.

Palabras clave: Fractura de pelvis; APCII; escala de Majeed; variables.
Nivel de Evidencia: IV

Received on February 17th, 2021. Accepted after evaluation on February 2nd, 2022 • Dr. JESÚS REY MOGGIA • reymoggiajesus@gmail.com https://orcid.org/0000-0002-8197-424X

How to cite this article: Rey Moggia J, Chiodini M, Galán F, Amadei Enghelmayer R. Treatment of APCII Pelvic Fractures. Variables That Affect the Outcomes. *Rev Asoc Argent Ortop Traumatol* 2022;87(2):165-176. https://doi.org/10.15417/issn.1852-7434.2022.87.2.1322

INTRODUCTION

Pelvic fractures affect approximately 20-37 per 100,000 inhabitants per year. They are associated with high-energy trauma, and the main cause is car accidents, although they can also be caused by low-energy trauma.[1] The mortality rate varies from 5% to 46% and is directly related to the type of injury. suffered trauma.[2,3] In addition, this condition generates long periods of hospitalization and recovery.[4]

If pelvic fractures are not treated correctly, they can cause long-term sequelae, such as chronic pain, dysmetria and various functional problems.[5,6] In the event of an injury to the pelvic ring, we must determine the magnitude and decide on the appropriate management of the patient according to the degree of instability.[7,8]

The classification system developed by Young and Burgess[9] is still widely used. Injuries to the pelvic ring can be of different magnitudes and cause a wide range of instabilities that can be life-threatening.[10] In injuries due to an anteroposterior compression mechanism (type II of the Young and Burgess classification), called "open book" (APCII), the pubic symphysis, pelvic floor (including sacrospinous ligament), and anterior sacroiliac ligaments are injured. The posterior ligaments remain intact, so the hemipelvis is defined as partially unstable.[11] According to the AO/OTA classification,[12] this injury is classified as 61B2.3. To unify the nomenclature, in this study, they will be defined as APCII.

The classic treatment of APCII lesions was based solely on anterior fixation. Over time, and with the analysis of the range of rotational instability, the need for supplementary fixation of the posterior ring with sacroiliac screws was recognized.[13-16] A series of controversies regarding variables and definitive treatment have taken place in the literature, some of which we will analyze in this article.[2,3,5-7,11]

The aim of this study was to explore whether emergency treatment, associated injuries, waiting time for definitive surgery, type of fixation used, postoperative reduction, and surgical site infection were associated with final functional outcome in patients who suffered pelvic fractures due to type II anteroposterior compression mechanism of the Young and Burgess classification.

MATERIALS AND METHODS

A retrospective study was carried out in a cohort of patients with anteroposterior type II pelvic compression fractures of the Young and Burgess classification by collecting data from the medical records archive of the Orthopedics and Traumatology Service. All patients signed the corresponding informed consent form and we obtained the approval of the ethics committee of our hospital. We began with a "pelvic fracture" diagnosis and then each particular clinical record was selected according to the inclusion and exclusion criteria.

The inclusion criteria were: 1) age >15 years, 2) type II anteroposterior compression fractures of the pelvis according to the Young and Burgess classification (APCII; AO/OTA: 61B2.3), 3) surgery performed in our site between January 2014 and January 2018, 4) minimum follow-up of one year, and 5) surgeries performed by the same surgeon.

Patients with one or more of the following characteristics were excluded: 1) >75 years old, 2) pathological fracture, 3) fractures with orthopedic treatment, and 4) psychiatric illnesses and sensorium decline that prevented interpretation and compliance with indications.

According to the criteria described, 23 patients were obtained for analysis from a sample of 79 patients with pelvic fractures in our hospital.

Fractures were classified according to the Young and Burgess classification in panoramic (Figure 1), pelvic inlet (Figure 2) and outlet (Figure 3) radiographs, and computed tomography.

Clinical evolution was evaluated with the Majeed scale,[17] which assesses pain, sitting, standing and walking, and sexual intercourse, with a maximum score of 80 that decreases according to severity. The sum of the parameters yields a score and this is evaluated as: excellent (70-80 points), good (55-69 points), fair (45-54 points), and poor (<45 points). The original score also includes work activity, adding 20 more points, reaching a maximum of 100. This variable was not included, because it would generate more confusion in the results, since not all the patients analyzed were working when they had an accident. In addition, work activities varied widely, from field laborers and construction workers to administrative and other jobs without greater physical effort than sitting in front of a computer for less than four hours.

The variables evaluated were: 1) emergency treatment, 2) associated injuries, 3) waiting days until surgery, 4) type of fixation used, 5) quality of immediate postoperative reduction, and 6) surgical site infection.

Figure 1. Panoramic pelvic radiograph.

Figure 2. Pelvic inlet radiograph.

Figure 3. Pelvic outlet radiograph.

Each variable was analyzed per patient, and the result obtained according to the Majeed scale was compared between subgroups.

Emergency treatment was analyzed according to whether it had been a pelvic strap, anterior external fixation, or pelvic packing. The patients were divided into two groups: those treated with a strap and those treated with external fixation or pelvic packing. External fixation is supra-acetabular, unless it is not possible due to soft tissue injuries or another situation.

"Pelvic fracture with associated injuries" was defined as one that presented injuries that could affect the final outcome according to the Majeed score, for example, open or closed fracture of the acetabulum, ankle, calcaneus, or long bones of the lower limbs, severe traumatic brain injury, and ligamentous injuries. In this way, patients were divided into two groups: with or without associated lesions. Injuries that, due to their evolution or severity, did not affect the final outcome, such as upper limb fractures, cutting wounds, spinal fractures without spinal cord involvement, and traumatic brain injury without loss of consciousness were not considered to be associated.

Waiting days until surgery ranged from 1 to 60. Two groups were formed: waiting up to 7 days and waiting 8 days or more for surgery.

The types of fixation analyzed were divided into two groups. The first group included patients operated on with anterior plate fixation using a Pfannenstiel and percutaneous sacroiliac approach. The second group was made up of patients operated solely with anterior plate fixation using a Pfannenstiel approach (without posterior fixation), plus those operated on with anterior external and percutaneous sacroiliac fixation. The division into groups was made in this way to compare the treatment that is currently most accepted and recommended in the literature (anterior plate fixation and posterior percutaneous fixation) with the rest of the treatments. The treatment for each patient was selected together with the other treating services according to their characteristics and their associated diseases and injuries. In addition, the first patients in the series had been treated with anterior fixation only; in the later years of the series, percutaneous posterior fixation was added. Anterior fixation was performed, in all cases,

with a 3.5-mm reconstruction plate or DCP plate, depending on availability. Most of the patients were operated on with 3.5 mm reconstruction plates and two with 3.5 mm DCP plates. The sacroiliac screws used were 6.5 mm and 7 mm.

The degree of postoperative reduction was analyzed in the radiographs. According to the criteria of Matta and Tornetta,[18] "excellent" was defined as a reduction with less than 0.4 cm of displacement; "good", when it was between 0.4 and 1 cm; "tolerable", when it was between 1 and 2 cm; and "poor", when it was more than 2 cm. They were divided into two groups for statistical analysis: reduction <1 cm and >1 cm.

Patients who had a surgical site infection were compared with those who did not. A patient was considered to have a surgical site infection if there were signs and symptoms of infection and a microbial rescue was obtained from a tissue sample taken in the operating room. This variable was corroborated with the records of the Infectious Diseases Service of our institution. Patients who suffered a surgical site infection were treated by surgical debridement and intravenous treatment directed by the Infectious Diseases Service.

The analysis was performed with the Stata 14.1 program (StataCorp, Texas, USA). The final outcome of the Majeed numerical scale was compared in two groups formed by each predictive variable using the Mann-Whitney test. Fisher's exact test was used to compare proportions in groups defined by categories of the Majeed scale. A p-value <0.05 was considered statistically significant.

RESULTS

Twenty-three patients diagnosed with APCII pelvic fracture (16 men and 7 women) were analyzed. The median age was 32 years (range 15-70). Median follow-up was 3.2 years (min. 2, max. 6). Associated injuries were documented in nine patients (39.13%). Emergency treatment was pelvic strap in 19 patients (82.61%), external fixator in two (8.69%) (Figure 4) and two (8.69%) were hemodynamically stabilized by pelvic packing. The median wait until definitive surgery was 10 days (range 1-60).

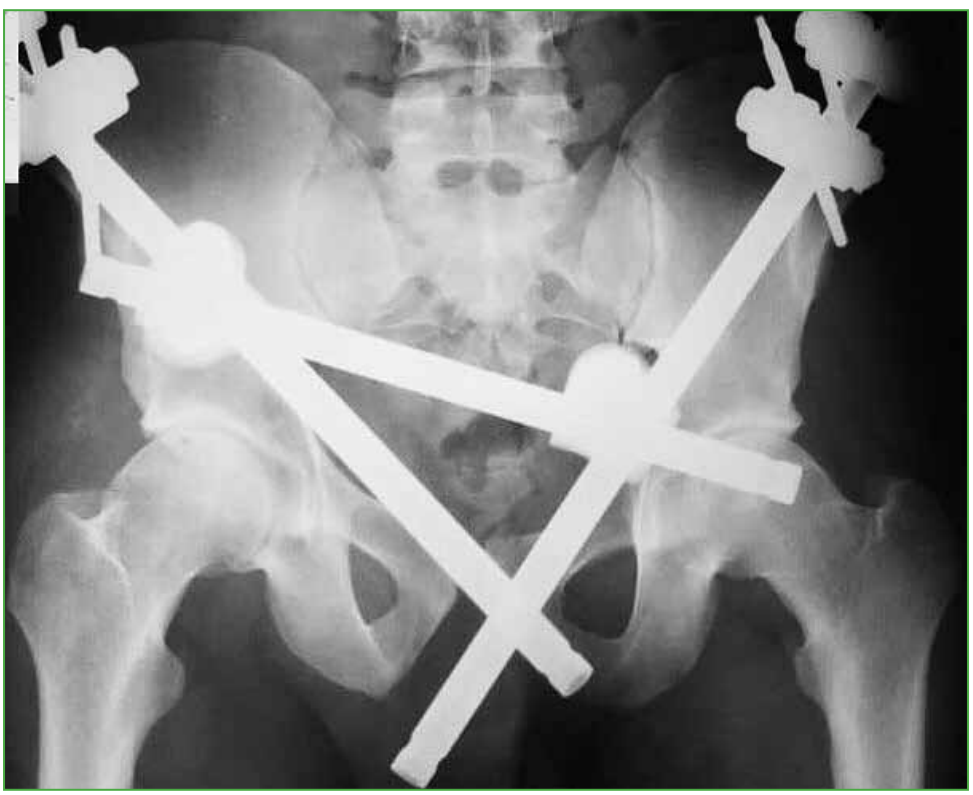

Figure 4. Panoramic radiograph of the pelvis with external fixator.

Five patients (21.73%) underwent anterior fixation only with a Pfannenstiel approach, 13 (56.52%) underwent anterior and percutaneous sacroiliac fixation (Figure 5-7), and five (21.73%) underwent anterior and percutaneous sacroiliac external fixation. Postoperative reduction was <1 cm in 16 patients (69.57%). Five (21.73%) suffered from a surgical site infection.

Figure 5. Panoramic pelvic radiograph. Anterior fixation with plate and posterior with sacroiliac screw.

Figure 6. Pelvic inlet radiograph. Anterior fixation with plate and posterior with sacroiliac screw.

Figure 7. Pelvic outlet radiograph. Anterior fixation with plate and posterior with sacroiliac screw.

The median Majeed scale score was 70 (excellent) (range 30-80). Table 1 shows the comparison of medians in different groups. No differences were found between the groups according to associated injuries. The medians of the scale were higher in groups <40 years old, men, emergency treatment with a tutor or packing, time <8 days until definitive surgery, and in the group with the Pfannenstiel approach fixated in the anterior region with a plate and the posterior region with sacroiliac screws, but the differences were not statistically significant. We observed that patients who had an immediate postoperative reduction <1 cm obtained a better functional scale score (median 75 points) compared to those with a reduction >1 cm (median 65 points) and the difference was statistically significant (p = 0.0310). We observed that the patients who suffered from infections (5 in total) obtained worse functional outcomes (median 56 points) compared to those who did not (median 75 points) and the difference was statistically significant (p = 0.0006).

Table 1. Comparison of medians of the Majeed scale in different groups.

Variables	Number (n)	Median	Range	p*
Age				
≥40 years	8	64.5	52-80	0.1857
<40 years	15	70	30-80	
Sex				
Male	16	72.5	56-80	0.2307
Female	7	65	30-80	
Emergency treatment				
Sheet wrap	19	70	30-80	0.1575
Tutor or packing	4	77.5	70-80	
Associated injuries				
Yes	9	70	56-80	0.8464
No	14	70	30-80	
Waiting time until surgery				
<7 days	8	77.5	69-80	0.0639
≥8 days	15	69	30-80	
Fixation type				
Anterior with plate and posterior percutaneous	13	75	52-80	0.0700
Anterior alone or tutor and posterior percutaneous	10	67	30-80	
Quality of immediate postoperative reduction				
≤1 cm	16	75	56-80	0.0310
>1 cm	7	65	30-80	
Surgical site infection				
Yes	5	56	30-60	0.0006
No	18	75	65-80	

*Mann-Whitney test.

According to the categories of the Majeed scale, eight (34.78%) patients obtained an excellent outcome; six (26.09%), good; five (21.74%), fair; and four (17.39%), poor. Although the results were not statistically significant, the group with a "poor" outcome was older, had a higher frequency of reduction >1 cm, was wrapped with a sheet in the emergency room, and waited more than 8 days for definitive treatment. We observed a statistically significant association of surgical site infection with the Majeed scale (Table 2).

Table 2. Comparison of the characteristics of the sample (n = 23) in groups of results according to the Majeed scale

Variables	Majeed Scale				p*
	Excellent (n = 8)	Good (n =6)	Fair (n = 5)	Poor (n = 4)	
Age <40 years	6	5	3	1	0.333
Male sex	6	5	3	2	0.711
Sheet wrap as an emergency treatment	6	4	5	4	0.481
Associated injuries	3	2	2	2	0.999
Waiting time until definitive treatment ≥8 days	4	3	4	4	0.347
Anterior fixation with plate and posterior percutaneous	6	4	2	1	0.362
Post-surgical reduction >1 cm	1	1	2	3	0.147
Surgical site infection	0	0	1	4	<0.001

The results are presented as number of observations (n).
*Fisher's exact test.

In the five patients with surgical site infection, methicillin-resistant *Staphylococcus aureus* was isolated and, in one of them, also *Klebsiella pneumoniae*. All five underwent surgery after seven days of hospitalization and all were over 40 years old.

DISCUSSION

In this study, different long-term variables were evaluated by comparing them with the functional outcomes according to the Majeed scale in patients with APCII injuries. According to a systematic review of 28 articles carried out by Lefaivre et al.,[19] the Majeed scale was used in more than half of them.

Regarding data collection, most of the patients in all the groups observed did not have sexual disorders or dysfunctions, probably due to incomplete information on these charts. This idea coincides with the findings of Harvey-Kelly et al.,[20] who reported a high rate (28%) of patients who refused to complete the sexual questionnaires. The incidence of sexual dysfunction and dyspareunia reported in the literature varies from 5% to 44%.[11,21]

No statistically significant relationship was found between the initial treatment in the emergency room and the final functional outcome according to the Majeed scale. This may be due to multiple variables not analyzed in our study, such as the hemodynamic status at admission, the available resources, and the experience of the surgeon in charge of emergency treatment.

The relationship between the patients who suffered associated injuries and the final score on the Majeed scale was not statistically significant. In contrast to this, Hessmann et al.[21] stated that functional outcomes after pelvic trauma are often affected by associated injuries and other variables. In our study, four patients also had acetabular fracture; three, fracture of long bones (femur or tibia); two, spinal fracture; four, fracture around the ankle and foot; one, severe traumatic brain injury and a sciatic nerve injury.

The patients who underwent surgery within seven days had better functional outcomes on the Majeed scale, while those who underwent surgery after 7 days had worse outcomes, although without significant differences. Vallier et al.[22] reported a decrease in morbidity and length of hospitalization in patients who received early treatment, but did not assess the long-term functional outcome. In addition to this, it can be noted that five patients in the group that had undergone surgery after seven days of admission suffered a surgical site infection and had poor functional outcomes. This is understandable, since prolonged hospitalization increases the probability of infection by hospital germs and impoverishes the final outcomes.

Previous studies have shown that age, severity of injury, type of fracture, and type of fixation used could influence functional outcomes.[20,23,24] In our study, patients who underwent surgery with anterior plate fixation using the Pfannenstiel approach without sacroiliac fixation, along with patients operated on with anterior external fixation and percutaneous posterior fixation, had worse functional outcomes than those treated with anterior plate fixation and percutaneous sacroiliac fixation. However, no statistically significant results were obtained. In 2011, Sagi et al.[15] proposed a modification to the Young and Burgess classification of "open book" injuries based on dynamic stress examination with fluoroscopy under anesthesia. In this case, APCII lesions were divided into two subgroups: those that required only anterior fixation (APCIIa) and those that required additional posterior fixation (APCIIb). In 2016, Avilucea et al.[16] carried out a comparative study and reported a lower rate of material failure and malunion when anterior fixation was supplemented with posterior percutaneous fixation, when compared to anterior fixation with an isolated plate in APCII pelvic fractures. These authors attribute the poor outcomes to inadequate fixation, and this coincides with our observations, because stable anterior and posterior internal fixation led to better outcomes.

A better functional outcome (median 75 points) was observed in patients who obtained a postoperative reduction <1 cm compared to those who obtained reductions >1 cm, with statistically significant values, coinciding with the statements of Hessmann et al.[21] In their reviews, Lefaivre et al. concluded that the correlation is unknown, since there is a wide variety of measurement methods, and none of them is properly validated.[25] According to our study, the degree of postoperative reduction influences the long-term functional outcome in patients with APCII injuries.

Likewise, it was shown with statistically significant values that patients who suffered a surgical site infection obtained worse functional outcomes compared to those who did not. This may be due to increased hospitalization days, days in intensive care, or prolonged surgical times.

In summary, we found, with statistically significant values (Table 1), that the variables "immediate postoperative reduction quality" and "surgical site infection" affect the final outcome in patients with APCII pelvic fractures. In addition, the medians of the functional scale were higher in groups of patients under 40 years of age, men, emergency treatment with tutor or packing, time <8 days until definitive surgery, and in the group with a Pfannenstiel approach with anterior plate fixation and posterior sacroiliac screw fixation, but the differences were not statistically significant.

The strengths of our study are that it focused on a specific pelvic injury and explored the relationship between clear variables and the final functional outcome. In addition, all the patients in the series were operated on and monitored over time by the same surgeon, with the same follow-up protocol, which gave the sample greater purity. Another point in favor is that we carried out a comparative study for a better statistical evaluation. To our knowledge, there is no research of this type in the national literature.

The weaknesses are the design (retrospective without double blind), the small universe, and the lack of a multivariate statistical analysis.

We believe that our research can be a good starting point for multicenter studies, such as prospective studies with a larger sample, to adapt the classification systems to new knowledge about the mechanism of trauma and the different associated variables, thus predicting long-term functional outcomes.

CONCLUSION

We can affirm that the quality variables of immediate postoperative reduction and infection of the surgical site in patients with anteroposterior compression fracture of the pelvis—type II (APCII) of the Young and Burgess classification—are directly associated with the long-term functional and clinical outcomes.

Conflict of interest: The authors declare no conflicts of interest.

M. Chiodini ORCID ID: https://orcid.org/0000-0003-2778-8072
F. Galán ORCID ID: https://orcid.org/0000-0002-7264-488X
R. Amadei Enghelmayer ORCID ID: https://orcid.org/0000-0002-0032-3016

REFERENCES

1. Lefaivre K, O'Brien PJ, Tile M. Pathoanatomy, mechanisms of injury and classification. En: Tile M, Helfet DL, Kellam JF, Vrahas M (eds). *Fractures of the pelvis and acetabulum: principles and methods of management.* 4th ed. New York: Thieme; 2015: p. 39-60.
2. Black SR, Sathy AK, Jo MD, Wiley MR, Minei JP, Starr AJ. Improved survival after pelvic fracture: 13-year experience at a single trauma center using a multidisciplinary institutional protocol. *J Orthop Trauma* 2016;30:22-8. https://doi.org/10.1097/BOT.0000000000000443
3. Hak DJ, Smith WR, Suzuki T. Management of hemorrhage in life-threatening pelvic fracture. *J Am Acad Orthop Surg* 2009;17(7):447-57. https://doi.org/10.5435/00124635-200907000-00005
4. Grimshaw CS, Bledsoe JG, Moed BR. Locked versus standard unlocked plating of the pubic symphysis. *J Orthop Trauma* 2012;26:402-6. https://doi.org/10.1097/BOT.0b013e31822c83bd
5. Metze M, Tiemann AH, Josten C. Male sexual dysfunction after pelvic fracture. *J Trauma* 2007;63:394-401. https://doi.org/10.1097/01.ta.0000241145.02748.df
6. Meyhoff CS, Thomsen CH, Rasmussen LS, Nielsen PR. High incidence of chronic pain following surgery for pelvic fracture. *Clin J Pain* 2006;22:167-72. https://doi.org/10.1097/01.ajp.0000174266.12831.a2
7. Musso D, Vindver G, Bidolegui F, Mohanty K, Di Stefano C, Powell J. Manejo en la urgencia de las lesiones del anillo pelviano. *Rev Asoc Argent Ortop Traumatol* 2004;69(3):270-80. Available at: https://www.aaot.org.ar/revista/2004/n3_vol69/art14.pdf
8. Nork SE. The management of the injured pelvic ring: internal fixation of the anterior pelvic injuries-open book type (B1). En: Tile M, Helfet DL, Kellam JF, Vrahas M (eds). *Fractures of the pelvis and acetabulum: principles and methods of management.* 4th ed. New York: Thieme; 2015: p. 159-74.
9. Young JW, Burgess AR, Brumback RJ, Poka A. Pelvic fractures: value of plain radiography in early assessment and management. *Radiology* 1986;160:445-51. https://doi.org/10.1148/radiology.160.2.3726125
10. Whiting PS, Auston D, Avilucea FR, Ross D, Archdeacon M, Sciadini M, et al. Negative stress examination under anesthesia reliably predicts pelvic ring union without displacement. *J Orthop Trauma* 2017;31:189-93. https://doi.org/10.1097/BOT.0000000000000766
11. Collinge CA, Archdeacon MT, LeBus G. Saddle-horn injury of the pelvis. The injury, its outcomes, and associated male sexual dysfunction. *J Bone Joint Surg Am* 2009;91:1630-6. https://doi.org/10.2106/JBJS.H.00477
12. Meinberg EG, Agel J, Roberts CS, Karam MD, Kellam JF. Fracture and dislocation classification compendium–2018. *J Orthop Trauma* 2018;32(1):S71-76. https://doi.org/10.1097/BOT.0000000000001066
13. Varga E, Hearn T, Powell J, Tile M. Effects of method of internal fixation of symphyseal disruptions on stability of the pelvic ring. *Injury* 1995;26(2):75-80. https://doi.org/10.1016/0020-1383(95)92180-i
14. Eastman JG, Krieg JC, Routt ML Jr. Early failure of symphysis pubis plating. *Injury* 2016;47(8):1707-12. https://doi.org/10.1016/j.injury.2016.05.019
15. Sagi HC, Coniglione FM, Stanford JH. Examination under anesthetic for occult pelvic ring instability. *J Orthop Trauma* 2011;25:529-36. https://doi.org/10.1097/BOT.0b013e31822b02ae
16. Avilucea FR, Whiting PS, Mir H. Posterior fixation of APC-2 pelvic ring injuries decreases rates of anterior plate failure and malunion. *J Bone Joint Surg Am* 2016;98(11):944-51. https://doi.org/10.2106/JBJS.15.00723
17. Majeed SA. External fixation of the injured pelvis: the functional outcome. *J Bone Joint Surg Br* 1990;72:612-14. https://doi.org/10.1302/0301-620X.72B4.2380212
18. Matta JM, Tornetta P 3rd. Internal fixation of unstable pelvic ring injuries. *Clin Orthop Relat Res* 1996;(329):129-40. https://doi.org/10.1097/00003086-199608000-00016

19. Lefaivre KA, Slobogean GP, Valeriote J, O'Brien PJ, Macadam SA. Reporting and interpretation of the functional outcomes after the surgical treatment of disruptions of the pelvic ring: a systematic review. *J Bone Joint Surg Br* 2012;94(4):549-55. https://doi.org/10.1302/0301-620X.94B4.27960
20. Harvey-Kelly KF, Kanakaris NK, Obakponovwe O, West RM, Giannoudis PV. Quality of life and sexual function after traumatic pelvic fracture. *J Orthop Trauma* 2014;28:28-35. https://doi.org/10.1097/BOT.0b013e31828fc063
21. Hessmann MH, Rickert M, Hofmann A, Rommens PM, Buhl M. Outcome in pelvic ring fractures. *Eur J Trauma Emerg Surg* 2010;36(2):124-30. https://doi.org/10.1007/s00068-010-1042-0
22. Vallier HA, Cureton BA, Ekstein C, Oldenburg FP, Wilber JH. Early definitive stabilization of unstable pelvis and acetabulum fractures reduces morbidity. *J Trauma* 2010;69(3):677-84. https://doi.org/10.1097/TA.0b013e3181e50914
23. Suzuki T, Shindo M, Soma K, Minehara H, Nakamura K, Uchino M, et al. Long-term functional outcome after unstable pelvic ring fracture. *J Trauma* 2007;63:884-8. https://doi.org/10.1097/01.ta.0000235888.90489.fc
24. Holstein JH, Pizanis A, Köhler D, Pohlemann T; Working Group Quality of Life After Pelvic Fractures. What are predictors for patients' quality of life after pelvic ring fractures? *Clin Orthop Relat Res* 2013;471:2841-5. https://doi.org/10.1007/s11999-013-2840-y
25. Lefaivre KA, Blachut PA, Starr AJ, Slobogean GP, O'Brien PJ. Radiographic displacement in pelvic ring disruption: reliability of 3 previously described measurement techniques. *J Orthop Trauma* 2014;28(3):160-6. https://doi.org/10.1097/BOT.0b013e31829efcc5