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Problems with fixing chronic injuries of the anterior pelvic ring

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ABSTRACT

BACKGROUND: A separate problem is the surgical treatment of the pelvic joints, especially the pubic joint. Stabilization in the case of chronic pelvic injuries using standard methods used in the treatment of patients with acute pelvic injuries reveals cases of plate fatigue fractures, metal structures migrations and the need for repeated surgical interventions. In this regard, in order to fix injuries to the anterior pelvis in case of chronic injuries, it is necessary to use other, special tactical approaches to fixing bone fractures and joint ruptures, and to develop metal structures adapted for such cases.

AIM: To study of the features of fixation in chronic pelvic injuries and analysis of the results with various methods of fixation of the anterior pelvic ring in chronic cases.

MATERIALS AND METHODS: Under our supervision in the first department of the “FGBU NMITs TO im. NN Priorov” of the Ministry of Health of the Russian Federation for the period from 2000 to 2015. 117 patients were observed who underwent surgical treatment using standard reconstructive plates for chronic injuries of the anterior pelvis used in the surgical treatment of acute injuries of the pelvic ring.

RESULTS: Group No. 1, consisting of 65 patients who underwent fixation of the anterior half-ring with reconstructive plates, implanted in the standard way as in acute trauma, 12 patients (10.2%) had migration or fracture of metal structures for a period of 2 to 6 months from the date of surgery.

Group No. 2 consists of 52 patients who underwent fixation of the anterior pelvic semicircle with two plates located on the pubic bones mutually perpendicular to each other using the standard method. Destabilization of metal structures was detected in 7 patients (13.4%) with X-ray control in the period from 2 weeks to 2 months after the operation.

CONCLUSION: The standard approach to fixation of such injuries, as in acute (up to 3 weeks from the moment of injury), does not create conditions for stable fixation. In the first case, attention is drawn to the fact that after the plate fracture, the diastasis between the pubic bones increased to almost the same level as at the time of admission. From this, it can be concluded that the fibro-cicatrice process formed in traumatic foci creates a rigid deformation, and when restoring the anatomical integrity of the pelvic ring, with the use of bone osteosynthesis, the plate with chronic injuries experiences stronger loads than in acute trauma and causes a fatigue fracture of metal structures.

Keywords: pelvis; pelvic ring; chronic pelvic injury; osteosynthesis of pelvic bones.

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Проблемы при фиксации застарелых повреждений переднего отдела тазового кольца

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АННОТАЦИЯ

Актуальность. Актуальной проблемой является хирургическое лечение сочленений таза, в особенности лонного сочленения. При стабилизации в случае застарелых травм таза стандартными методами, применяемыми при лечении пациентов при острых повреждениях таза, выявляются случаи усталостных переломов пластин, миграций металлоконструкции и необходимости повторных оперативных вмешательств. В связи с этим для фиксации повреждений переднего отдела таза при застарелых повреждениях необходимо применение иных, особенных тактических подходов к фиксации переломов костей и разрывов сочленений, разработка адаптированных для таких случаев металлоконструкций.

Цель. Изучение особенностей фиксации при застарелых повреждениях таза и анализ результатов при различных способах фиксации переднего отдела тазового кольца в случаях давних травм.

Материалы и методы. Под нашим наблюдением в первом отделении ФГБУ НМИЦ ТО им. Н.Н. Приорова МЗ РФ с 2000 по 2015 год находились 117 пациентов, которым проведено хирургическое лечение с использованием стандартных реконструктивных пластин при застарелых повреждениях переднего отдела таза, применяемых при оперативном лечении острых травм тазового кольца.

Выводы. В 1-й группе, состоящей из 65 пациентов, которым производилась фиксация переднего полукольца реконструктивными пластинами, имплантированными стандартным способом как при острой травме, у 12 пациентов (10,2%) выявлена миграция или перелом металлоконструкций в срок от 2 до 6 мес с момента оперативного вмешательства.

Во 2-й группе 52 пациентам была проведена фиксация переднего полукольца таза двумя пластинами, расположенными на лонных костях взаимоперпендикулярно по отношению друг к другу стандартным методом. Дестабилизация металлоконструкций выявлена у 7 пациентов (13,4%) при рентгенологическом контроле в сроки от 2 нед. до 2 мес после проведенной операции.

Заключение. Стандартный подход к фиксации таких повреждений, как при острых травмах таза (до 3 нед. с момента травмы), не создает условий для стабильной фиксации. В первом случае следует отметить, что после перелома пластины диастаз между лонными костями увеличился практически до того же уровня, что и на момент поступления. Отсюда можно сделать вывод, что фиброзно-рубцовый процесс, сформировавшийся в травматических очагах, создает ригидную деформацию, и при восстановлении анатомической целостности тазового кольца с применением накостного остеосинтеза пластина при застарелых повреждениях испытывает более значительные нагрузки, чем при острой травме, и вызывает усталостный перелом металлоконструкций.

Ключевые слова: таз; тазовое кольцо; застарелое повреждение таза; остеосинтез костей таза.

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BACKGROUND

Currently, the issue of pelvic ring injury treatment is relevant in traumatology. Among the musculoskeletal system injuries, pelvic ring injuries account for 4%–8% of cases in traumatism. Pelvic ring injuries represent one of the most severe musculoskeletal system injuries. In cases of polytrauma, the number of pelvic ring injuries increases to 25%; whereas, pelvic injuries account for up to 60% of cases in injuries due to road traffic accidents [1–3, 6–8, 10]. Patients with such injuries are often in a serious, critical condition, which prevents the final osteosynthesis of pelvic ring injuries in the acute period, and only urgent methods are allowed to stabilize the pelvic ring [1, 2, 9, 10]. With emergency pelvic fixation, an anatomical restoration of traumatic foci of the pelvic ring is often impossible. Long-term recovery and stabilization of the patient's vital functions lead to a transition from the acute phase of pelvic ring injury to an inveterate, rigid form of damage [6–8].

The need for surgical anterior pelvic treatment and the choice of fixation method for such injuries remains debatable to date. Studies revealed that 60% of pelvic ring stability is provided by the posterior sections and only 10% is ensured by the anterior pelvic ring. Notably, the anterior pelvic integrity provides 40% of the pelvic ring stability [1, 4–7]. The largest number of fractures in pelvic ring injuries occurs in the pubic rami, as well as pubic symphysis ruptures, which account for approximately 70% of cases with pelvic injuries.

A separate problem is the surgical pelvic joint treatment, especially the pubic articulation. In chronic pelvic injuries, stabilization using standard methods [11] that are applied in the treatment of patients with acute pelvic injuries revealed cases of fatigue fractures of the plates, surgical hardware migration, and the need for repeated surgical interventions. Thus, other special approaches to fixing bone fractures and joint ruptures are required, as well as the development of surgical hardware for such cases, to fix anterior pelvic injuries in case of chronic trauma.

This study aimed to determine the aspects of fixation in chronic pelvic injuries and analyze the results of various methods of anterior pelvic ring fixation in chronic cases.

MATERIALS AND METHODS

A total of 117 patients, who underwent surgical treatment using standard reconstructive plates for chronic anterior pelvic and acute pelvic ring injuries, were under our supervision from 2000 to 2015 in the Department 1 of the N.N. Priorov National Medical Research Center of Traumatology and Orthopedics of the Ministry of Health of the Russian Federation.

Most of these patients were of working age of 20–59 years old ($n=101$), whereas others were older people ($n=12$) and younger patients ($n=4$). Male patients (70 patients) were more than females (47 patients). In terms of the nature

of the injury, injuries from road accidents predominated (65 patients), those from object compression were registered in 18, catatrauma in 15, and other causes in 19 patients.

The patients mainly complained of pain in the anterior pelvic ring, aggravated by physical exertion and gait disturbances. The patients sought medical help after 4 weeks to 3 years after the pelvic ring injury, after conservative or hardware treatment.

The patients were carefully examined, and interviews were conducted with patients, which included detailed history taking, X-ray multiprojection examination, and computed tomography examination of the pelvic ring.

In 65 patients, reconstructive plates of the Association of Osteosynthesis (AO) and AO pelvic plates were used as the method of choice for pelvic ring stabilization. Fixation was performed using the standard method for acute pelvic injuries. In 52 patients, the anterior pelvis was fixed with two reconstructive AO plates, of which one was placed as standard along the upper edge of the pubic bones and the other along the anterior surface of the pubic bones perpendicular to plate 1.

No differences were found in the postoperative management in operated patients, which included antibacterial, anti-inflammatory, and anticoagulant therapy. Additionally, patients were activated on postoperative day 2 and were recommended to walk with additional support on crutches for 2 months postoperatively, with periodic outpatient examinations and X-ray control every 2 months.

The surgical treatment results in both groups were evaluated using the Majeed scale [12].

The Ethics Committee issued the protocol of the Local Ethics Committee of the N.N. Priorov National Medical Research Center of Traumatology and Orthopedics of the Ministry of Health of Russia, No. 3 dated 09/22/2020.

RESULTS

In group 1, which consisted of 65 patients who underwent anterior ring fixation with implanted reconstructive plates using the standard method, as in acute injuries, migration or fracture of surgical hardware was detected in 12 patients (10.2%) within postoperative 2–6 months.

Clinical case No. 1. A 52-year-old patient had an injury due to a road traffic accident 1 year and 1 month ago. At the site of injury, conservative treatment was performed with skeletal traction for the tuberosity of the right tibia for 1 month. The patient was admitted to the Department 1 of the N.N. Priorov National Medical Research Center of Traumatology and Orthopedics 1 year after the injury with a diagnosis of a long-standing pubic symphysis rupture, misaligned right acetabulum fracture, aseptic necrosis of the right femur head, chronic dislocation of the right femur head, and right and left sacroiliac joint ruptures (Fig. 1).

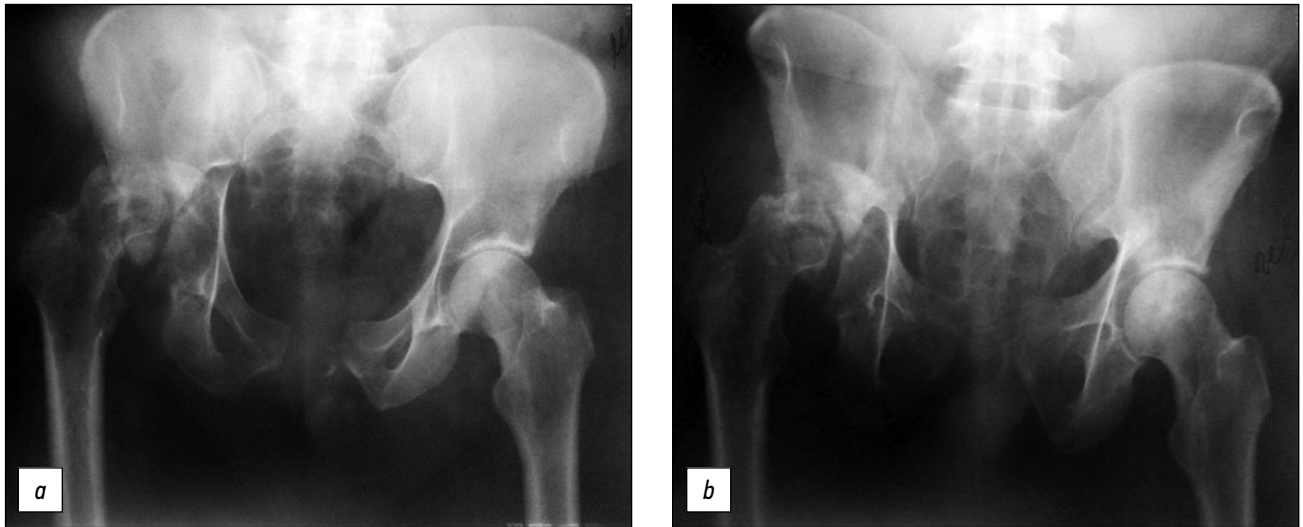


Fig. 1. Patient, 58 years old. X-rays 1 year after injury: *a* — frontal, *b* — out-let.



Fig. 2. X-rays after surgery.



Fig. 3. 34 days after surgery.



Fig. 4. Plain radiography of the pelvis.

After the examination and preparation of the patient, performing a hardware fusion of the anterior pelvic ring with a reconstructive plate was decided (Fig. 2).

After 34 days, the patient came for a consultation complaining of anterior pelvic pain. The radiograph revealed hardware destabilization (Fig. 3).

In group 2, 52 patients underwent anterior pelvic ring fixation with two plates located on the pubic bones that are mutually perpendicular to each other by the standard method. Hardware destabilization was detected in seven patients (13.4%) during X-ray control in 2 weeks to 2 months postoperatively.

Clinical case No. 2. A 53-year-old female patient was admitted 4 weeks after a catatrauma with a diagnosis of consequences of a severe concomitant injury, a chronic bilateral pubic symphysis and sacroiliac joint rupture, a chronic left pubic and ischial bone and left acetabulum

fracture, and vertical displacement of the left half of the pelvis (Fig. 4).

Pelvic computed tomography was performed (Fig. 5).

A two-stage surgical treatment was decided. At stage 1, the left sacroiliac joint mobilization was performed with the imposition of skeletal traction for the left tibia tuberosity for 14 days (Fig. 6).

After bringing down the left half of the pelvis at stage 2, a hardware fusion of the anterior pelvic ring was performed with two reconstructive plates, and the left sacroiliac joint was fixed with two cannulated screws (Fig. 7, 8).

Although the anterior pelvic ring was stabilized with two plates and the posterior pelvic ring was fixed, the hardware destabilization was detected 14 days postoperative when the patient started her locomotor activity (Fig. 9).

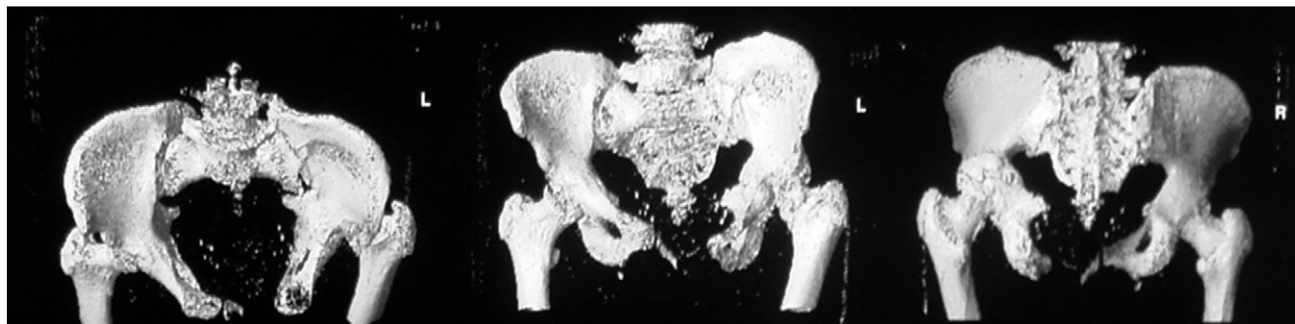


Fig. 5. Computed tomography of the pelvis.

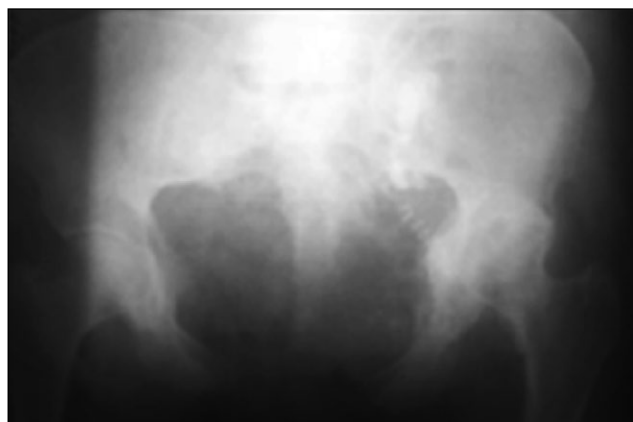


Fig. 6. X-ray after the mobilization of the left sacroiliac joint.



Fig. 7. Plain radiography of the pelvis after surgery.



Fig. 8. Caudal radiography of the pelvis. In-let projection.

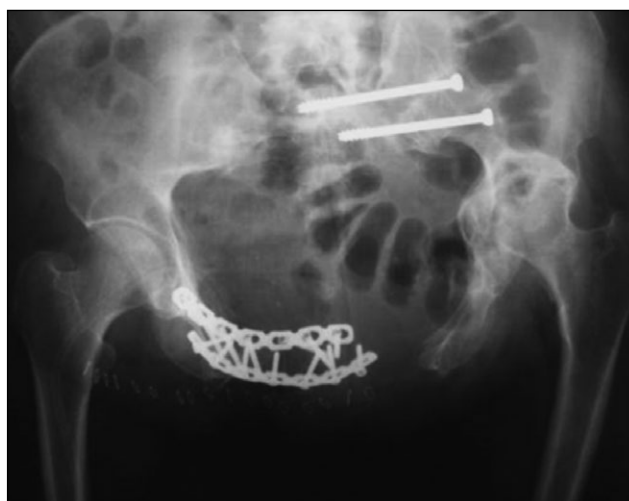


Fig. 9. Plain radiography of the pelvis. Destabilization of metal structures.

Table 1. The evaluation of treatment results using the Majeed scale

Surgical treatment result	Group 1		Group 2	
	one plate		two plates	
	n	share, %	n	share, %
Excellent	8	12,3	16	38,8
Good	14	21,5	23	44,2
Satisfactory	31	47,7	6	11,5
Poor	12	18,5	7	13,5
Total	65	100,0	52	100,0
– including destabilization	12	10,2	7	13,4

The statistical analysis of long-term surgical treatment results in the study groups revealed that in group 1, with stabilization using one plate, the average score using the Majeed scale was 67 ± 0.5 , which corresponds to satisfactory treatment results. Further, in group 2, with stabilization performed using two plates, the average score was 74 ± 1.1 , which is considered good results (Table 1).

DISCUSSION

The result analysis in the study concluded that standard approaches are not always effective in surgical stabilization of chronic anterior pelvic ring injuries and the search for a special method, different from the standard ones, is required for acute injury treatment, as well as an adapted approach to the choice of method and means of surgical stabilization with chronic injuries. Over time, in the absence of appropriate treatment of fractures and pelvic ring joint ruptures, scar-fibrous adhesions of the pelvic ring are formed, which rarely provide pelvic stability as a single system, leading to rigid post-traumatic pelvic ring deformity.

Considering the cases of hardware destabilization in the studied groups (10.2% and 13.4% in groups 1 and 2, respectively), as well as the analysis of the long-term obtained results, standard approaches in stabilizing the anterior pelvic ring are ineffective in cases of chronic pelvic ring injuries.

The use of fixation methods for acute injuries (up to 3 weeks from the moment of injury) in cases of chronic injuries does not achieve the necessary conditions for stable fixation. In clinical case 1, the diastasis between the pubic bones returned to the same level as at admission when the hardware was destabilized. Therefore, we conclude that the fibrous-cicatrical process formed in traumatic foci has a stable, rigid structure, and when an anatomical pelvic reposition is achieved using the standard method of extra-cortical osteosynthesis, the plate experiences stronger mechanical loads than that of a recent injury, thus fatigue fracture of the hardware occurs.

In clinical case 2, the hardware destabilization was assumed due to the use of two plates that are forced to be directly fixed with a large number of screws in the superior pubic rami, which decreases the bone mass and the strength of the bone itself. Both plates and each plate separately bear multidirectional loads that are experienced by the pubic symphysis, leading to hardware instability.

Given these hardware destabilization factors, developing new hardware that is biomechanically adapted to stabilize the anterior pelvic ring in chronic cases became necessary.

CONCLUSIONS

1. In the surgical treatment of chronic anterior pelvic injuries, a new special approach is required, which differs from the treatment of similar joint fractures and ruptures with recent injuries.
2. In cases of chronic anterior pelvic ring injuries, due to pelvic rigidity due to the fibrous-cicatrical process, more significant rupture forces destabilize standard hardware, which necessitates the search for new fixators that can withstand the forces acting on the rupture.
3. Chronic anterior pelvic ring injuries often accompany posterior pelvic injuries, which also require fixation.

ADDITIONAL INFO

Author contribution. Thereby, all authors made a substantial contribution to the conception of the work, acquisition, analysis, interpretation of data for the work, drafting and revising the work, final approval of the version to be published and agree to be accountable for all aspects of the work.

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Competing interests. The authors declare that they have no competing interests.

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