



## Palisade Technique – the New Method for Open Reduction of Pelvic Fractures

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### Abstract


**Background.** Restoration of the pelvic bones and acetabulum anatomy after fracture is an important criterion for functional outcome. Often, the reduction of flat pelvic bones is not an easy task. The authors proposed a method of reduction using a special support site of two or three 3.5 mm cortical screws for Matta bone forceps. **The aim of the study** was to demonstrate a new way of pelvic bones fragments reduction. **Method.** Three clinical situations are presented when a new method was used: 1) reduction of a pointed fragment of the acetabulum posterior column transverse fracture; 2) reduction of the acetabulum quadrilateral plate fragments with medial displacement and 3) reduction the rupture of the pelvic bones in the sacroiliac joint with the vertical displacement. Previously, a support site was created in one of the fragments from two or three not fully twisted 3.5 mm cortical screws. One of the Matta bone forceps branches was placed on the formed site, and the second on another fragment and the displacement was eliminated. Then the final osteosynthesis was performed with pelvic plates and/or cannulated screws according to the surgical plan. Before closing the wound the support site was removed. **Conclusions.** The proposed method has shown its effectiveness during the reduction of the flat bones fragments, as it allows you to compress the spongy bones of the pelvis with a thin cortical layer stronger, compared with existing methods during which fragments splitting and «pulling out» anchor screws in the branches of reduction forceps can occur. The developed method of reduction demonstrated convenience and reliability.

**Keywords:** pelvic fracture, reduction, pelvic fracture osteosynthesis, acetabular fracture osteosynthesis, ilio-sacral joint dissociation.

**Funding:** state budgetary funding.

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 **Cite as:** Zadneprovskiy N.N., Ivanov P.A., Nevedrov A.V. [Palisade Technique – the New Method for Open Reduction of Pelvic Fractures]. *Travmatologiya i ortopediya Rossii* [Traumatology and Orthopedics of Russia]. 2021;27(3):94-100. (In Russian). <https://doi.org/10.21823/2311-2905-2021-27-3-94-100>.

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Received: 09.08.2021. Accepted for publication: 16.09.2021.

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## «Заборчик» (palisade technique) – новый способ открытой репозиции переломов костей таза

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### Реферат

**Актуальность.** Восстановление анатомии костей таза и вертлужной впадины после перелома является важным критерием функционального исхода. Нередко репозиция и удержание плоских костей таза представляют собой непростую задачу. Авторами предложен способ репозиции с использованием специальной упорной площадки из двух-трех 3,5 мм кортикальных винтов для костных щипцов Matta. **Цель** — демонстрация нового способа репозиции отломков плоских костей таза. **Описание метода.** Представлено три клинических наблюдения с применением нового способа: 1) при репозиции остроконечного фрагмента поперечного перелома задней колонны вертлужной впадины; 2) при репозиции отломков четырехугольной поверхности вертлужной впадины с медиальным смещением; 3) при сопоставлении разрыва костей таза в крестцово-подвздошном сочленении с вертикальным смещением. Предварительно в одном из отломков создавали упорную площадку из двух-трех не полностью закрученных 3,5 мм кортикальных винтов. Одну из бранш костных щипцов Matta упирали в сформированную площадку, а вторую — в другой отломок и устраняли смещение. Далее выполняли окончательный остеосинтез тазовыми пластинами и/или канюлированными винтами согласно хирургического плана. Перед закрытием раны упорную площадку демонтировали. **Заключение.** Предлагаемый способ показал эффективность во время репозиции плоских костей, так как позволяет сжимать губчатые кости таза с тонким кортикальным слоем сильнее по сравнению с существующими методами во время которых может происходить раскалывание отломков и «вырывание» якорных винтов в браншах репозиционных щипцов.

**Ключевые слова:** переломы костей таза, репозиция, остеосинтез вертлужной впадины, разрыв крестцово-подвздошного сочленения.

**Источник финансирования:** государственное бюджетное финансирование.

Заднепровский Н.Н., Иванов П.А., Неведров А.В. «Заборчик» (palisade technique) — новый способ открытой репозиции переломов костей таза. *Травматология и ортопедия России*. 2021;27(3):94-100. <https://doi.org/10.21823/2311-2905-2021-27-3-94-100>.

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Рукопись поступила: 09.08.2021. Принята в печать: 16.09.2021.

## Background

Treatment of acetabulum fractures is a complex area of traumatology, which is constantly being improved, since the restoration of the pelvic bones and acetabulum anatomy is an important factor in further functional outcome [1, 2]. Surgical technique is complex and requires many years of training of specialist in pelvic surgery. In addition, it is extremely important to have highly specialized pelvic instruments in the operating room: various types of bone forceps, clamps, cutters, elevators, pushers, etc. [3]. Even with all the necessary conditions, the exact reduction of pelvic bones is not always an achievable task [4]. To hold complex multi-plane fractures, several reductional forceps have to be used at once. However, the relatively small area of the bone surface in the wound makes it difficult to simultaneously place bulky forceps and fixing plates. Applying large forces to the flat spongy bones of the pelvis with a thin cortical layer can lead to splitting of fragments, "pulling out" anchor screws in the branches of reduction forceps, which creates significant difficulties during the surgery.

The aim of the paper was to demonstrate a new method of pelvic bones reduction.

## Method description

The method for flat pelvic bones reduction, called by us "palisade technique"\*, consists in creating an artificial stop for Matta forceps from two or three incompletely twisted cortical screws with a diameter of 3.5 mm into one of the fragments. To create a stop, two or three holes were formed using a 2.5 mm drill at a distance of 5-6 mm from each other perpendicular to the plane of the bone. Self-tapping cortical screws were screwed into these holes so that 7-8 mm from the bone surface to the upper edge of the screw head remained outside (Fig. 1 a).

One branch of the Matta forceps was placed for the created stop, the second branch - for the dis-

placed fragment of the pelvis and then the diastasis was eliminated. Due to the presence of Matta sphere forceps with a sharp spike at the end of the branch, an effective grip of the fragment by the screws is ensured (Fig. 1b).

The location of the support site at a distance of 2-3 cm from the edge of the fracture line provides the necessary field of view for X-ray and internal fixation, which simplifies osteosynthesis and reduces the traumatic nature of the surgery. At the end of the surgery, the need for support screws disappears, and they are removed so as not to interfere with the remaining reduction manipulations and the final osteosynthesis.

Empirically, we have identified three situations when this method is most effective:

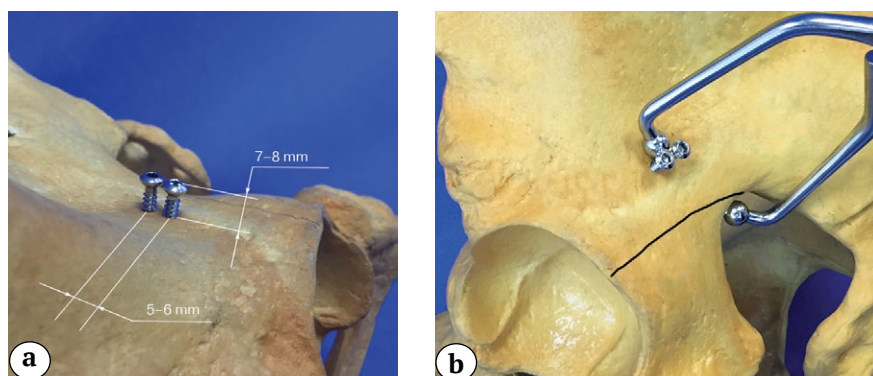
- 1) transtectal and juxtectal transverse fractures of the acetabulum with the formation of a sharp edge of the posterior column fragment;
- 2) fractures of the quadrangular surface of the acetabulum with displacement into the pelvic cavity;
- 3) ruptures of the sacroiliac joints.

## Reduction of the right acetabulum posterior column

The method for reduction the posterior column consists in implanting two 3.5 mm cortical screws into the body of the ilium parallel to the fracture line and at distance of 3 cm from it. The reduction was performed in the manner described above using Marta forceps.

## Clinical case

A 27-year-old patient was injured in road accident (driver). Three weeks later, surgery was performed for a juxtapectal transverse fracture of the right acetabulum with a predominant displacement in the region of the posterior column and medial subluxation of the femoral head (Fig. 2 a).

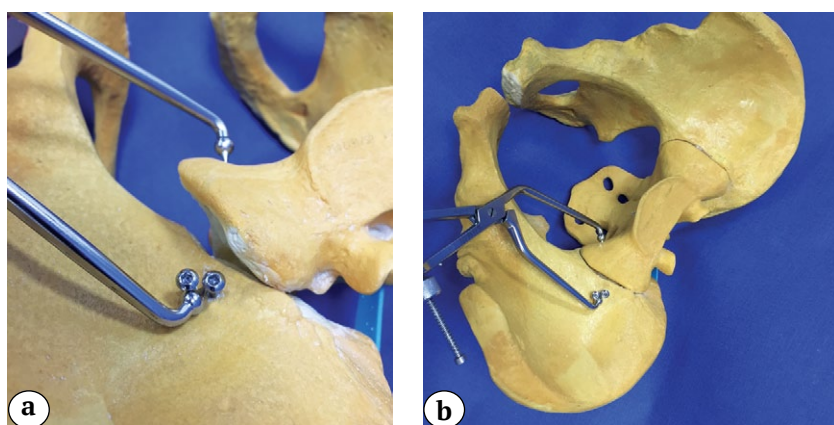


**Fig. 1.** Position of the Matta forceps in case of the acetabulum fracture on a plastic model of the pelvis: a — appearance of the support site for one of the Matta bone forceps; b — the position of the Matta forceps during the reduction of the posterior column of the acetabulum fracture on a plastic model of the pelvis

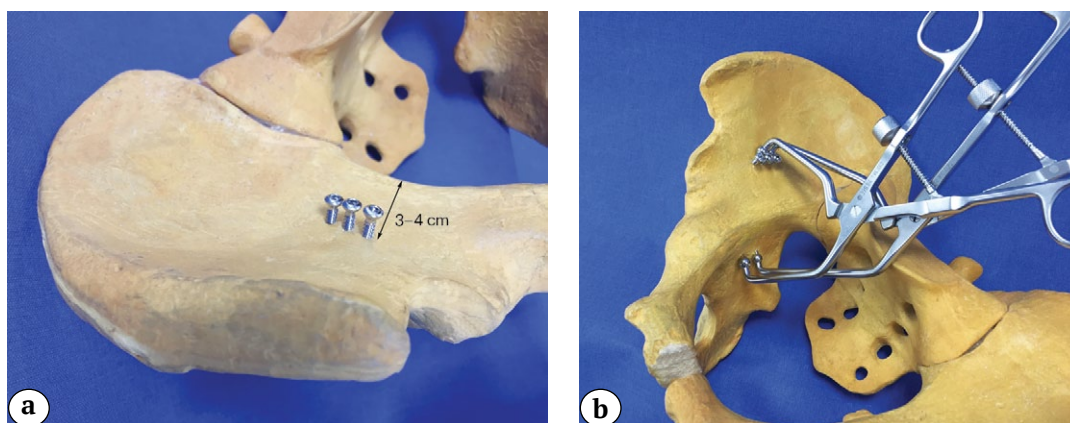
In the patient's decubitus position, a classic posterior approach to the acetabulum was performed according to Kocher – Langenbeck. An attempt to carry out reduction maneuver using large Jungbluth forceps with 4.5 mm screws proved ineffective due to the "pulling out" of the anchor screw from the distal fragment. On the first attempt, a successful reduction was performed using the developed method and the achieved position was fixed with a 1/3 tubular locking plate Synthes (Fig. 2b). Then the final osteosynthesis of the posterior column was performed with a neutralizing pelvic plate Matta (Stryker) and 3.5 mm cortical screws.

### *Reduction of the acetabulum quadrilateral surface*

The method of reduction a quadrilateral surface consists in implanting two or three 3.5 mm cortical screws parallel to the linea terminalis in the iliac wing at a distance of approximately 3-4 cm from the fracture line. The reduction was performed using two Matta forceps, placing one branch at close range, and the other on the quadrilateral surface of the acetabulum (Fig. 3).



**Fig. 5.** Position of the Matta forceps branch in case of rupture of the left SIJ on a plastic model of the pelvis: a – before reduction; b – view after reduction of the left SIJ

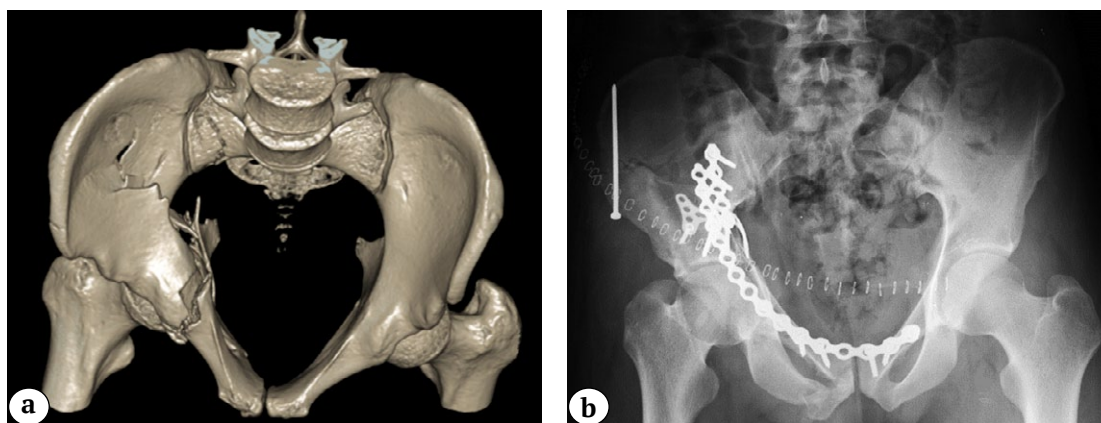


**Fig. 3.** Position of the Matta forceps branch in case of the acetabulum fracture on a plastic model of the pelvis: a – view of the support screws for reduction with two Matta forceps; b – the position of the Matta forceps branches during the reduction of the acetabulum quadrilateral plate fracture

### *Clinical case*

A 29-year-old patient was injured as a result of a fall from three meters height. Surgery was performed for a two-column fracture of the right acetabulum with medial displacement of the quadrilateral surface and the femoral head (Fig. 4a). In the supine position of the patient, classic anterior approach to the right acetabulum was performed by Letournel. The reduction of the quadrilateral surface was performed using the

developed method and two Matta forceps through the medial and lateral "windows" of approach. Fixation of the achieved position was performed by a T-shaped spring-loaded locking plate Synthes. The T-shaped plate was previously bent at an angle of 100° in its middle. Next, the final osteosynthesis of the posterior column was performed with Matta (Stryker) pelvic plates and 3.5 mm cortical screws (Fig. 4b).



**Fig. 4.** Two-column fracture of the right acetabulum (AO/OTA 62C1e): a – CT 3D-reconstruction of the pelvis in inlet view; b – postoperative X-ray of the pelvis in the AP view

### **Reduction in the sacroiliac joint**

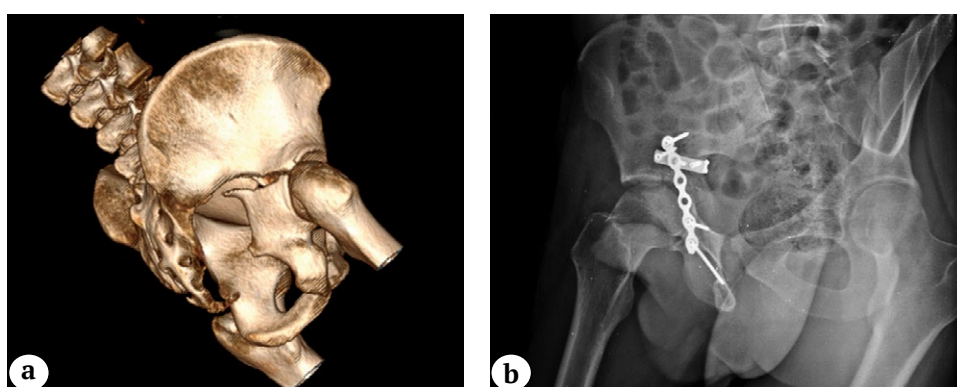
The support for the reduction of the sacroiliac joint is formed from two 3.5 mm cortical screws in the posterior region of the iliac wing, implanted parallel to the anterior surface of the sacral wing at a distance of 1-2 cm from the sacroiliac joint. The reduction was performed using Matta forceps, placing one branch against support site, and the other on the anterior-upper surface of the sacral wing (Fig. 5).

### **Clinical case**

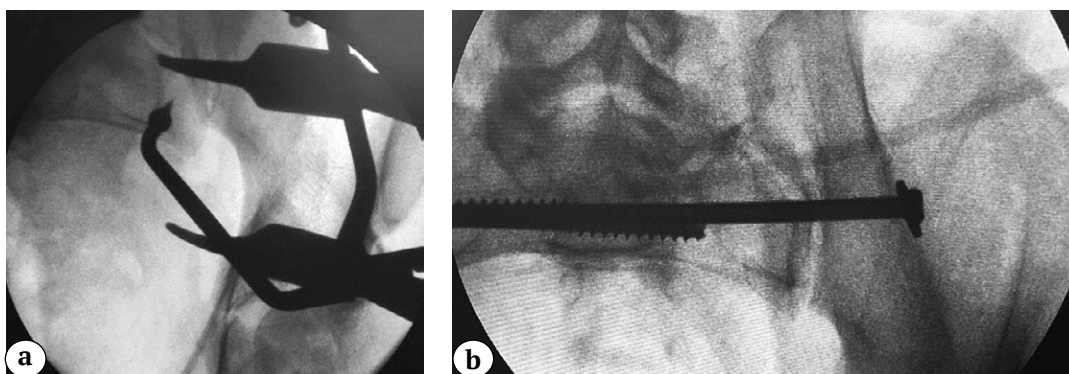
A 34-year-old patient was injured as a result of a fall from four meters height. Surgery was performed for the rupture of the left sacroiliac joint with the displacement of the left half of the pelvis posteriorly and cranially.

In the supine position of the patient, anterior approach to the left sacroiliac joint was performed according to Smith - Peterson with osteotomy of the anterior superior spine of the pelvic wing. After creating a support site in the posterior region of the ilium, the reduction of the sacroiliac joint was performed using Matta forceps according to the above technique (Fig. 6). The achieved position of the sacroiliac joint was fixed with a 6.5 mm cannulated Synthes tightening screw with a 32 mm partial thread and a washer.

One should be careful when applying Matta forceps, since there is a risk of damage to the roots of L5, L4, the occlusal nerve and the superior gluteal artery passing in the area of the anteroposterior surface of the wings of the sacrum [5, 6]. To prevent complications, soft tissues should be carefully removed and forceps should be placed directly on the bone under visual control.



**Fig. 2.** Transverse juxtatectal fracture of the right acetabulum with displacement (AO/OTA 62B1.2): a – CT 3D-reconstruction of the pelvis; b – postoperative X-ray of the right acetabulum in the oblique iliac Judet view



**Fig. 6.** Rupture of the left SIJ with displacement of the left half of the pelvis posteriorly and cranially: a – X-ray performed during the reduction of the left SIJ by the developed method; b – after reduction the left SIJ and fixing it with a cannulated screw

## Discussion

In one case, for the reduction of the posterior column of the acetabulum, we used the Kocher – Langenbeck posterior approach [7, 8]. In the second case, Letournel anterior approach was used to reduction the quadrilateral surface of the acetabulum [9]. In the third case, a Smith – Peterson lateral approach with osteotomy of the anterior superior spine of the pelvic wing was used to reduction the rupture of the sacroiliac joint [10]. In all cases, we were able to apply the developed method of reduction fragments with good and excellent restoration of joint congruence. It should be noted that in all cases, the transition to the developed method of reduction was made after unsuccessful attempts at reduction by standard methods. The proposed method of reduction makes it possible to shorten the surgery time, avoid damage to the neurovascular structures in the fracture area, improve the reduction from "good" to "excellent" and provide optimal conditions for stable fixation of the achieved position of the fragments. This approach coincides with the modern provisions of pelvic surgery, when the exact comparison of fragments reduces the incidence of osteoarthritis and improves the overall clinical and functional outcome of treatment of pelvic bone injuries [11, 12].

Part of the reduction forceps work on the principle of an anti-lock: one branch rests against one fragment, and the other on the opposite side of the pelvis, which requires additional incisions or punctures. This is how straight and curved Matta forceps, asymmetric King Tong forceps, large straight pelvic forceps work. The other part of the forceps works using "anchor" screws in the fragments, which allows reduction on one side of the pelvis, for example, Farabeuf forceps and Jungbluth forceps. However, it should be noted that in this case, the total vector of efforts during reduction is directed not perpendicular to the plane of the frac-

ture, but at an angle, which can lead to the "pulling out" of the screws from the spongy bone of the pelvis. Our experience shows that the use of pointed Weber forceps is not always possible, as there is often a sliding of the branches from the inclined surfaces of the pelvic bones or the eruption of bone tissue.

The use of support site of several screws in one of the fragments and the presence of spheres with a spike at the ends of the Matta forceps make it possible to form a vector of reduction forces almost perpendicular to the plane of the fracture and perform a maneuver on one side of the pelvis. In no case did we observe the "pulling out" of support screws or splitting of fragments, even with powerful efforts. In the post-operative period, we did not observe neurological and inflammatory complications from soft tissues.

## Conclusions

The complexity of the pelvic bones fractures reduction is due to many reasons: the features of the anatomy and spongy nature of the pelvic bone tissue, the proximity of important neurovascular formations in the area of surgery, the relatively small area of the bone surface in the surgical manipulation sector, large reduction efforts applied to fragments, etc. Even with the use of special reduction pelvic instruments, it is not always possible to achieve the goal, which encourages surgeons to search for new reduction techniques. The "palisade technique", method proposed by us allows performing effective reduction of flat pelvic bones with Matta bone forceps from a standard set for pelvic surgery and 3.5 mm cortical screws.

## Informed consent

The patients gave written informed consent to participate in the study and publish its results.

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*Zadneprovskiy N.N.* — writing the text of the manuscript.

*Ivanov P.A.* — research design.

*Nevedrov A.V.* — literature review.

All authors have read and approved the final version of the article. All authors agree to be responsible for all aspects of the work in order to ensure proper consideration and resolution of all possible issues related to the correctness and reliability of any part of the work.

*Conflict of interest:*

The authors declare that there is no conflict of interest.