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COMPARATIVE ASSESSMENT OF SURGICAL TREATMENT OUTCOMES IN PATIENTS WITH SACROILIAC JOINT INJURY

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The authors declare that they
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Keywords:

trauma, sacroiliac joint, minimally
invasive locking osteosynthesis.

Abstract

The aim of the study is to evaluate the results of surgical treatment in patients with sacroiliac joint injury.

Methods. An analysis of the results of surgical treatment of 60 patients with sacroiliac joint injury was conducted at the Center of polytrauma and orthopedic surgery of the State Public Healthcare Institution "Emergency Hospital" in Abai Region, the Trauma and Endoprosthesis Department of the State Public Healthcare Institution "Multispecialty City Hospital No. 1" in the city of Astana, and the "Shymkent City Clinical Hospital No. 1" from June 2019 to August 2022.

Patients were divided into two groups. Patients in the control group underwent surgery using the standard technique, while patients in the experimental group underwent surgery using a device developed by us for minimally invasive locking osteosynthesis of sacroiliac joint injuries. The study was a randomized controlled trial by design.

Results. The use of the device for minimally invasive locking osteosynthesis of sacroiliac joint injuries leads to a significant reduction in the length of hospitalization for all types of sacroiliac joint injuries regardless of the patient's initial condition ($p=0.001$). Correlation analysis revealed a correlation between the observation group and patient pain assessment at 12 months ($p=0.001$).

According to the Majeed Pelvic Score at 12 months, the maximum score in the experimental group was 98 points, while in the control group, it was 70 points. A satisfactory assessment on the Majeed Pelvic Score at 12 months was observed in 3 (10%) of patients in the control group and none in the experimental group. There were no unsatisfactory responses in both groups (significant differences were found, $p=0.001$).

Conclusions. The use of the device developed by us for minimally invasive locking osteosynthesis of sacroiliac joint injuries reduces the length of hospitalization and the time to return to work (12 months in the control group and 8 months in the experimental group). The absence of pain in patients after 12 months in the experimental group was 26 (86.7%) and 20 (66.6%) in the control group. According to the Majeed Pelvic Score in the long term (3, 6, and 12 months), the frequency of excellent results increases from 13.3% to 90.0% in the experimental group and from 10% to 73.4% in the control group.

Сегізкөз-мықын байламының зақымданулары бар науқастарда
хирургиялық емдеу нәтижелерін салыстырмалы бағалау.

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Түйіндеме

Зерттеудің мақсаты сегізкөз-мықын байламының зақымданулары бар науқастарда хирургиялық емдеу нәтижелерін бағалау.

Әдістері. Абай облысының ДСБ “жедел медициналық жәрдем ауруханасы” ШЖҚ КМК политравма және ортохирургия орталығында, Астана қаласы әкімдігінің “№1 көпсалалы қалалық аурухана” ШЖҚ КМК политравма және эндопротездеу бөлімшесінде және Шымкент қаласының “№1 қалалық клиникалық аурухана” ШЖҚ КМК политравма бөліміндерінде 2019 жылдың маусымынан 2022 жылдың тамызына дейінгі аралықта сегізкөз-мықын байламы зақымданған 60 науқастың хирургиялық емдеу нәтижелеріне талдау жүргізілді

Науқастар екі топқа бөлінді. Бақылау тобындағы науқастарға стандартты әдіс бойынша операция жасалды, ал тәжірибелік топтағы науқастарға біз әзірлеген сегізкөз-мықын байламы зақымдануларының аз инвазивті құлыптаушы остеосинтезіне арналған құрылғыны пайдалану арқылы операция жасалды. Дизайн бойынша зерттеу болды рандомизацияланған бақыланатын сынақ.

Нәтижелер. Сегізкөз-мықын байламы зақымдануларының аз инвазивті құлыптаушы остеосинтезіне арналған құрылғыны қолдану науқастың бастапқы жағдайына қарамастан сегізкөз-мықын байламы зақымдануының барлық түрлерінде ауруханада ем алу мерзімінің төмендеуіне әкеледі ($p=0.001$). Корреляциялық талдау 12 айдан кейін бақылау тобы мен пациенттердің ауырсынуын бағалау арасындағы корреляциялық байланысты ($p=0.001$) анықтады.

The Majeed Pelvic Score бойынша 12 айдан кейін эксперименттік топтағы ең жоғары балл 98 баллды, бақылау тобында 70 баллды құрады. 12 айдан кейін the Majeed Pelvic Score бойынша қанағаттанарлық бағалау бақылау тобындағы науқастардың 3 (10%) байқалып, негізгі топта бірде-бір науқаста байқалмады. Екі топта да қанағаттанарлықсыз жауаптар байқалмады (сенімді айырмашылықтар анықталды ($p=0.001$)).

Қорытынды. Сегізкөз-мықын байламы зақымдануларының аз инвазивті құлыптаушы остеосинтезіне арналған құрылғыны қолдану ауруханада жату мерзімін, еңбекке қабілеттіліктің қалпына келу мерзімін қысқартады (бақылау тобында 12 ай, ал негізгі топта 8 ай). Тәжірибе тобында 12 айдан кейін науқастарда ауырсынудың жойылуы 26 (86.7%) және бақылау тобында 20 (66.6%) құрады. Алыс кезеңдегі (3, 6 және 12 ай) the Majeed Pelvic Score шкаласы бойынша өте жақсы нәтижелердің жиілігі тәжірибелік топта 13.3% - дан 90.0% - ға дейін, ал бақылау тобында 10% - дан 73.4% - ға дейін артады.

Мүдделер қақтығысы:

Авторлар мүдделер қақтығысының жоқтығын мәлімдейді

Түйінді сөздер:

жарақат, сегізкөз-мықын байламы, аз инвазивті құлыптаушы остеосинтез.

Сравнительная оценка результатов хирургического лечения у пациентов с повреждением крестцово-подвздошного сочленения

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Аннотация

Цель исследования – оценить результаты хирургического лечения у пациентов с повреждением крестцово-подвздошного сочленения.

Методы. Проведен анализ результатов хирургического лечения 60 пациентов с повреждением крестцово-подвздошного сочленения в Центре политравмы и ортохирургии КГП на ПХВ «Больница скорой медицинской помощи» УЗ области Абай, отделений политравмы и эндопротезирования КГП на ПХВ «Многопрофильная городская больница №1» акимата города Астана, ГКП на ПХВ «№1 городская клиническая больница» г.Шымкент с июня 2019 года по август 2022 года.

Пациенты были разделены на две группы. Пациенты в контрольной группе были прооперированы по стандартной методике, а пациенты в опытной группе – прооперированы с использованием разработанного нами устройства для малоинвазивного блокирующего

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Ключевые слова:

травма, крестцово-подвздошное сочленение, малоинвазивный блокирующий остеосинтез.

osteosynthesis поврежденных крестцово-подвздошного сочленения. По дизайну исследование было рандомизированное контролируемое исследование.

Результаты. Применение устройства для малоинвазивного блокирующего остеосинтеза поврежденных крестцово-подвздошного сочленения ведет к достоверному уменьшению сроков госпитализации при всех типах повреждений крестцово-подвздошного сочленения независимо от исходного состояния пациента ($p=0.001$). Корреляционный анализ выявил корреляционная связь между группой наблюдения и оценкой боли пациентами через 12 месяцев ($p=0.001$). Согласно the Majeed Pelvic Score через 12 месяцев максимальный балл в опытной группе составил 98 баллов, в контрольной группе 70 баллов. Оценка удовлетворительно согласно the Majeed Pelvic Score через 12 месяцев наблюдалось у 3 (10%) пациентов в контрольной группе и ни одного пациента в основной группе. Неудовлетворительных ответов в обеих группах не отмечено (выявлены достоверные различия ($p=0.001$)).

Выводы. Применение разработанного нами устройства для малоинвазивного блокирующего остеосинтеза поврежденных крестцово-подвздошного сочленения сокращает сроки госпитализации, срок восстановления трудоспособности (в контрольной группе 12 месяцев, а в основной группе 8 месяцев). Отсутствие боли у пациентов через 12 месяцев в опытной группе составило 26 (86.7%) и 20 (66.6%) в контрольной группе. По шкале Маджида в отдаленном периоде (3, 6 и 12 месяцев) частота отличных результатов увеличивается с 13.3% до 90.0% в опытной группе, а в контрольной группе с 10% до 73.4%.

Introduction

Various authors in their works confirm that pelvic ring injuries are relatively rare, comprising 0.3% to 8% of all fractures, occurring approximately in 20 to 37 per 100.000 population.^{1,2} The increase in unstable pelvic bone injuries is proportional to the rise in transportation, industrial, and domestic trauma.^{3,4} In cases of polytrauma, pelvic bone fractures are categorized as rotationally or vertically unstable in 50-60% of instances, falling under Type B and C according to AO/ASIF classification.⁵

Injuries to the posterior regions, including the sacrum, sacroiliac joints, and posterior portions of the iliac bones, occur in 20% to 51.0% of pelvic trauma cases. They are classified as Type C (vertically unstable, severe) and are more prevalent among younger patients (15-30 years).^{6,7} Most pelvic ring injuries result from high-energy traumas such as road accidents, falls from height, crush injuries, or direct impacts.⁸

One challenging task in orthopedic surgery is the treatment of pelvic ring injuries, with surgical methods gaining recognition. Numerous open and closed surgical stabilization methods for the pelvic ring are described in works by authors from different countries.^{6,9,10,11,12} However, the current unsatisfactory results persist, ranging from 30% to 60% according to various researchers.^{7,9}

Therefore, improving diagnostics and enhancing the effectiveness of treating sacroiliac joint injuries remains one of the most pressing issues in traumatology today. The aim of this research is to evaluate the outcomes of surgical treatment in patients with sacroiliac joint injuries.

Materials and Methods.

At the Trauma Center and Orthopedics Department of the State Public Healthcare Institution "Emergency Hospital" in Abai Region, the Trauma and Endoprosthetics Department of the State Public Healthcare Institution

"Multispecialty City Hospital No. 1" in the city of Astana, and the State Public Healthcare Institution "Shymkent City Multispecialty Hospital," a total of 60 patients with sacroiliac joint (SIJ) injuries were treated from June 2019 to August 2022. These patients were divided into control and experimental groups. Given the rarity of sacroiliac joint injuries, we conducted a comprehensive sampling. To obtain the necessary information, data extraction was performed for all SIJ patients who were admitted to the research databases during the study period.

Prior to commencing the study, we obtained approval from the Ethics Committee of NAO "Semey Medical University" (Protocol No. 2, dated October 18, 2019). We developed a data extraction form based on a review of the literature, taking into account the key factors required for conducting a comparative analysis

Study Design: Randomized Controlled Trial

Patient allocation into groups was done randomly using the "Randomus" random number generator with subsequent envelope opening. As a result, 30 patients were assigned to the experimental group, and 30 patients were assigned to the control group.

Patients in the control group underwent surgery following the standard procedure,^{6,13,14,15} while patients in the experimental group were operated on using a device developed by us for minimally invasive locking osteosynthesis of sacroiliac joint injuries.

Inclusion criteria for patients in the study were as follows: patients aged 18 to 65 years, admitted to the trauma department during the selected period, undergoing surgical intervention for unstable pelvic ring injuries classified as type B and C according to the AO classification, patients with sacroiliac joint disruption, sacral fractures of I, II types by Denis, and informed consent to participate in the study.

Exclusion criteria for patients from the study included individuals below the age of 18 and above 65, pregnant women, patients with oncological pathologies receiving chemotherapy or radiation therapy, or with bone metastases, and patients with complex pelvic organ injuries.

Regarding professional affiliation, all members of the sample were distributed among the following categories: laborers, white-collar workers, healthcare professionals, self-employed individuals, homemakers, retirees, individuals with disabilities, unemployed individuals, and other professional groups.

The clinical diagnosis was encoded according to the ICD-10 (*Clinical protocols of the Ministry of Health of the Republic of Kazakhstan - 2018 (Kazakhstan). Polytrauma*): T.06.8 - other specified injuries involving multiple body regions, T.02.8 - other combinations of fractures involving multiple body regions, S.32.7 - multiple fractures of the lumbar-sacral spine and pelvic bones, T.02.8 - fractures involving multiple regions of the upper and lower limbs, S.32.1 - sacral fractures.

Based on the mechanism of injury, we categorized them into four groups: domestic, transport-related, street, and occupational. Regarding the mode of patient arrival, they were categorized into three groups at the hospital's emergency department: 1) ambulance arrival, 2) air ambulance, 3) independent appeal; 4) transfer from another healthcare facility. Traumatic shock was coded into two categories: 1) yes, 2) no. Traumatic shock severity was further classified into: 1) first-degree, 2) second-degree, 3) third-degree. According to the method of pelvic fixation in the emergency department, they were categorized into three groups: 1) external fixation device, 2) swaddling, 3) pneumatic compression. Injury severity was assessed using the Polytrauma Score (PTS), categorized into four groups: 1) up to 19 points - stable condition, 2) 20-34 points - borderline condition, 3) 35-48 points - severe condition, 4) 49 or more points - critical condition. The timing of surgery was divided into three categories: 1) within 7 days, 2) within 10 days, 3) after 3 weeks. Pain levels on a numeric rating scale from 0 to 10 points were

categorized into three groups: mild pain (1 to 4 points), moderate pain (5 to 6 points), severe pain (7 to 10 points).

The duration of recovery of workability was also divided into three categories: 1) up to 4 months, 2) 5-8 months, 3) 9-12 months. Subsequently, an assessment was conducted based on the sum of criteria on the Majeed Pelvic Score (MPS) no earlier than 3 months, at 6 months, and 12 months after treatment.^{16,17,18} Five factors were considered and assessed: pain, the ability to stand, sit, perform work, and sexual function.

This variable was divided into four categories: 1) excellent (a total score of more than 85), good (a total score from 70 to 84 points), satisfactory (a total score from 55 to 69 points), and unsatisfactory (less than 55 points).¹⁶ Statistical analysis of the results was performed using the statistical software package SPSS (Statistical Package for the Social Sciences) version 23.0 for Windows (NAO "Semey Medical University"). The comparison of quantitative variables between comparison groups was carried out using the Mann-Whitney U test. For describing quantitative data with a normal distribution, the mean and standard deviation were used. A 95% confidence interval (CI) was calculated for the population mean. Frequencies and percentages were used to describe qualitative data. Confidence intervals were also calculated for the sample mean and sample proportion. Pearson's chi-squared test was used to compare two independent groups of nominal variables. Correlation analysis was conducted using Pearson's correlation coefficient.

Results

Patients were stratified into five age groups: 18-27 years, 28-37 years, 38-47 years, 48-57 years, and 58-65 years. The average age of patients in the experimental group was 36.8 years (Mean = 33.5; Q1=24.5; Q3=49.3 years), and in the control group, it was 37.1 years (Mean = 34.5; Q1=27.5; Q3=43.3 years).

The socio-demographic characteristics of patients included in the experimental and control groups are presented in Table 1.

Variables	Experimental group, abs (%)	Control group, abs. (%)	P value
Gender			
Women	14 (46.7%)	15 (50.0%)	0.702
Men	16 (53.3%)	15 (50.0%)	0.544
Age			
18-27 years	10 (33.3%)	7 (23.3%)	0.309
28-37 years	6 (20.0%)	10 (33.3%)	0.128
38-47 years	5 (16.7%)	7 (23.3%)	0.785
48-57 years	5 (16.7%)	3 (10.0%)	0.771

Table 1.
Socio-demographic characteristics
of patients

58-65 years	4 (13.3%)	3 (10.0%)	0.935
Professional affiliation			
Civil servant	8 (26.7 %)	6 (20.0%)	0.169
Laborer	1 (3.3 %)	1 (3.3%)	0.337
Retiree	0	1 (3.3 %)	0.491
Homemakers	6 (20.0 %)	6 (20.0%)	0.163
Self-employed individuals	3 (10.0%)	3 (10.0%)	0.238
Healthcare professionals	1 (3.3 %)	1 (3.3%)	0.357
Retiree	0	1 (3.3%)	0.493
Unemployed	7 (23.3 %)	5 (16.7%)	0.130
Disabled	0	1 (3.3 %)	0.222
Other	4 (13.3%)	6 (20.0 %)	0.513

As evident from Table 1, the majority of patients in both the experimental group 11 (36.7%) and the control group 17 (56.6%) were in the age range of 28 to 47 years. At the same time, in this sample, 4 (13.3%) of patients in the experimental group and 3(10.0%) of patients in the control group were aged over 58 years. No significant differences in age were found between the compared groups, $p=0.559$.

Regarding gender, patients were evenly distributed, and there were no significant differences in gender composition; the groups were homogeneous ($p=0.185$). In our study, the majority of patients in the experimental group 8 (26.7%) and in the control group 6 (20.0%) were white-collar workers, which corresponded to the age structure of this sample. The least common professional groups were laborers (one patient in the control group (3.3%) and one in the experimental group) and healthcare professionals 1 (3.3%) in the experimental group and 1 (3.3%) in the control group). Thus, the groups were comparable in terms of their main socio-demographic characteristics.

The study groups of patients are similar in the compared parameters, including the composition of clinical observations, the nature of the trauma, and the morphology of sacroiliac joint injuries. In both study groups, the distribution of patients by clinical diagnosis was also comparable. In the experimental and control groups, the majority of patients had a diagnosis of "other specified injuries involving multiple body regions," accounting for 19 (63.3%). The second most common diagnosis in both groups was "other combinations of fractures involving multiple body regions," at 7 (23.3%), and multiple fractures of the lumbar-sacral spine and pelvic bones ranked third (10% in the experimental group and 6.7% in the control group).

Fractures of the sacrum were less frequent

in the control group 1 (3.3%) and absent in the experimental group, while fractures involving multiple regions of the upper and lower extremities were equally prevalent in both groups 1 (3.3%).

The majority of patients in both the experimental 13 (43.3%) and control groups 11 (36.7%) sustained transport-related injuries, with domestic injuries ranking second 7 (23.3%) in the experimental group and third 10 (33.3%) in the control group. Occupational injuries came in third (20% and 23.3%, respectively), followed by street injuries (13.3% and 6.7%, respectively). When analyzing the distribution of patients by the type of injury and the observation group, no significant differences were found ($p=0.353$).

In the study groups, the distribution of patients by the method of delivery to the hospital was also comparable. In both the experimental and control groups, the majority of patients were brought by an ambulance team 26 (86.7%) and 24 (80%), respectively). The second method of delivery was medical aviation 2 (6.7%) in the experimental group and 4 (13.3%) in the control group), followed by self-referral 2 (6.7%) in the experimental group and 2 (6.7%) in the control group). Correlation analysis data indicate no significant relationship between the method of hospital delivery and the observation group ($p=0.72$).

Traumatic shock was observed in 18 (60%) of the main group and 17 (56.6%) of the control group. Among them, first-degree shock was observed in 4 (13.3%) in both the main and control groups, second-degree shock in 5 (16.7%) in the main group and 6 (20%) in the control group. Third-degree traumatic shock was equally observed in both the main and control groups 3 (10%).

We did not establish a relationship between the presence or absence of traumatic shock and

the compared groups ($p=0.26$), indicating the comparability of the groups ($p=0.86$).

Regarding the method of emergency fixation of the pelvis, the majority of patients, 19 (63.3%) in the main group and 20 (66.7%) in the control group, underwent external fixation device application. Pelvic binding was applied in 11

(36.7%) of the main group and 10 (33.3%) of the control group. Correlation analysis revealed no significant correlation between the observation group and the method of pelvic fixation ($p=0.36$).

In the next stage of our study, we assessed the severity of the injury using the PTS scale (Table 2).

Variable	Experimental group, abs (%)	Experimental group, abs (%)	P value
Up to 19 points	23 (76.7%)	23 (76.7%)	0.148
20-34 points	6 (20.0%)	6 (20.0%)	0.163
35-48 points	1 (3.3%)	0	0.309
49 and more points	0	1 (3.3%)	0.111

Table 2.
Distribution of patients on the PTS scale

As evident in Table 2, a stable condition according to the PTS scale was observed in 23 (76.7%) patients in both the main and control groups. A borderline condition was observed in 6 (20%) patients in both groups. One patient (3.3%) in the main group had a severe condition, while no severe condition was observed in the control group. A patient in critical condition was present in the control group 1 (3.3%). The probability of a lethal outcome exceeding 50% was observed in one patient (3.3%) in both groups. Correlation analysis did not reveal a significant association between the PTS rating and the patient group ($p=0.67$).

Before the operation, 4 (13.3%) of patients with transforaminal sacral fractures in the main group exhibited neurological symptoms, such as perianal pain, numbness in the posterior surfaces of the thighs and the groin area. All these patients had the posterior pelvic ring fixed with our device, creating distraction, and achieved a positive result with the regression of pain and numbness on the same evening. In the control group, 2 (6.7%) of patients were diagnosed with postoperative neurological complications, including numbness in one toe, moderate perianal pain, and numbness in the groin area.

The majority of patients, 16 (53.3%) in the main group and 15 (50%) in the control group, underwent surgery primarily within 5 to 7 days. Patients in the main group 7 (23.3%) and in the control group 7 (23.3%) underwent surgery within 10 days. In the experimental group, 7 (23.3%) underwent surgery after 3 weeks, while in the control group, this was the case for 8 (26.7%). Analysis of the timing of the surgery and the observation group did not reveal any significant differences ($p=0.760$).

In the early postoperative period, one patient (3.3%) in the control group experienced severe pain in the left gluteal and inguinal region (with a zone II sacral fractures). A follow-up CT scan revealed incorrect screw placement, passing

through the upper cortex of the lateral sacral mass, where the L5 nerve root of the lumbosacral plexus is anatomically located. After the screw was removed and repositioned, the neurological symptoms regressed.

In the research groups, 2 (6.6%) of patients exhibited pelvic dimorphism. Technical problems arose during surgery in the control group, leading to severe pain for patients in the postoperative phase. Patients in the experimental group did not report such symptoms. Therefore, one of the advantages of our original device is that the nail is implanted behind the sacrum, where there are no nerves and medium to large blood vessels, thereby minimizing the risk of damaging neural structures.

The assessment of treatment effectiveness involved the evaluation of pain at discharge, pain assessment at 3 months post-surgery, pain assessment at 6- and 12-months post-surgery, duration of disability, and evaluation using the MPS at 3, 6 and 12 months.

Pain assessment upon admission was the same in both groups, with scores of 10 points. However, there was a statistically significant difference in patient responses regarding pain assessment at discharge when considering the observation groups ($p=0.001$). The average pain level on the day of discharge was 2.9 points in the experimental group (Mean = 3.0; Q1=2.0; Q3=4.0 points) and 3.0 points in the control group (Mean = 2.5; Q1=2.0; Q3=5.0 points). In the majority of patients – 26 (86.7%) in the main group and 21 (70.0%) in the control group, patients rated their pain as mild (1 to 4 points). Moderate pain (5 to 6 points) was reported in the experimental group 4 (13.3%) and the control group 6 (20.0%). No patients in the experimental group reported severe pain, whereas 3 (10%) did so in the control group.

The average pain level reported by patients three months after discharge in the experimental group was 0.43 ± 0.77 points (Median = 0; Q1=0;

Q3=1.0 points), while in the control group, it was 0.83±1.1 points (Median = 0; Q1=0; Q3=3.0 points). In the control group, 4 (13.3%) rated their pain at 3 points, which was not observed in the main group. Correlation analysis revealed a significant correlation between the observation group and pain assessment by patients three months after the operation (p=0.001).

The length of hospital stay was another important factor. On average, patients in the experimental group spent 21.7±10.9 days in the hospital (Median = 17; Q1=12.7; Q3=21.5 days), while in the control group, it was 32.6±14.3 days (Median = 28; Q1=16; Q3=29.5 days). Statistical analysis of the data on the number of hospitalization days indicated that the use of the minimally invasive locking osteosynthesis device for sacroiliac joint injuries led to a significant reduction in hospitalization duration for all types of injuries to the sacroiliac joint, regardless of the patient's initial condition (p=0.001).

It is known that the duration of returning to work significantly affects the quality of life of patients. During the study, statistically significant differences were found in the distribution of patients based on the duration of returning to work and the observation group (p=0.000).

The distribution of patients by the duration of returning to work in the experimental group had an average of 3.3 months ± 1.4 months (Median = 3.0; Q1=3; Q3=5 months), while in the control group, it was 4.8 months ± 3 months (Median = 3.0; Q1=3; Q3=5 months). In the control group, 13.3% (n=4) of patients regained their work capacity after 9-12 months, whereas no such patients were observed in the main group, with the maximum recovery period of 8 months.

The long-term pain assessment results (after 12 months) are as follows: In the majority of patients, 26 (86.7%) in the experimental group and 20 (66.6%) in the control group rated their pain as 0 points. Patients in the experimental group rated their pain as mild (from 1 to 4 points), comprising 10 (33.4%), while in the control group, it was 6 (20%). Correlation analysis revealed a significant correlation between the observation group and pain assessment by patients after 12 months (p=0.001).

The next step in our study was the assessment using the MPS. The assessment was performed based on the sum of the MPS criteria not earlier than 3 months, 6 months, and 12 months after the operation (Table 3).

Table 3.
Distribution of the assessment on
the Majeed Pelvic Score

Variable	Experimental group, abs. (%)	Control group, abs. (%)	P value
3 months after surgery			
excellent	4 (13.3%)	3 (10.0%)	0.001
good	23 (76.7%)	16 (53.3%)	0.000
satisfactory	3 (10.0%)	8 (26.6%)	0.002
unsatisfactory	0	3 (10.0%)	0.001
6 months after surgery			
excellent	22 (73.4%)	15 (50.0%)	0.000
good	6 (20.0%)	8 (26.7%)	0.001
satisfactory	2 (6.6%)	6 (20.0%)	0.000
unsatisfactory	0	1 (3.3%)	0.001
12 months after surgery			
excellent	27 (90.0%)	22 (73.4%)	0.001
good	3 (10.0%)	5 (16.6%)	0.000
satisfactory	0	3 (10.0%)	0.003
unsatisfactory	0	0	0.001

When analyzing the distribution based on the MPS assessment and the observation group, significant differences were observed (p=0.000). After 3 months following the operation, the minimum score in the experimental group was 62, while in the control group, it was 49 points. The maximum score in the experimental group reached 96 points, compared to 88 points in the

control group. An unsatisfactory assessment on the MPS after 3 months was observed in 3 (10.0%) of patients in the control group and none in the experimental group.

After 6 months, the minimum score in the experimental group was 78 points, whereas it was 55 points in the control group. The maximum score in the experimental group was 98 points,

compared to 90 points in the control group. An unsatisfactory assessment on the MPS after 6 months was observed in 1 (3.3%) of patients in the control group and none in the experimental group. The maximum score in the experimental group after 12 months was 98 points, while it was 70 points in the control group. A satisfactory assessment on the MPS after 12 months was observed in 3 (10%) of patients in the control group and none in the experimental group. There were no unsatisfactory responses in both groups.

Discussion

Despite developments and improvements in surgical treatment methods for sacroiliac joint injuries, the question of developing new techniques and devices for the surgical treatment of posterior pelvic ring injuries remains relevant. Literature data support our research findings. The primary mechanism of injury often involves high-energy impacts resulting from traffic accidents, falls from a height, or occupational injuries,^{19,20,21,22,23} which are associated with a high level of mortality, reaching up to 32%.¹⁹

In cases of posterior pelvic ring injuries, clinical signs of neurological damage occur in 42-54% of cases. Post-traumatic pelvic deformities are accompanied by various manifestations of neuropathy in 57% of cases. Regression of neurological symptoms following surgical treatment is observed in 16% of cases, as realignment of bone fragments can prevent the consequences of contusion injuries to neural structures. Fractures of the pelvis, classified as type B and C according to the AO classification, can affect nerve roots ranging from L2 to S4, although more commonly, nerve roots L5 to S1 are involved. The most common sequelae

observed in our study.

According to the literature, most complications associated with percutaneous sacroiliac and sacral screw techniques are the result of poor knowledge of pelvic and sacral bone anatomy, as well as insufficient understanding of various types of pelvic X-ray imaging. Incorrect screw placement can be dangerous and harmful to many vascular and neural structures. These risks are increased in cases of altered pelvic or sacral anatomy, such as sacral dysmorphism, as well as in cases of partially reduced or unreduced sacral fractures. Iatrogenic injury to the lumbar plexus and S1 root resulting from extraosseous screw insertion is the most dangerous complication of sacroiliac screw placement. Estimates suggest that this injury occurs in 0.5-7.7% of cases, while incorrect screw positioning under the surgeon's supervision is encountered in 2-15% of cases.^{1,2}

The use of the device we developed for minimally invasive locking osteosynthesis of sacroiliac joint injuries reduces hospitalization time and the time to return to work (12 months in the control group, 8 months in the experimental group). Pain assessment among patients after 12 months was 26 (86.7%) in the experimental group and 20 (66.6%) in the control group. According to the MPS in the long-term period (3, 6 and 12 months), the frequency of excellent results increases from 13.3% to 90.0% in the experimental group, and from 10% to 73.4% in the control group.

Conclusions

Based on the findings, it can be concluded that one of the advantages of surgical treatment using the minimally invasive locking osteosynthesis device for sacroiliac joint injuries is the minimization of the risk of damaging neural structures.

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